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Abstract

Purpose – The purpose of this paper is to identify information governance (IG) requirements in the context of dynamic business networking (BN).

Design/methodology/approach – For the identification of IG requirements a systematic literature review is conducted. The practical significance of identified IG requirements is evaluated through a case study.

Findings – A comprehensive list of IG requirements in dynamic BN is identified. These requirements are classified in information quality, information security, and metadata domains. The conducted case study demonstrates information exchange issues in a real world dynamic BN that reflects the practical significance of the identified IG requirements.

Research limitations/implications – Exploiting emerging market opportunities through a dynamic BN necessitates the realization of a comprehensive IG program within the network. Otherwise, information exchange related risks can interrupt the operations in a BN. In this research the authors concentrate on interactions between parties within a BN. The interactions with customers for the co-creation of value are not addressed directly. Although the conducted case study reflects the practical significance of the identified IG requirements clearly, more empirical study is needed for prioritizing these IG requirements.

Practical implications – The governor of a BN needs to balance between the value obtained from dynamic networked interactions and the risk evolving from the dynamic inter-organizational information exchange.

Originality/value – The comprehensive list of IG requirements that are identified in this research can be used to develop an IG program that enables high quality and secure information exchange in a dynamic BN.

Keywords Metadata, Information security, Information governance, Information quality, Business networking, Inter-organizational business process

Paper type Research paper

1. Introduction

The competition in today's globalized markets increasingly forces organizations to provide mass customized integrated solutions for their customers (Vargo and Lusch, 2004; Tukker and Tischner, 2006). To achieve competitive advantage, organizations need to concentrate on their core competencies and outsource others (Prahalad and Hamel, 1990). This situation increasingly stresses the importance of dynamic business networking (BN)

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to respond to emerging customer requirements (Mehandjiev and Grefen, 2010). A dynamic BN requires the sensing of customer needs and a rapid response to these needs through the agile orchestration of resources distributed among parties (Sambamurthy *et al.*, 2003). This highlights the importance of information-intensive and dynamic inter-organizational business processes (Grefen *et al.*, 2009). The information-intensity points to a dynamic evolution of inter-organizational business process to respond to environmental requirements (Reichert and Weber, 2012). Information-intensity is increasingly enabled by the internet of things technologies – like sensor, RFID, and social media technologies – that create more and more digital information about real world objects (Lohr, 2012). This information can be generated by suppliers (such as logistics-related information) or by customers (such as information implying customers' experience in social media). Although the access to globally distributed information enables a BN to exploit environmental opportunities, it also can result in emerging issues such as unsecured information access and low-quality information products (Tallon, 2013; Haug *et al.*, 2013; Silvola *et al.*, 2011; Rasouli *et al.*, 2015c). These issues can strongly disrupt the performance of a BN. So, they need to profoundly be recognized and responded by information governance (IG) mechanisms (Tallon, 2013).

IG can be characterized as a holistic approach to different mechanisms that are required to enable high quality information exchange (Hulme, 2012; Kooper *et al.*, 2011). It should maximize the value of information for all stakeholders and safeguard information as an asset within its whole lifecycle (Tallon *et al.*, 2013). In this way, IG addresses different domains like information quality (IQ), information privacy, information security, and metadata (Khatri and Brown, 2010; Young and McConkey, 2012). Although IG within organizational boundaries has increasingly been attended in recent literature, the research on IG in the context of BN is lacking (Otto *et al.*, 2011). The related work on IG in the context of BN is mostly concentrated on architectural solutions enabling quality information exchange (like Dustdar *et al.*, 2012; Scannapieco *et al.*, 2004). But, these architectural solutions do not have a comprehensive view on different aspects of IG including information service quality, information product quality, security, and metadata (see Rasouli *et al.*, 2015a). On the other hand, IG in a dynamic BN encounters with various emerging issues such as context aware semantic information exchange or collaboratively created information ownership. These emerging information exchange issues in dynamic BN result in new IG requirements to enable quality information exchange (Otto *et al.*, 2011; Rasouli *et al.*, 2015c).

The BN engineering approach (Alt *et al.*, 2000; Grefen, 2013) requires to pay much more attention to the way how parties within a BN interact, not only on what they exchange. This requires recognizing interactions among parties within inter-organizational business processes. An inter-organizational business process is enacted by two or more autonomous organizations, of which at least one organization exposes a non-black box projection of the explicit control flow structure of an internal process to the other organization(s) (Grefen, 2013). Based on the BN engineering approach, in this research we focus on the identification of IG requirements within inter-organizational business processes in the context of BN. In this way, the research question that is going to be responded in this research has been stated as:

RQ1. What are the IG requirements in dynamic inter-organizational business processes within a BN?

For the specification of this research question, we frame it within four facets, respectively, the context, the intervention, the population, and the outcomes (Petticrew

and Roberts, 2008); see Figure 1. A BN, as a context of this research, can be defined as the organization and management of IT-supported business relationships with internal and external business partners (Alt *et al.*, 2000). Based on a business engineering view (Alt *et al.*, 2000; Grefen, 2013), three different layers can be recognized within a BN, respectively, the strategy layer, the business process layer, and the information system layer. The strategy layer addresses capabilities that a BN requires to respond to environmental needs effectively (e.g. capabilities proposed by Rasouli *et al.*, 2015c; Otto *et al.*, 2011). The business process layer points out interactions among parties in the form of inter-organizational business processes that support BN capabilities (Grefen, 2013). The information system layer enables inter-organizational business processes to use different IT facilities. In this research, since we aim to identify IG requirements enabling quality information exchange, our focus is on the inter-organizational business process layer within a BN. Indeed, information exchange among parties within a BN is realized by inter-organizational business processes. Moreover, regarding the distinction between a supply chain and a demand chain dimension within BN (Hilletofth, 2011; Rasouli *et al.*, 2014), in this research we focus on a supply chain dimension which concentrates on supplier-supplier interactions. So the customer processes (e.g. processes for the co-creation of the value proposed by Payne *et al.*, 2008) are not covered in this research.

Within the aforementioned context, we concentrate on a situation that networked business processes need to be dynamic (i.e. the intervention facet; see Figure 1). This dynamism is required due to the market forces for mass customization of products and services regarding customers' unique needs (Gunasekaran *et al.*, 2008; Hilletofth, 2012). Based on Sambamurthy *et al.* (2003), this dynamism can be characterized by dynamic operating and dynamic partnering. Dynamic operating reflects the modification of the interactions among a certain set of parties within BN. Dynamic operating has been characterized within different types in previous research studies (e.g. Reichert and Weber, 2012; Schonenberg *et al.*, 2008). In this research we do not distinguish between these different types of dynamic operating. On the other hand, in this research dynamic partnering points to the agile collaboration of parties within a value network (e.g. in the form of a virtual enterprise) to exploit an emerging environmental opportunity (Grefen *et al.*, 2009).

Based on the specified research question in Figure 1, the aim is the identification of the consequences of dynamic networked business processes on IG domains (i.e. the population facet; see Figure 1). This means that the dynamic networked business processes result in new issues that need to be responded by IG. In this way, the outcome of this research question is a set of IG requirements in the context of dynamic BN (i.e. the outcome facet; see Figure 1). These identified IG requirements can be a well-established basis to develop different structural, procedural, and relational IG solutions.

To answer the elaborated research question, in line with the design science research approach (Aken, 2004; von Alan *et al.*, 2004), we organize the research within two phases:

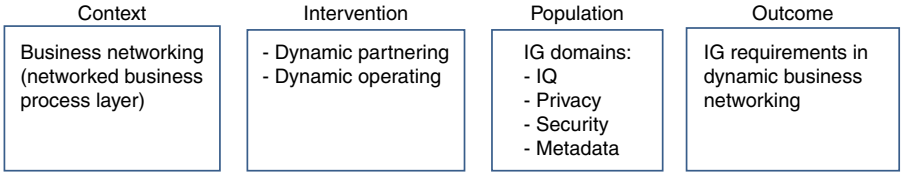

Figure 1.
The specification of the research question

the development phase and the evaluation phase (see Figure 2). Within the first phase, we identify IG requirements in dynamic BN that results in a comprehensive list of requirements. The approach for the identification of IG requirements is elaborated in Section 2. A comprehensive list of the identified IG requirements is represented in Section 3. To evaluate the practical significance of the identified IG requirements we conduct a case study in a BN that provides integrated mobility solutions. This case study is described in Section 4. We conclude this paper in Section 5 which embraces the discussion about the findings, the theoretical and practical implications and the conclusion.

2. The approach for the identification of IG requirements

For the identification of IG requirements, as a first phase of this design science-based research, we investigate three potential research approaches, respectively a survey, a case study, and a systematic literature review (SLR). In this research, due to the specified research question that concentrates on a particular business situation (i.e. dynamic BN), a high consideration of the research context is needed. However, a survey's ability to take into consideration contextual factors in the exploration of a phenomenon is extremely limited (Yin, 2013). Case study research enables an in-depth investigation of contextual factors (Yin, 2013), but it cannot support the comprehensive identification of IG issues sufficiently. The SLR approach (Keele, 2007; Tranfield *et al.*, 2003) enables a comprehensive search for relevant evidences of an issue within a context and so it fits best with our research approach. The SLR as an exploratory research approach enables reviewing relevant evidences to the specified research question sufficiently. The main limitation of this approach is that systematically reviewed evidences are originated from theory. Although within this approach the scientific rigor of the explored evidences to answer the specified research question can be supported, their practical significance needs to be investigated empirically. For the investigation of practical significance of the explored evidences we use case study research (see Section 4).

On the basis of Keele (2007) and Tranfield *et al.* (2003), to conduct the SLR for the identification of the IG requirements in a BN, the subsequent steps are followed:

(1) planning the review;

(2) identifying research;

(3) practical screening;

(4) extracting quality evidences; and

(5) synthesizing and reporting evidences.

Planning the review

After the identification of the need to conduct a SLR, the research question is specified and framed (see Figure 1). The theoretical relevance of this research question is clearly addressed in recent research studies (e.g. Otto *et al.*, 2011; Tallon, 2013). To ensure the practical relevance of this research question we conduct two in-depth interviews in a BN

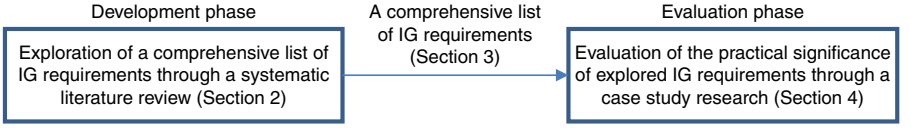

Figure 2.
The structure of the research

which provide integrated mobility solutions for customers (the detail of this case is elaborated in Section 4). To reduce the researcher bias, a review protocol is developed and submitted to three reviewers. These three reviewers are selected from three different relevant expertise domains, respectively, dynamic BN, business process management, and IT governance.

Identifying research

To clarify search terms we rely on the specified research question (see Figure 1). Relevant keywords within each of the determined facets of the research question are listed (see Table I). We aim to generate a list of keywords that is "both wide enough to recall a sufficient quantity of references and precise enough, in the light of information explosion, to eliminate unnecessary material" (Duff, 1996). To evaluate the relevance of the identified keywords, we refer to three reviewers with expertise in related domains. The search terms are represented in Table I. The identified keywords are repeatedly used in the context of networked communication that is related to the infrastructural technologies supporting the communication between devices. Regarding the specified research question, which concentrates on the business process layer within a BN, the networked communication domain is out of scope of this research. We determine some terms to exclude these irrelevant sources (see Table I; not related terms).

The strings are used to search for full-text publications in related bibliography databases. Regarding the research question in this review, the bibliography databases containing sources related to IG and business process management could be relevant. Regarding reviews that have been conducted in these contexts (e.g. Otto *et al.*, 2011; Xiao *et al.*, 2014) we have chosen five bibliography databases, respectively:

(1) EBSCO online;

(2) Emerald;

(3) AIS electronic library;

(4) ACM electronic library; and

(5) IEEE.

In addition, we also search for publications by key contributors in IG, business process management, and BN domains that are published in other databases. These key contributors are recognized by using the conducted search. We also tested this list of key contributors by three domain experts. The identified research containing 90 query strings was conducted during the spring of 2015. These queries resulted in 4,960 sources.

Intervention		Context		IG domains		Not related terms
Dynamic OR Flexible OR Agile OR	And	Network OR Collab(oration) OR Interorganization	And	Process OR Service composition	And	Information/data quality OR Information/data privacy OR Information/data security OR Metadata/ontology	And NOT	Wireless Sensor Agent Grid Bandwidth Routing

Table I. Keywords and query strings used in the systematic review

Practical screening

The selection of primary studies is based on determined inclusion and exclusion criteria. Regarding the research question in this review we apply the following inclusion criteria:

- From the content point of view, all studies within the selected databases related to IG and dynamic processes in the context of BN are included. Since BN can be realized in different forms (such as supply chain, collaborative network, and B2B e-marketing), we take into consideration studies about all types of BN.
- No limit on publication date is considered.
- All types of publications including conceptual, research, and literature study, as well as conference proceedings, are included.

The exclusion criteria are as follows:

- studies relating to IT infrastructure (such as network communication) are excluded;
- studies that are not focussed on a BN context are excluded;
- studies that focus on technical solutions for data integration are excluded;
- studies focussing on social media and customer information management are excluded;
- studies that do not clearly address an IG domain are excluded.

To ensure the reliability of inclusion and exclusion decisions, a randomized set of sources in each step are assessed with two other researchers. A high consistency in the decisions of three researchers reflects the reliability of the used inclusion and exclusion criteria. The selection of primary studies, which is based on the determined inclusion and exclusion criteria, is conducted within three steps, respectively:

(1) Assessment based on the title: the sources that are found by conducted queries were added to the databases if their title satisfies the inclusion criteria. This step resulted in the selection of 358 sources among all found sources.

(2) Removing the repeated sources: the research queries return many repeated sources. In this step we removed repeated sources: this resulted in 267 sources.

(3) Assessment based on abstracts and conclusions: since in the domain of our research, the abstracts are not qualified sufficiently (Keele, 2007), we investigate the conclusions of the selected sources as well. This step resulted in a final set of 87 sources.

Extracting quality evidences

We conducted quality assessment and data extraction steps at the same time. To do so, we extracted evidences within all the 87 selected sources. To investigate the quality of extracted evidences we rely on their relevance to the research question as well as their scientific rigorousness. The investigation of the relevance of extracted evidences is based on the research question facets (see Figure 1). In this way, extracted evidence is relevant if this addresses an IG domain in the context of dynamic BN, especially within the business process layer. To assess the scientific rigorousness of the extracted evidences we rely on the hierarchy of evidences quality proposed by Keele (2007).

An evidence can be accepted as a sufficiently qualified evidence if it covers at least the lowest level of the mentioned quality hierarchy (i.e. the evidence has been peer-reviewed by experts). A form is designed to conduct the data extraction and quality assessment. The data gathered within the designed form are stored in a database. To test the reliability of the extraction and quality assessment process, a set of randomized publications are extracted and evaluated by authors independently. The consistency of the results shows the reliability of the process.

The extraction of quality evidences within 87 selected sources led to 163 evidences. These quality evidences are extracted from 51 publications. This means that we do not find any quality evidence within the other 36 sources.

Synthesizing and reporting evidences

Regarding different synthesis strategies ranging from a narrative synthesis to a meta-analysis (Tranfield *et al.*, 2003), we follow the realist synthesis strategy. This strategy captures a list of vital ingredients that underpin each aspect of the research question (Pawson, 2002). With respect to our intent in this research for the identification of the IG requirements, this strategy fits best. We synthesize the extracted evidences related to the different IG domains, respectively, IQ, information security, and metadata. Within each IG domain, evidences reflecting a same direction are integrated. The synthesis led to 39 IG requirements. The synthesized evidences are evaluated independently by two domain experts. This evaluation relies on the relevance of evidences synthesized together as well as the fine granularity of the synthesized evidences. A consensus process is conducted between the researcher and two independent domain experts, which finally led to a synthesis of evidences within 28 IG requirements.

3. The identified IG requirements

The identified IG requirements in dynamic BN and their sources are listed in Table II. These IG requirements are categorized within three main domains of IG, respectively, the IQ, the information security, and the metadata domain. The IQ domain indicates the extent to which information provided within a BN fits with stakeholders' needs (Wang, 1998; Otto *et al.*, 2011). Based on Kahn *et al.* (2002), in the IQ domain both information product quality and information service quality can be distinguished. The former considers information as a product that needs to be produced by a manufacturing process with an end-product of information stored in a database. But, information service quality focusses on the activities which occur after information is stored as an end-product in a database, i.e. to enable consumers to obtain and use information. The information security domain underlines the protection of information confidentiality, integrity, and availability (Bishop, 2003). The metadata domain reflects information about information that enhances the usability and understandability of an information service (Khatri and Brown, 2010). The identified IG requirements, which are classified within the aforementioned three domains, are elaborated further.

Modification of syntactic and semantic information inconsistency

Due to the autonomous nature of parties in a BN, a certain information product can be produced by different parties using different rules (syntactic) and different language and norms (semantic). This issue is more highlighted in a dynamic BN, where parties can repeatedly be switched. Moreover, the presence of parties from different contexts,

Induced IG requirement	Sources
IQ requirements	
1 Modification of syntactic information product inconsistency	Hassine-Guetari (2009), Lu and Xu (2014), Hüner *et al.* (2011b), Botha *et al.* (2014), Dawyndt *et al.* (2005), Song and Xiongying (2010), Hsu and Rubenstein (1994), Nakatani *et al.* (2006), Falge *et al.* (2012) and Rasouli *et al.* (2015b)
2 Modification of semantic information product inconsistency	Mecella *et al.* (2002), Barnickel *et al.* (2010), Botha *et al.* (2014), Finin and Joshi (2002), Dawyndt *et al.* (2005), Song and Xiongying (2010), Guo *et al.* (2003), Bizer *et al.* (2012), Hsu and Rubenstein (1994), Batini *et al.* (2004) and Liu *et al.* (2011)
3 Handling information product repetition	Mecella *et al.* (2002), Botha *et al.* (2014), Dawyndt *et al.* (2005), Ofner *et al.* (2012), Nakatani *et al.* (2006), Batini *et al.* (2004), Haug *et al.* (2013); Xu *et al.* (2002) and Rasouli *et al.* (2015b)
4 Linkage of relevant information products	Lu and Xu (2014) and Falge *et al.* (2012)
5 Dismission of not added value information products	Botha *et al.* (2014) and Rasouli *et al.* (2015b)
6 Information product synchronization	Lu and Xu (2014), Nakatani *et al.* (2006), Schemm and Legner (2008b), Hoellrigl *et al.* (2010) and Demeter *et al.* (2007)
7 Information product pooling	Schemm and Legner (2008a), Yang (2012), de Corbiere (2009) and Haug and Stentoft Arlbjørn (2011)
8 Information service clarification	Felici *et al.* (2013) and Lotz *et al.* (2012)
9 Information service quality certification	de Corbiere (2009), Nakatani *et al.* (2006), Batini *et al.* (2004), Falge *et al.* (2012), Haug and Stentoft Arlbjørn (2011), Hüner *et al.* (2011b)
10 Quality aware information service brokery	Haug *et al.* (2013), Xu *et al.* (2002), Felici *et al.* (2013), Haug and Stentoft Arlbjørn (2011), Mecella *et al.* (2002) and Missier and Batini (2003)
11 Information networkability modification	Hu and Grefen (2002), Hoellrigl *et al.* (2010), Hüner *et al.* (2011a), Shankaranarayanan and Cai (2005), Nakatani *et al.* (2006) and Falge *et al.* (2012)
12 Continuity of information service	Felici *et al.* (2013) and Lu and Xu (2014)
Information security requirements	
13 Prevention of information leakage and misappropriation	Roy *et al.* (2012), Sathyanarayana and Sheela (2013) and Rasouli *et al.* (2015b)
14 Information asset ownership management	Lu and Xu (2014), Miseldine *et al.* (2008), Haug and Stentoft Arlbjørn (2011) and Steinke and Leamon (1996)
15 Prevention of data remanence	Sathyanarayana and Sheela (2013)
16 Preserving added value information	Roy *et al.* (2012), Lu and Xu (2014), Hüner *et al.* (2011b), Ofner *et al.* (2012) and Tallon (2013)
17 Traceability of information provenance	Hassine-Guetari (2009), Handel and Wang (2011), Velikova *et al.* (2009) and Sathyanarayana and Sheela (2013)
18 Dynamic trust management	Velikova *et al.* (2009), Roy *et al.* (2013), Xu *et al.* (2002) and Qi *et al.*
19 Aligning diversified security ontologies	Lu and Xu (2014)
20 Creation of trustworthy information exchange environment	Yang (2012) and Lotz *et al.* (2012)
21 Modification of inconsistent security policies	Teo and Ahn (2007)
22 Identity federation	Hoellrigl *et al.* (2010) and Seigneur (2005)

(*continued*)

Table II.
The explored IG requirements

Induced IG requirement	Sources
Metadata requirements	
23 Metadata collaborative repository	Schemm and Legner (2008a) and Hüner *et al.* (2011a)
24 Metadata traceability	Myrseth *et al.* (2011)
25 Modification of collaborative metadata inconsistency	Barnickel *et al.* (2010), Becker *et al.* (2008) and Hüner *et al.* (2011a)
26 Metadata evolution	Schemm and Legner (2008a), Myrseth *et al.* (2011) and Barnickel *et al.* (2010)
27 Collaborative metadata robustness	Batini *et al.* (2004)
28 Metadata context awareness	Schemm and Legner (2008b) and Falge *et al.* (2012) and Shankaranarayanan and Cai (2005)

Table II.

which each have various norms and language, stimulates this issue in a dynamic BN aiming at the provision of integrated solutions for customers. The governor of a dynamic BN requires the modification of the syntactic and semantic information inconsistency to enable information exchange between parties.

Handling information repetition

In a dynamic BN in that parties are loosely linked, each party needs to produce and to keep critical information about its environmental entities (e.g. the customer-related information). This independent view on the reality by each party can easily result in repetitive information products. To avoid garbling information, unnecessary information production costs, and repeating information entry by customers, the governor of a dynamic BN requires the coherent management of the information production.

Linkage of relevant information

Because of the independent view on facts by parties, information about similar facts can be distributed among different parties. This distributed information about facts might be biased due to a party's interest or perspective. A well-established decision making that is supported by consistent evidences requires the linkage of the relevant information about similar facts.

Dismission of not added value information products

The change of information needs in a dynamic BN can result in the disutility of an information product. To avoid costs of production and storage of not added value information, the governor of a dynamic BN requires pursuing polices to remove the not added value information products.

Information product synchronization

Because of the distributed nature of a BN, a change in the environment can be recognized by a party. To keep the information products consistent and updated, the recognized change needs to be disseminated in all the relevant information products distributed among different parties.

Information product pooling

Since the bilateral information exchange between parties has proven to be costly and complex, the centralization of critical information products (i.e. master data) that are

repeatedly used by parties is inevitable. In a dynamic BN context, the master data needs to be evolved in conformance with the change of information requirements.

Information service clarification
The governability of information service in a dynamic BN depends on its transparency. Exposing the information service interface without sufficient visibility of its internal view (e.g. related to the information production process) can limit its usability.

Information service quality certification
Information services provided by parties within a BN are different from a quality point of view. To ensure that an information service has sufficient quality to be used by another party, a quality certification is required. In the context of dynamic BN, this certification should be based on standards that are globally regarded. But, on the other hand, these standards need to be flexible to cover the emerging requirements of a dynamic BN.

Quality aware information service brokery
The information need of a party in the context of a BN can be responded by different information services. The information governor of a BN needs to ensure that the best matched quality information service is selected and used by an information consumer. The information service brokery can facilitate this quality aware match making in a dynamic BN.

Information networkability modification
Information networkability refers to the usability and understandability of an information service by different parties within a BN. For the modification of the information networkability in a dynamic BN, diversified B2B syntactic and semantic interaction protocols need to be governed.

Continuity of the information service
In BN information services are mostly composed to respond to an operational or decision making request. In a dynamic BN, this composition might be dynamic because of the switching information sources. To avoid the interruption of the operation, a composite information service requires reliability.

Prevention of information leakage and misappropriation
A BN necessitates the sharing of information assets based on trust between parties. But, shared information assets are threatened by opportunistic behaviors. This issue can be more highlighted in a dynamic BN due to the loosely link between parties. The governor of a dynamic BN requires the insurance that these treats are sufficiently prevented.

Information asset ownership management
In a BN, valuable information assets are mostly created collaboratively. In a dynamic BN, which collaborations are short term, the information governor requires to distribute collaboratively created information assets after the dissolution of certain collaboration.

Prevention of data remanence within departed parties
Collaboratively created information assets are distributed among parties within a BN. In a dynamic BN in that parties can easily be switched, the information governor requires the insurance that information assets have not been used illegally by a departed party.

Preserving added value information
When a party leaves the collaboration, a part of critically important information assets can be lost. To avoid the interruption of BN operations due to its dynamism, a well-established legal policy is required for preserving added value information.

Traceability of information provenance
Information provenance is used to access the IQ reliability of different information sources. The traceability of information provenance in a dynamic BN enables the insurance of the integrity of the information that is consumed by a party.

Dynamic trust management
The access to information assets in a dynamic BN is based on the trust between parties. To secure information assets within a BN, a well-established policy is required to determine the trust value for parties and to manage the access to information assets based on this trust value. In a dynamic BN, this trust value needs to be updated continuously.

Aligning diversified security ontologies
Each local security system, which is used by a party, has an understanding about its own vulnerabilities and threats which are addressed by security ontology. In a dynamic BN in which parties are loosely linked, these diversified security ontologies need to be aligned. This aligned security ontology supports a shared understanding of threats and vulnerabilities.

Creation of a trustworthy information exchange environment
The role of trust as a basis to shape a BN is proven. However, the loosely linkage between parties in dynamic BN encounters trust. To deal with this issue, in addition to mechanisms ensuring the prevention of opportunistic behavior, the information governor of a dynamic BN needs to create a trustworthy environment. This trustworthy environment can be based on legal foundations as well as on the reputation of the BN orchestrator.

Modification of inconsistent security policies
Autonomous parties within a dynamic BN may have inconsistent security policies. To facilitate a secure access to information distributed in a BN a coherent security policy requires to be regarded by all parties.

Identity federation
Autonomous parties within a BN store identity-related information locally. The heterogeneity and distribution of identity-related information, which can be intensified in a dynamic BN, can result in unauthorized and incorrect service delivery. To counter this issue, identity-related information requires to be federated.

Metadata collaborative repository
Because of the independent view on the reality by parties within a dynamic BN, each party has a certain ontological view that results in diversified metadata. The metadata collaborative repository is required for the recognition of metadata used by each party.

Metadata traceability
To counter the semantic inconsistency in a dynamic BN, the metadata used by an information service provider needs to be traceable. The governor of a dynamic BN requires the insurance of the traceability of metadata related to information services.

Modification of collaborative metadata
To enhance a shared ontological understanding about reality, collaborative metadata needs to be managed. Collaborative metadata, which can be represented in the form of metadata standards, is required for the governance of the information exchange.

Collaborative metadata evolution
The dynamism of a BN, like switching parties or emerging environmental needs, can result in an adaption of ontologies and metadata used by parties. Collaborative metadata requires to be evolved to keep aligned with realized changes.

Collaborative metadata robustness
Since collaborative metadata is regarded as a semantic foundation for all parties within a BN, it needs to be sufficiently robust. Otherwise, unceasing change will be loaded to all parties, which can then disturb a BN.

Metadata context awareness
Within a BN to provide an integrated solution, parties collaborate from different contexts. Standardization of metadata is usually context specific. The semantic information exchange between parties from different contexts requires the context awareness in collaborative metadata used by parties.

The findings of the conducted SLR, which are synthesized within 28 concrete IG requirements, provide a thorough view on the necessities of dynamic BN. However, these theoretically originated findings need to be evaluated in a real-life situation. The evaluation of the practical significance of the identified IG requirements is addressed in the next section.

4. The evaluation of the identified IG requirements

We conducted a case study to investigate the practical significance of the identified IG requirements in a real world situation. Indeed, we aim to investigate "how" the dynamism in a BN results in the emergence of the identified IG requirements. The case study research approach is appropriate to respond to this "how" question, because it enables the exploration of a chain of in-depth evidences reflecting IG issues within a real-life dynamic BN (Yin, 2013). The ability of other alternative research approaches – like the survey research – is limited for the investigation of the complex context such as a dynamic BN (Cleven *et al.*, 2009). In this case study, we explore information exchange issues resulting from the dynamism of networked business processes. A theoretically explored IG requirement is practically significant if it addresses a real-life information exchange issue (see Figure 3).

In this case study the unit of analysis is a BN. Our concentration is on a dynamic BN (see Table I) and so we need to choose a BN that handles dynamic networked business processes. Since we rely on the analytical generalization in this case study (Yin, 2013), we use a single-case study design. Based on this design, if we can empirically deduce the practical significance of the identified IG requirements in the selected case, then we can argue that these IG requirements are also significant in other dynamic BNs. We select a dynamic BN in the financial industry in the Netherlands. This dynamic BN is orchestrated by a car leasing organization. Other parties are car dealers, maintainers, and insurance organizations. This BN is in a transition toward the provision of integrated mobility solution for customers. To do so, new parties are added to this BN like car rentals, other transportation service providers, and fuel service providers. The mass customization of the integrated mobility solution by this BN requires dynamic interactions between parties.

Regarding our focus of the identification of information exchange issues on the business process layer, we selected two inter-organizational business processes, including a customer invoicing process and a mobility solution offering process. A customer can get services from different providers within this BN during a contract, but pays once for all of the services. The car leasing organization needs to integrate related information from all parties and needs to invoice for the provided integrated solution. Also the car leasing organization needs to offer a customized mobility solution for each customer. To do so, the car leasing organization needs to integrate information related to a customer's experience and to analyze it to offer customized value propositions.

To investigate information exchange issues in these dynamic networked business processes, choreography diagrams that show the interactions between parties and also orchestration diagrams representing the processes within each of parties are mapped. In doing so, we rely on the data from the "CoProFind" project that has already been conducted in this BN (Lüftenegger, 2014; Traganos, 2014). Within the mapped networked business processes, we look for information exchange issues that the car leasing organization deals with. In addition to direct observations based on the mapped intra and inter-organizational business processes, we also conducted nine in-depth interviews with employees in IT, accounting, business architecture, and procurement departments. These in-depth interviews are based on a semi-structured questionnaire that is developed on the basis of the identified IG requirements. The interviews are

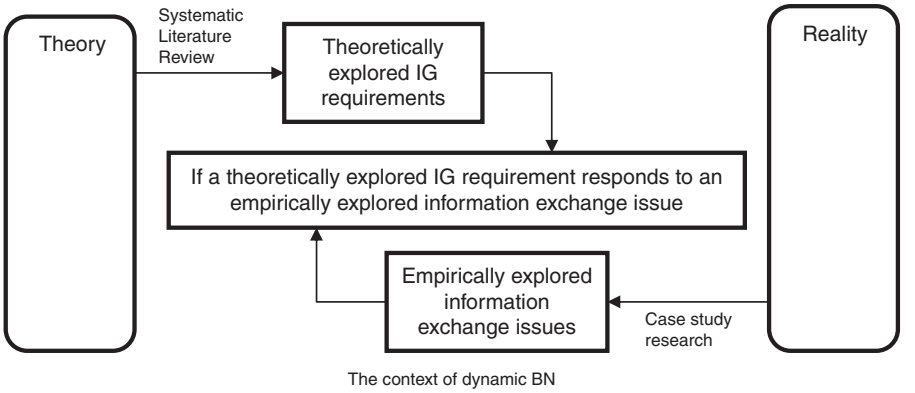

Figure 3.
The logic of reasoning to evaluate the practical significance of the identified IG requirements

organized as prolonged interviews that take place over two hours and are recorded using recording devices. The recorded files are transcribed and sent to the interviewees to check the correctness of the interpretation.

To analyze the data gathered through the direct observations and the in-depth interviews we develop a logic model. The logic model as an analytic technique consists of matching empirically observed events to theoretically identified issues (Funnell and Rogers, 2011). This logic model, which shows cause-effect patterns among the gathered evidences, represents how dynamic operating and dynamic partnering result in emerging issues in different domains of IG. For the development of this logic model, we rely on the supporting theories in the context of IG that characterize the sources of IQ issues (see Wand and Wang, 1996; Stvilia *et al.*, 2007). In doing so, we empirically deduce how dynamic networking triggers IQ issue sources and how these IQ issue sources result in concrete IG issues corresponding the theoretically identified IG requirements. The findings of this case study research based on the elaborated logic model are codified according to the identified IG requirements (see Table III; the findings are sorted in the same order as in Table II).

The findings reported in Table III reflect information exchange issues that the car leasing organization as the orchestrator of the BN deals with during the execution of the inter-organizational business processes for invoicing customers and offering mobility solutions. These issues clearly show that this BN in order to be able to provide mass customized integrated solutions for customers through dynamic operating and partnering, needs to respond to the identified IG requirements effectively. Although these findings sufficiently reflect the practical significance of the identified IG requirements, due to our limitations in this case study the findings, as reliable empirical evidences, are not at the same level of the confidence. Some of the findings are based on facts that have directly been observed in the case study. But, since the investigated case is in a transition toward a quite dynamic BN, some others have not directly been observed. But, in-depth interviews with employees, who are involved in information exchange related positions in different departments, strongly point out the practical significance of other identified IG requirements as well. The car leasing organization as the orchestrator of this BN is going to conduct an IG program to respond these requirements. There is a clear consensus that transition toward a dynamic BN without taking into consideration these IG requirements can easily interrupt their business.

5. Discussion and conclusion

Discussion

Information exchange among parties in a dynamic BN, which is characterized by dynamic partnering and dynamic operating (Gunasekaran *et al.*, 2008; Sambamurthy *et al.*, 2003), encounters with emerging information exchange issues. These issues need to be addressed by IG mechanisms. The requirements of IG in a dynamic BN are described in Sections 3 and 4. The related literature to IG in the context of BN can be categorized within the business-oriented and IT-oriented studies. The former studies focus on the characterization of information exchange in BN (e.g. Croom *et al.*, 2007; Prajogo and Olhager, 2012; Rai *et al.*, 2006). The latter concentrates on solutions that support information exchange in BN (e.g. Dustdar *et al.*, 2012; Scannapieco *et al.*, 2004). This research can be situated in the intersection of these two related studies. Indeed, this research, based on the characteristics of dynamic BN (see Rasouli *et al.*, 2014; Mehandjiev and Grefen, 2010), addresses concrete requirements that need to be responded by IG solutions. In this way, this research can be seen as a basis an

	Information exchange issues reflecting the practical significance of the explored IG requirement
1	Some personnel in accounting department are employed to re-enter financial information received from some other parties
2	Different maintainers, which are dynamically selected by customers, use different terms that causes misinterpretation of received information
3	Due to the autonomous nature of parties, the same financial information that is stored by car leasing organization, also are kept by car rentals
4	Customers' experience related information is distributed among all parties
5	There is a high amount of information relating to car deficiencies stored by car leasing organization. In a new business model that asset monitoring is undertaken by car rentals, this information would be useless
6	Provided services are unregarded in the invoice because of the un-updated information by parties
7	Because of the importance of car deficiencies information for different parties, this information is kept by at least 4 different parties
8	Not clarified pricing logic by car rentals can result in compliances by customers
9	The lack of information integrity audit can lead to insubstantial financial information, especially by maintainers
10	Since car rentals may use different realized costs during the usage of a car by a customer to optimize their pricing decision support systems, unawareness about the quality of information provided by different parties can result in unrealistic decisions
11	Currently the car leasing organization is set up to be able to handle pre-defined XML files that are received from car rentals. But adding new car rentals that do not use these pre-defined formats can result in information exchange issues
12	Issuing an invoice embracing all history of services provided to a customer may not be possible because of the absence of information by some parties that already have left this BN
13/14/15/18	Understanding of a customer's experience about an integrated provided solution necessitates sharing and collaboratively usage of information stored in distributed CRM systems. However, since some parties in this BN are competitors as well (e.g. car rentals or car dealers), the leakage of these information can result in a misusage
16	Leaving the BN by parties that own critical information (e.g. car rentals) can interrupt the provision of mass customized solutions
17	Handling customers' complaints about issued invoices necessitates the traceability of related information provenance
19/21	Because of the different authorization and authentication by parties, direct access to information services can mostly be impossible
20	If parties, particularly market competitors, be in doubt about the misusage of their information asset by their competitors, this BN would be disrupted
22	Customers are identified by local identifiers resulting in difficulty to integrate information relating to a customer
23	Lack of access to metadata used by each party can suffer car leasing organization in generating consistent invoices
24	To respond customer complaints, information in an invoice needs to be re-interpreted by using of original information. This re-interpretation requires traceability of metadata
25	The inconsistent metadata used by parties (particularly maintainers) causes to many complaints by customers concerning unreal service reporting in an invoice
26	Emerging services offered by new parties (e.g. different navigation and traffic solutions) requires enriching the collaborative metadata
27	Generation of online queries by parties in order to online access to related information is costly. The repeated request to change these queries cannot be regarded by parties
28	The deficiencies terms used by car rentals conflict by deficiencies terms by maintainers

Table III.
Findings of case study research in a BN that provides integrated mobility solutions

architectural design that links business characteristics with related enabling solutions. Indeed, although this research does not demonstrate a concrete solution for IG in dynamic BN, it provides a well-established basis as well as a comprehensive view to develop and integrate different relevant solutions. In this way, it can be said that most related literature to this study is focussing on architectural designs in the context of dynamic BN. In the sequel we discuss how the identified IG requirements have been addressed in these architectural designs that aim to link the characteristics of BN and relevant solutions, particularly within the inter-organizational business process layer.

Most of the related works in the context of dynamic BN have focussed on the syntactic aspect of IG requirements (Izza, 2009) while the semantics related requirements have not been sufficiently addressed in this context. Meanwhile, due to the dominance of the service-oriented architecture, most of the relevant studies have focussed on the information service quality requirements (e.g. availability, and usability) (Dustdar *et al.*, 2012). Information product quality requirements (e.g. handling information product repetition, or information product synchronization) have not sufficiently been considered (Rasouli *et al.*, 2015a). The implicit assumption in most of the related works is that the information product quality requirements need to be handled by each party and the network governor should only care about the information service quality requirements. But, the findings in this research, that are also proved by the empirical evidences in the case study, demonstrate that most of the information product quality requirements resulting from dynamic BN cannot be responded by parties separately and need to be attended by a network governor centrally.

Although different solutions have been developed to support information security requirements in the context of BN (e.g. Blaze *et al.*, 2009; Takabi *et al.*, 2010), a comprehensive view on the issues resulting from a dynamic BN is missing. For instance, the modification of inconsistent security policies established by autonomous parties cannot easily be responded by conventional dynamic trust management mechanisms. Meanwhile, because of the co-creation of information assets in dynamic BN the management of the information asset ownership is quite challenging. This issue is intensified by the dynamic partnering and most of the proposed solutions (e.g. Rosenbaum, 2010) dramatically limit the agility of BN.

Related work on the metadata domain of the IG requirements in the context of dynamic BN can be categorized within the studies on semantic business process management as well as on collaborative ontology management. The research on semantic inter-organizational business process management (e.g. Hoang *et al.*, 2014) is mainly focussed on the gap between business experts and IT experts in the business process management lifecycle. However, the identified requirements in this research address another issue that is related to misalignment of the semantics between parties within a networked business. In this way, the identified metadata related IG requirements highlight the alignment between heterogeneous information services among different parties participating in the inter-organizational business process, rather than the semantic alignment between business and IT experts within a business process. Meanwhile, the research on the technologies supporting the semantics-aware interactions are principally related to ontology technologies like WSMO, METERO-S, and OWL-S (see Fensel *et al.*, 2011). These technologies enable semantic modeling, configuration, and execution of the inter-organizational business processes (Karastoyanova *et al.*, 2008). But, the semantics-aware conceptualization of the inter-organizational business processes is not addressed by these ontology technologies. The identified metadata related IG requirements highlight the need for

the development and evolution of a collaborative ontology to support the conceptualization of the inter-organizational business processes in dynamic BN.

A deep view on the relevant solutions supporting IG requirements shows that some IG requirements can be responded by well-established solutions embracing the structural, procedural, and relational mechanisms (De Haes and Van Grembergen, 2009), but some others cannot be responded easily. For instance, dynamic semantic interactions between parties collaborating from different contexts (i.e. the 11th requirement in Table II) is difficult to be responded completely by related state-of-the-art solutions such as semantic interoperability technologies, or domain specific standardizations (Izza, 2009). Meanwhile, some IG requirements are conflicting. For instance, information service clarification (i.e. the ninth requirement in Table II), which insists on the accessibility and visibility of internal information production by a party, conflicts with information privacy and ownership (i.e. the 14th requirement in Table II). Also most of the semantic interaction solutions (i.e. the second and 11th requirements in Table II), which are mostly based on the standardization, conflict with business flexibility, and dynamism (i.e. the business requirements to respond market needs). So, due to the limitations on the solutions, conflict between IG and business requirements, and conflict between IG requirements themselves an IG program cannot respond all emerging requirements in a dynamic BN. This means that moving toward a dynamic BN situation, which can lead to value for parties by exploiting market opportunities, can also result in risks originating from impossibilities to respond to all IG requirements. Consequently, a BN has to make a trade-of between on the one hand value, that emerges from a transition toward more dynamism, and on the other hand risks, emerging from information exchange in a dynamic situation.

Implications

The identified IG requirements, which are validated by the empirical evidences, clearly demonstrate that the theories in the marketing as well as in the operations management, that state the necessity for a co-creation of mass customized integrated solutions (Hakanen, 2014), need to attend deeply the information artefact exchange issues among parties. Particularly, the BN engineering approaches (e.g. Alt *et al.*, 2000; Grefen, 2015) necessitate an intense consideration of IG through the development of relevant methods and tools supporting information exchange. In line with the increasing importance of the information artefact as a critical asset enabling the business, the network governance and the IT governance theories need further development to address IG requirements resulting from the dynamic interactions in the BN. Meanwhile, IG theories (Tallon *et al.*, 2013; Khatri and Brown, 2010; Young and McConkey, 2012) should go beyond the organizational boundaries to be able to support forthcoming requirements of the business environment, which is characterized by a clear necessity for dynamic interactions with partners in globalized markets.

From a practical point of view, the findings of the research imply that a strategic transition plan for moving from a stable supply chain toward a dynamic BN, which enables the provision of integrated solutions for customers, needs to be aligned with a well-established IG program. This IG program should be based on the identification of emerging information exchange issues in the context of dynamic BN and the recognition of relevant solutions to respond to these issues effectively. Indeed, the business ambitions for radical change from a stable supply chain toward highly dynamic BN need to be lessened regarding emerging information exchange risks.

Misalignment between business ambitions and IG capabilities can result in losing a competitive strategic position in the market or can interrupt the operations because of low-quality and unsecure information.

Also the multidisciplinary nature of an IG program makes it difficult to be developed and realized properly. With respect to the identified IG requirements in Table II, as well as findings from the case study in Table III, an IG program needs to be developed and implemented by the cooperation of experts from different domains, such as strategy, marketing, business architecture, system architecture, and technical IT solutions. This program also needs to be shared and regarded by all parties within a BN. This multidisciplinary as well as multi-organizational nature of the development and implementation of an IG program makes it difficult to be realized.

Conclusion

In this paper a comprehensive set of the IG requirement in the dynamic BN has been identified as a set of 28 concrete requirements. These identified IG requirements are classified within the IQ, the information security, and the metadata domain. A case study research is conducted for the evaluation of the identified IG requirements. The findings of this case study demonstrate the practical significance of the identified IG requirements in practice. The findings of this research provide a well-established basis for the development of an IG program to support quality and secure information exchange in dynamic BN.

In this research, for the exploration of IG requirements, we concentrated on interactions between business parties. But, the co-creation of integrated solutions with customers requires a attention to customer-supplier interactions as well. The identification of IG requirements, concerning the value co-creation processes that underline interactions between customers and suppliers during the usage of a product or service, needs to be addressed in future research. Also, for the investigation of the practical significance of the identified IG requirements we rely on the findings from a single-case study. However this single-case study reflects the significance of the identified IG requirements sufficiently, but more empirical research can enhance the confidentiality of the findings. Also more empirical studies can be conducted for the investigation of the practical importance of the explored IG requirements. This can enable better fitting trade-of decisions in the case of conflicts between requirements.

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