

On the use of an Interoperability Framework In coopetition context

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Abstract. The simultaneous cooperation and competition between companies referred to as coopetition in the strategy literature is becoming a recurring theme in the business settings. Companies cooperate with their competitors to gain access to supplementary and complementary resources and capabilities in order to create more value for the customers in order to achieve sustainable value creation and distribution. To coopete, the companies need to be interoperable. Growing globalization, competitiveness and rising environmental awareness are driving many companies to prepare and control their interoperability strategy in order to enhance their ability to interoperate. In this paper, we use an interoperability model called the Maturity Model for Enterprise Interoperability (MMEI) to the coopetition context and we present some initial thoughts on the use of this maturity model in the coopetition context.

Keywords: Coopetition, Enterprise Interoperability, framework, interoperability potential, maturity model, assessment.

1. Introduction

To survive, an enterprise must interact with external entities in its environment to achieve sustainable value creation and distribution [1]. This interaction occurs in two basic ways: *cooperation* in the exchange of resources [2,3] and

competition to attract and retain customers [4] and resources [1] in product and resource markets, respectively. In business strategy, interactions between enterprises have conventionally been viewed through either a cooperative or a competitive lens (see for example [4,5]). However, in various business settings, firms can be observed to compete and cooperate at the same time in a wide diversity of ways to ensure their viability. Such hybrid strategies comprising simultaneous cooperation and competition have been characterized as *coopetition* [6-8].

Ever since Branderburger and Nalebuff [see 6-8] introduced the *coopetition* concept to the academia and business world, researchers in the field have been invoking various theoretical perspectives in order to gain an understanding of *coopetition* as a phenomenon of interest and its impact on business viability. Such research activities have served to *shed light on* important issues as diverse as, the drivers, potential advantages and challenges of *coopetition*. Moreover, a growing body of literature has been developed that captures *coopetitive* relationships between business parties in form of case study research.

So far, however, limited work has been done to provide business and strategy managers with insights into the organizational pre-requisites that need to be in place in order to initiate and sustain successful inter-organizational relationships (IOR) in general and *coopetition* in particular. Some researchers in the field of *coopetition* have highlighted this research gap, see for e.g. [9].

In this paper, we present a framework called “Maturity Model for Enterprise Interoperability” (MMEI) [10, 11]. MMEI enables an enterprise to assess its interoperability maturity and provides a set of best practices [12] (i.e. tasks and activities) that when put in place by an enterprise; allow reaching a targeted level of interoperability. Thus, MMEI can contribute to the inter-organizational research by developing insights into how an enterprise can be able to efficiently interact, collaborate and exchange information with business partners while avoiding potential conflicts. In this paper we explore how MMEI can be extended to address the complexities inherent in a multifaceted inter-organizational relationship such as *coopetition*. In this due, we seek to augment the existing set of best practices in MMEI to develop a reference model to be adopted by the enterprises to ensure interoperability in a *coopetitive* relationship.

The paper is structured as follows. In section 2, the Framework of Enterprise Interoperability which defines a classification for interoperability knowledge and the basis of MMEI is briefly presented. In section 3 we present the specification of the maturity model for enterprise interoperability. Then the application of the MMEI for cooperation is outlined in section 4. In section 5, we develop a use case to capture the potential changes to the MMEI when the company engages in cooperation (i.e. cooperate with its competitors) as compared to when it cooperates with non-competitors. Finally section 6 concludes the paper and proposes future work.

2. Preliminaries

In a general sense, interoperability is the *Ability of two or more systems or components to exchange information and to use the information that has been exchanged* (IEEE) [13]. When this ability is not achieved, interoperability becomes a problem that must be solved. Solutions to interoperability problems are characterized according to interoperability approaches defined in the ISO 14258 [14] and both solutions and problems can be localized into enterprises levels and characterized by interoperability levels, as defined in the Framework for Enterprise Interoperability.

The Framework for Enterprise Interoperability (FEI) initially elaborated in INTEROP NoE [15] and now under CEN/ISO standardization process (CEN/ISO 11354) is used as a basis to build the MMEI maturity model.

FEI defines a classification scheme for interoperability knowledge according to three dimensions: interoperability barriers, interoperability approaches, and enterprise levels.

2.1. Interoperability Barriers

According to the FEI, the establishment of interoperability consists in removing all the identified barriers. We can say that interoperability problems exist when there are such barriers. Three kinds of barriers are identified, referring each to one of the interoperability levels: Conceptual, Technological, and

Organizational. In fact, each of these interoperability levels corresponds to different views of an enterprise.

- *Conceptual* barriers which relate to the syntactic and semantic differences of information to be exchanged.
- *Technological* barriers relating to the incompatibility of information technologies (architecture & platforms, infrastructure...).
- *Organizational* barriers which relate to the definition of responsibilities and authorities.

2.2. Interoperability Concerns

The establishment or diagnosis of interoperability in an enterprise leads to identify the different operational levels of the enterprise that are concerned. The four levels defined in the FEI, namely business, processes, services and data, represent the areas concerned by interoperability in the enterprise.

- Interoperability of data aims to make work together different data models with different query languages to share information coming from heterogeneous systems.
- Interoperability of services aims at making work together various services or applications (designed and implemented independently) by solving the syntactic and semantic differences.
- Interoperability of processes aims to make various processes work together. In the interworked enterprise, the aim will be to connect internal processes of two companies to create a common process.
- Interoperability of business aims to work in a harmonized way to share and develop business between companies despite the difference of methods, decision making, culture of the enterprises, the commercial making, etc.

2.3. Interoperability Approaches

Deriving from ISO 14258, we can consider the following three basic ways to relate entities together to establish interoperations [14]:

- The integrated approach, characterized by the existence of a common format for all the constituents systems. This format is not necessarily a

standard but must be agreed by all parties to elaborate models and build systems.

- The Unified approach, also characterized by the existence of a common format but at a meta-level. This meta-model provides a mean for semantic equivalence to allow mapping between diverse models and systems.
- The Federated approach, in which no common format is defined. This approach maintains the identity of interoperating systems; nothing is imposed by one party or another and interoperability is managed in an ad-hoc manner.

2.4. Interoperability and Coopetition

Interoperability has to be addressed as a critical topic in the development of cooperative relations. As explained earlier coopetition is a multifaceted relationship that transcends a single focus on cooperation and completion to achieve the advantages of both. Hence, Coopetition is of a higher complexity as compared to a purely cooperative or competitive relationship. This inherent complexity accounts for the necessity to devise tailor –made interoperability models addressing the areas of concern in a coopetitive relationship.

3. MMEI : Maturity Model for Enterprise Interoperability

When an enterprise wants or needs to work or collaborate with other enterprises, different tools such as guidelines or metrics might be useful in order to ensure proper interoperation at all levels of the enterprise system. The Maturity Model for Enterprise Interoperability (MMEI) defined in [10, 16, 17] allows companies to evaluate their interoperability potentiality in order to know the probability that they have to support efficient interoperation and to detect precisely the weaknesses that are sources of interoperability problems.

In this section we present an overview of the MMEI model with a brief description of its levels. The complete description of the model can be found in [17].

3.1. The Scope of MMEI

MMEI is intended to be used by people who are concerned by the assessment of enterprise interoperability and by the detection of which might need to be improved to meet the needs and ambitions of the enterprise.

For that, we need to collect information through a series of interviews. The content of the assessment interview depends on the assessment scope and the enterprise needs. From the interviews, a rating shall be assigned based on validated data. Conclusions are taken by the assessor team after analysis.

3.2. Overview

MMEI defines five levels of interoperability maturity:

- Level 0, Unprepared: Characterized by proprietary or closed systems. In such systems, resources are not meant to be shared with others. Either documentations or Models are incomplete or nonexistent, or else partly available. The organization usually does not provide a stable environment to support the interoperability process, or there is no desire for the systems to interoperate with others.
- Level 1, Defined: Some ad hoc interoperations with other systems can take place, but the interoperability remains very limited and frequently exceeds the budget. It depends on the competence of the people in the organization and not on the use of proven strategy. Some basic IT devices are connectable. Simple electronic data exchange becomes possible. Organization systems are characterized by a tendency to over commit, abandonment of any type of external interaction in case of serious problems or in a time of crisis and an inability to repeat it.
- Level 2, Aligned: System is able (i.e. has the capabilities) to make changes in its components in order to adhere to common formats (standards). Processes, models, data and services are managed and mostly based on standards. There is possibility to adjust models, services or business policies, in order to, adapt to environment changes... In case of interoperation, the concerned sub-system provides adequate resources, assigns responsibility for performing this interoperation. These practices are retained during times of stress.

- Level 3, Organized: At this level, enterprise is well organized to deal with interoperability challenges. The meta-modeling is performed, and mapping using meta-models is generalized. Flexibility has been achieved in organization structure. A defined process is in place to precise how to do in case of interoperability. The Organization team is trained and knows how to do in case of changes. The required competencies, roles, infrastructure and work environment are defined.
- Level 4, Adapted: This level corresponds to the highest level of interoperability maturity (universal). Companies are able to dynamically adjust and accommodate 'on the fly'. There exist in general shared domain ontologies. There is a focus on continually improving performance of the system fields through innovative methods and technology improvements that enhance the organization's ability to meet its quality and performance objectives. Companies are able to interoperate with multi-lingual and multi-culture heterogeneous partners. The performance, definition, and management of the interoperability process is continually improved.

The following table gives an overview of MMEI levels.

Table 1. Overview of MMEI levels

<i>Maturity Level</i>	<i>Maturity capability</i>
<i>Level 4 – Adaptive</i>	Capable of negotiating and dynamically accommodating with any heterogeneous partner
<i>Level 3 – Organized</i>	Capable of meta modeling to achieve the mappings needed to interoperate with multiple heterogeneous partners
<i>Level 2 – Aligned</i>	Capable of making necessary changes to align to common formats or standards
<i>Level 1 – Defined</i>	Capability of properly modeling and describing systems to prepare interoperability
<i>Level 0 – Unprepared</i>	Not relevant: there is no capability for interoperation

Each one of the cited levels is described based on a simplified version of the interoperability framework that contains only two basic dimensions "interoperability levels" and "enterprise concerns" as shown in figure 1.

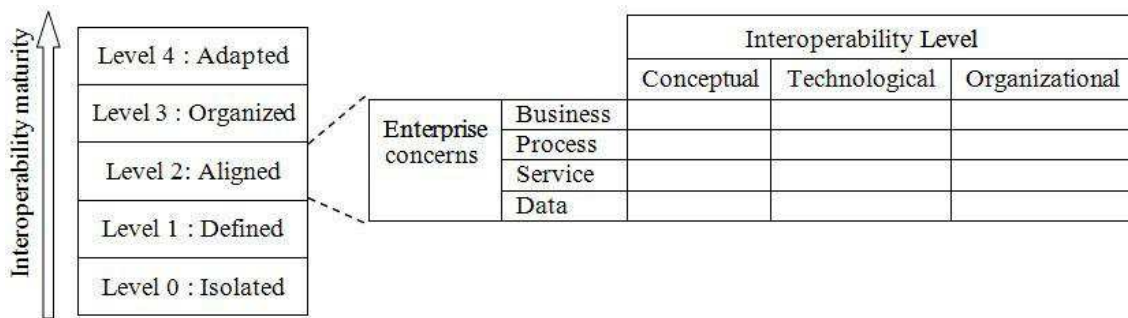


Figure 1: Zoom on MMEI level

The intersection between the two dimensions is described as states or qualities that should have the assessed enterprise and best practices to be considered at each level [16].

In order to have a clearer idea of the description of a maturity level and the way that best practices are presented, we provide in Table 2 the description of the MMEI level 1.

Table 2. Description of the MMEI level 1.

	Conceptual	Technological	Organizational
Business	Models are defined and documented.	IT infrastructure / platform in place, and connectable.	Responsibilities / authorities defined and in place.
Process	(Idem.)	Platform dependant Processes.	(Idem.)
Service	(Idem.)	Platform dependant Services.	(Idem.)
Data	(Idem.)	Connectable devices or simple electronic exchange possible.	(Idem.)

Behind each description (in each cell), there are a number of best practices that have to be in place in order to be conform to the level description.

We won't detail all best practices related to MMEI but we cite some of them in the next section.

3.3. Groundwork for potential interoperability

The interoperability of systems to support cooperative work requires moving beyond purely technical issues; it also concerns the means and practices that enterprises adopt to carry on their cooperative activities.

Preparing interoperability involves all levels of the enterprise; which needs significant efforts. Level 0 does not include any type of preparation, it reflects a close system or a system which fails to partially achieve its outcomes or have no desire to interoperate. This subsection highlights points to consider and activities to be performed when preparing to interoperability.

Level 1. At this level, the system is intended to be open to interoperability, this can be achieved by:

- Define objectives for interoperability.
- Describe assumptions and constraints considered in defining the objectives.
- Consider risks related to fulfill defined objectives.
- Have all necessary information concerning the interoperability environment
- Identify stakeholders and communication mechanisms to be used.
- Define private elements not to be exchanged
- Include milestones and timetable for preparing interoperability.
- Identify tasks, resources, responsibilities and infrastructure needed to perform interoperability.
- Ensure that the company (with its levels) and its organization are modeled

Level 2. At this level, the system has to be able to make changes in its components in order to avoid or resolve interoperability problems, this can be achieved by:

- Identify standards to be used in an interoperation
- Be able to make changes to adhere standards and corrective actions
- Schedule training sessions on interoperability

Level 3. At this level, the system has to be well organized to deal with interoperability challenges, especially with multiple partners. This can be achieved by:

- Describe results and status of the interoperation

- Identify the gap, if exist, between what is realized (in terms of interoperability) and the defined objectives and plans
- Ensure that people are trained interoperability notions and guidelines
- Ensure that collaboration is pervasive in all levels of the company
- Expect some bridges to accommodate usual environment changes
- Have a process in place to precise how to do in case of interoperability.

Level 4. At this level, there is a focus on continually improving interoperability and the system performance through technologies and innovative methods. This can be achieved by:

- Improvement opportunities derived from new technologies are identified;
- Establish an implementation strategy to achieve improvement objectives.
- Set directions to interoperability innovation.
- Consider emergent risks in identifying improvement opportunities
- Classify and prioritize environment changes based on their impact on defined improvement objectives.

3.4. Discussion

MMEI best practices prepare enterprises to potential interoperability. However, these practices have to be updated in order to fit best to the enterprise cooperative context. Indeed, in a cooperative partnership, each company bears a risk of disclosing information or knowledge that would permit their partner to attain a cooperative advantage [18].

In this context, the emphasis towards the use of MMEI will be on the security and innovation sides of the inter-organizational relationships. This is to allow enterprise to have an advantage on preparing its competition.

4. Initial thoughts on the application of MMEI to cooperative context

MMEI can be applied to cooperative context with slight modifications. Indeed, the cooperative context needs more emphasis on the security and innovative issues.

The objective is to create well-planned multifaceted relations between potential partners from the start. Ideally any collaborative relation will take into account stakeholders needs, available technology and experience...

For multifaceted relationships issues, the real challenge lies in defining security policy. There are many security mechanisms to consider (This depends on the particular relationship or situation). These include:

- Identification and authentication
- Access control techniques (databases, resources,...)
- Confidentiality (About resources used, resources control innovative methods used or to be used, ...)
- Secure network protocols
- Respect for intellectual property and other ethical and legal requirements

Another important challenge for the enterprise in a dynamic and competitive environment is to be up to date and use innovative methods and technologies.

This leads enterprises to:

- Use and create innovative methods at all enterprise levels in order to catch opportunities before competitors.

While not exhaustive, this list of security and innovation considerations illustrates some of the variety of options that have to be added to the existing MMEI maturity model in order to fit best to the cooperative context.

5. Illustrative Example

In order to evaluate interoperability within the scope of assessment, we need to collect information through a series of interviews. The content of the assessment interview depends on the assessment scope and the enterprise needs. From the interviews, a rating shall be assigned based on validated data; Actions are taken to ensure that the data is accurate and sufficiently covers the assessment scope, including seeking information from independent sources; using past assessment results; and holding feedback sessions to validate the information collected. A quick synthesis on the interview and conclusion is done after by the assessor team.

To illustrate the use of the maturity model, we develop here a use case to capture the potential changes to the MMEI when the company engages in coopetition (i.e. cooperate with its competitors) as compared to when it cooperates with non-competitors. This will lead us to determining practices that should be in place to ensure interoperability in coopetition.

The presented case study has been first proposed under the Network of Excellence INTEROP [15]. The company modeled is part of a group of companies, which is specialized in telecommunications, production and distribution of batteries, as well as mobile phones. To distribute its products and services, the company retail sales to two kinds of distributors: Franchisees, who are distributors in exclusive contract with the company and may only offer its products and services; and independent dealers, who may have contracts with other companies. A franchisee must use the same tools as the company; therefore, interoperability issues in this case are irrelevant for our study. However, with independent dealers, the interoperability subject can be tackled. There are 6 main departments in the company: Commercial, Sales, Financial, Logistics, Sunlight and IT. IT department is responsible for system administration, imports and exports of data in different databases and creating specific reports needed by the other departments. It also uses BPMN (Business Process Model Notation) for the representation of processes and uses XML as a format for describing data. The products distribution is based on the rule of proportionality: If the total quantity of ordered products is available, all orders are fulfilled. Otherwise, the company decides what quantities to be allocated based on the proportionality between the quantity of products available and the quantity ordered by retailers. According to this rule, it adjusts its commands and publishes the bills that are sends to corresponding retailers for payment. Upon receipt of invoice, retailers emit a debit authorization for the sales department. Exchanged data between partners are of three types. (1) Orders from the retailer to the company (2) Invoices from the company to its retailer and, (3) Levy authorization from the retailer to the company. Currently the company headquarters and branches work with a decentralized database and there is a daily transfer of information from the shops to the headquarters and back. The goal is to investigate its interoperability potential in order to anticipate future interoperability operations.

According to the preparations made, the company aims to reach Level 2 of potential interoperability.

According to the given information, we make an assessment of the Organizational Interoperability. After a series of interviews, the assessors provide the evaluation sheet shown by table 3.

Table 3. Evaluation Sheet for Potential interoperability.

	Activities to evaluate	Observations	Team Rating			
			NA	PA	A	FA
Business	Adjust Business rules	Business is adjusted according to the proportionality rule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Process	Procedures of work and guidelines are defined	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Service	Adjustable procedures of work	Procedures can be adjusted if needed	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Data	Rules for data interoperability are in place.	Daily transfer of data	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>

The ratings are given by the assessors based on the achievement degrees of the activities being evaluated. Clearly, it is difficult for people to make such fine judgment, especially in our case where the achievement degree is not a binary one but a graduated state. We won't detail the used metrics here. However a specificity of our approach is that behind this evaluation, we have used the linguistic variables to facilitate the task of the assessors to find suitable scores according to their observations upon the enterprise. We have defined the linguistic variable [16, 19] "state of an activity" as rating the following values: Not achieved (NA), Partially Achieved (PA), Achieved (A) and Fully Achieved (FA). Each assessor chooses a value among latter ones to qualify the practices achievements. From these linguistic values, scores are assigned, based on previously defined membership functions [16]. According to team ratings of this use case (cf. table 3), the reached level regarding interoperability potential is 2. Instructions are then given to fill requirements towards the next level (level 3). Here we don't assess the security and innovative sides of the enterprise regarding the preparation of the enterprise organization to be cooperative. In order to take into account all IOR relationships, we need to add some practices to be evaluated such as:

- Protection of proprietary nature of data.
- Guidelines for innovative methodologies for enterprise services.

- Security data exchange
- Guidelines for innovative processes

Table 4. Evaluation Sheet for Potential competition.

	Activities to evaluate	Observations	Team Rating			
			NA	PA	A	FA
Business	Business rules can be adjusted	Business is adjusted according to the proportionality rule	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Process	Procedures of work and guidelines are defined	Yes	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>
Process	Guidelines for innovative processes	----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Service	Procedures of work are adjustable	Procedures can be adjusted if needed	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Service	Guidelines for innovative methodologies for enterprise services	-----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data	Rules for data interoperability are in place.	Daily transfer of data	<input type="checkbox"/>	<input type="checkbox"/>	<input checked="" type="checkbox"/>	<input type="checkbox"/>
Data	Guidelines for the protection of proprietary nature of data are in place	-----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data	Guidelines and standards-based methodologies for data generalization	-----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>
Data	Security data exchange	-----	<input checked="" type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>	<input type="checkbox"/>

According to this evaluation sheet the interoperability level 2 is not achieved. Preparations to cooperative relationships need more constraints regarding security and innovation.

6. Conclusion

The assessment is an activity that can be performed either as part of an improvement initiative or as part of a maturity determination approach. The first step to be done in an assessment process is to define its purpose (why it is being carried out), its scope, what constraints apply to the assessment and any additional information that needs to be gathered. In this paper, we have used the maturity model for enterprise interoperability (MMEI) within the cooperative context to evaluate multifaceted relationships a priori and determine practices to be put in place in order to prepare cooperation within competitiveness. Future work is planned to perform some more detailed case studies to detect all practices and the potential modifications to be considered by MMEI for cooperative relationships. A detailed questionnaire associated with a structured methodology will also be elaborated to support the use of MMEI in this context.

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