Value CoCreation (VCC) Language Design in the Frame of a Smart Airport Network Case Study

Christophe Feltus, Erik HA Proper
Luxembourg Institute of Science and Technology
avenue des Hauts-Fourneaux, 5
L-4362 Esch/Alzette, Luxembourg
christophe.feltus@list.lu, erik.proper@list.lu

Andreas Metzger
paluno, Universität Duisburg-Essen
Gerlingstraße, 16
45127 Essen, Germany
andreas.metzger@paluno.uni-due.de

Juan Francisco García López,
Castiñeira González Rodrigo
INDRA Sistemas,
C/ San Julián, 1, 28108 Madrid, Spain
jfglopez@indra.es, rcastineira@indra.es

***Abstract*—The design and engineering of collaborative networks and business ecosystems is a discipline that requires an outstanding and upfront attention of the value cogenerated among the parties involved in the business exchanges of these networks. Understanding this value cocreation is undoubtedly paramount, first to adequately sustain the design and the development of the information system that brings about this value, second, to support the communication between the information system designers, and third to allow discovering new cocreation opportunities amongst the networks companies. In that context, we proposed an abstract language (metamodel) that structures, and provides an explanatory semantics to, the cocreation of value between information system designers, allowing a better definition of the collaboration and of each one value propositions. The design of this language is achieved in the frame of the design science theory and accordingly follows an iterative improvement approach based on real case studies from practitioners. This paper introduces the second iteration of the language based on a real case in a Smart Airport Network.**

Keywords—Value cocreation, Language, Model, Collaborative network, Ecosystem, Smart airport, Case study, Design science.

I. Introduction

Collaborative networks design and engineering is a discipline that requires an outstanding and upfront attention of the value cogenerated amongst the stakeholders involved in these network's business exchanges. Value cocreation (VCC) is a notion which is anchored in the marketing theory and whose purpose is *the co-generation of value during business exchanges among two or more partners* [1], [2]. Examples of value cocreation are Nike that gives its customers an online tool where they can design and order their owns sneakers based on their preferences and flavours [3] or Starbucks that has developed a cutting edge online community platform where its worldwide customers may propose innovative ideas and where the most voted ones are put in practices [4]. In those cases, but also in other ones, VCC is made possible thanks to the interconnections between the information systems (IS) of the company and their customers. As a reason, understanding this value cocreation is essential for the design of these IS and to support the communication among the IS designers and developers. Unfortunately, despite a plethora of empirical research aiming at depicting the fundamental of VCC (e.g., value in use, value in exchange, etc. [1], [2], [5]-[9]), few contributions are poured until now in the area of languages to support VCC exchanges.

The research is supported by the National Research Fund, Luxembourg (http://www.fnr.lu) and financed by the ValCoLa (VCC Language) project, and it has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement no. 731932 (TransformingTransport).

Therefore, in our previous work [10], we investigated the design of such a language and we have observed that the creation of value is an integration of three dimensions: the nature of the value (e.g., financial value, quality, and security [11]-[14]), the object concerned by the value (e.g., a service, a contract, and a database [15]-[17]) and the method used to create the value (e.g., model-based, by design, chunk [18]-[21]). We have also observed that, in practice, each of these dimensions is expressed by the IS designer using a specific language and that no language allow expressing all dimensions together yet. This statement accounts for an issue when IS designers must communicate with each other, especially when there is a shift from a local creation of value to a cogeneration of value in a network of enterprises. Indeed, in this context, communication among the IS designers from each of the involved companies is paramount. Due to the different languages that may be used by the different companies engaged in value cocreation, however, communication can become overly complex.

Concretely, to face that problem, our approach consists in building a value creation metamodel able to abstract at the same time all the dimensions of the value. By abstracting the value propositions (originating from each companies of the network), our goal is twofold: first, to support the IS designers from those companies to communicate with each other using a shared language, expressed by means of common elements, having the same semantic (definitions of the concepts), the same structure (associations between concepts) and the same syntax (modelling language). Practically, and as demonstrated in [10], while being instantiable with specific languages, the VCC metamodel is suited to play the role of binding element between the modelling languages. Second, as value cocreation is not always at the origin of enterprises networks, it is pertinent to have adequate methods and tools to discover it during network operations. Therefore, [40] has proposed a model-based approach to support the IS designers in discovering these cocreation opportunities. This method consists in modelling the value propositions at each company sides following the VCC metamodel, to inject these models in a models management platform, e.g., Sottet et al. [22], and to discover similarities amongst the injected value propositions.

Practically, this research is performed in the frame of the design science theory and the artefact created (respectively the abstract VCC language) is achieved following iterative cycles of improvement. As a result, the paper is structured as following: in the next section, we explain the research method, and in Sec. III we present related work and briefly summarize our previous contribution, aka the first iteration of the value creation language. In Sec. IV, we introduce a real case study in a smart European airport. The latter is afterwards used to detect modelling issues and based on which the second version of the metamodel will be iterated (in Sec. V). In Sec. VI, we validate this new version and in Sec. VII we conclude the paper and propose future works.

II. Research method

At a methodological level, the research that we tackle concerns the improvement of value cocreation in the field of interconnected companies. Accordingly, we have defined and conceptualized an abstract language to support the value co-creation on the basis of the three value dimensions mentioned above. Through this research, we aim to strengthen the organizational capability to improve the design of the IS which sustains VCC. Accordingly, Hevner et al. [23] explain that the Design Science Research (DSR) paradigm seeks to extend the boundaries of human and organization capability by creating new and innovative artefacts. Practically, provided that we aim to design a new artefact (abstract language for VCC) to support the design of the information system, we acknowledge that this research may plainly be considered in the scope of DSR [24]. As advocated by the DSR theory [23], [24], the method that we use to design these value dimensions is an iterative approach consisting first of analysing different instances of the domain under scope, second of extracting the relevant concepts from the instances, and third of designing elementary domain models.

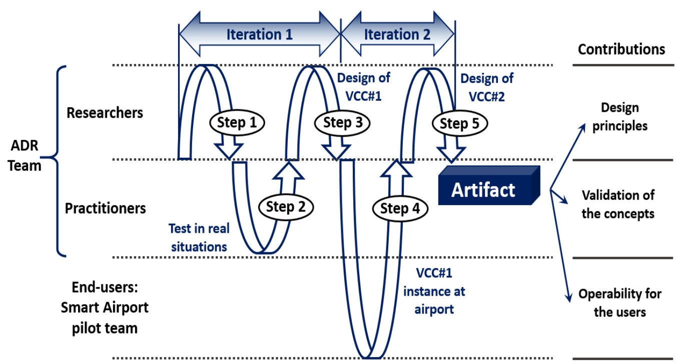

Fig. 1. IT-Dominant BIE generic schema applied to VCC design (adapted from [25])

Given that our artefact is motivated by real problem and relies on the knowledge of the field, we need to involve practitioners and end-users all along the artefact building activities. Therefore, we have applied the design research method proposed by Sein et al. [25]: the Action Design Research method that has for objective to strengthen the connections between the end-users (the smart airport pilot team) and the researchers by combining the building, intervention and evaluation (BIE) activities. Given that the elaboration of our artefact strongly relates to IS, we apply an IT-Dominant BIE Generic Schema (Fig. 1).

When applied to our research, at step 1, we (researchers) have proposed conceptualizing the creation of value following three dimensions. At step 2, this value creation metamodel has been tested in regard to real situations with the practitioners (end-users involved in research) from different domains but mostly healthcare and finance. At step 3, the researchers formalised the first version of the value creation metamodel (VCC#1) [10] [26]. This constitutes the first iteration. At step 4, this metamodel has been tested in the frame of a cocreation of value with end-users from the smart airport and based on it, a second version of the model has been formalized at step 5 by the researchers. The result of this second iteration (VCC#2) corresponds to the purpose of this paper.

Lastly, according to March et al. [27], the evaluation of a designed artefact must use precise evaluation criteria. Provided that the goal of our research is to support end-users with an operable metamodel supporting value cocreation, the validation criteria is the operability of the metamodel, defined in ISO 25010 (SquaRE – [28]), by the *ability of the [artefact] to be easily operated by a given user in a given environment*. In our context, this given environment consists in the JavaScript Flexible Modelling Framework (JSMF) models management tool [22], and its ability to operate the second iteration of the VCC metamodel with the purpose of discovering modelling pattern shared by different value propositions, and hence, VCC elements to be handled by the parties involved.

III. Previous works

This section first reviews the VCC related literature and second explains our previous contribution, i.e., the VCC#1.

A. Literature review

VCC discipline originates from the marketing theory. It aims to define and to explain the mechanism for the co-generation of value during business exchanges amongst two or more companies [1], [2], [5]. Vargo et al. [1], [2] formalized it using a framework for defining VCC in the perspective of the service dominant logic (S-DL). According to the authors, service is the *basis of all exchanges and focuses on the process of value creation rather than on the creation of tangible outputs*. As a result, a service system is *a network of agents and interactions that integrates resources for VCC* [1]. On that basis, Vargo et al. further elaborate on the idea that value is *derived and determined in use rather than in exchange*. That means that value is proposed by a service provider and is determined by a service beneficiary. Hence, the firm is in charge of the value-creation process and the customer is invited to join in as a co-creator [1]. For Grönroos et al. [29], this interaction is defined through situations in which the customer and the provider are involved in each other's practices. Consequently, the context (social, physical, temporal and/or spatial) determines the value-in-use experience of the user in terms of his individual or social environment.

Another conceptual framework for VCC has been proposed by Payne et al. [6]. This framework is composed of three processes: *customer value-creating*, *supplier value-creating*, and *value encounter* for which goals are defined in a customer learning perspective and may be of a type that can be *cognitive, emotive,* and *behavioural*. The idea behind being that the more the customer understands about the business opportunities, the greater the value. Accordingly, modelling value cocreation in the specific field of the Knowledge-Intensive Business Service has been addressed by Lessard [30] who proposes the value cocreation modelling (VCM) framework to fulfil the requirement emerging from that domain. In parallel, Hastings et al. [7] also define a set of six concepts to design the practice-driven service framework for value creation, to know: customers co-create value with providers, value is created in service systems, modular business architecture, scalable Glo-Mo-So (global, mobile, social) platforms, continuous improvement via learning, and multi-sided metrics. At the analytical level, Storkacka et al. [8] have complementarily proposed to analyse the actors' engagement as a micro-foundation (explanation on a low analytical level) for VCC and Frow et al. [9] propose a framework to assist firms in identifying new opportunities for value co-creation. Therefore, the authors provide a strategically important new approach for managers to identify, organize and communicate innovative opportunities.

Recently, Chew [31] has argued that, in the digital world, service innovation is focused on customer value creation and he proposes an integrated Service Innovation Method (iSIM) that allows analysing the interrelationships between the design process elements, including the service system. The latter being defined as an IT/operations-led cross-disciplinary endeavour. At the information system domains level, Gordijn et al. [32] explain that business modelling is not about process but about value exchange between different actors. Accordingly, in [33], Gordijn et al. propose e3value to design models that sustain the communication between business and IT groups, particularly in the frame of the development of e-business systems. In [34], Weigand extends e3value language for considering co-creation. Therefore, he defines the so called *value encounters* which consist in spaces where groups of actors interact to derive value from the groups' resources. In the same vein, Razo-Zapata et al. propose visual constructs to describe the VCC process [35]. These constructs are built on requirements from the service dominant logic and software engineering communities. They aim is to express three co-creation types (co-ordination, co-operation and collaboration) following the three elements of the customer relationship experience: *cognition, emotion* and *behaviour* [6]. According to [36], the co-creation may happen through different processes (B2C, B2B, C2B or C2C) and may refer to different types of value (for the company or the customer).

Two of the existing states of the art in the field of VCC are particularly interesting. The first one reviews the existing literature through both following perspectives: co-production and value-in-use [37], and the second one through two dimensions: theoretical dimension of the co-creation, and collaboration and co-creation between firms and customers [38]. Despite the undeniable need for designing an effective language to support the VCC management [33]-[35], the review of the state of the art demonstrates that, up to date, no approach fully considers all the dimensions necessary to cover the VCC domain.

B. Iteration #1 of the value creation metamodel

In our previous work [10], one first contribution consisted in a value creation model structured according to three dimensions (Fig. 2): the nature of the value, the method of value creation, the object concerned by the value.

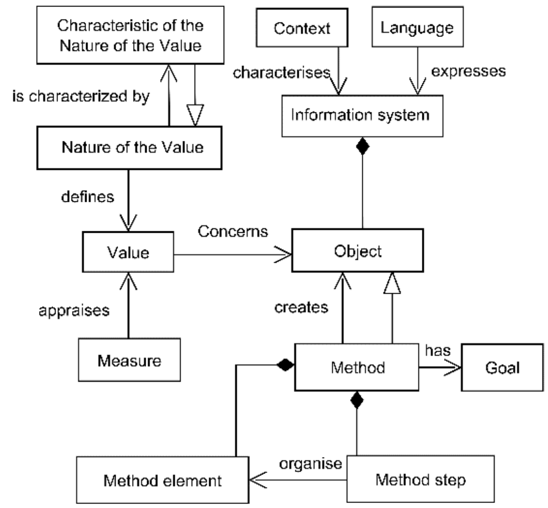

Fig 2. Iteration #1 of the value creation metamodel (VCC#1)

These three dimensions of the value creation are defined as:

- **Nature of the value.** The value has a nature that expresses a domain of interest and a context that characterize an element of the information system. E.g., the web quality [11], actor's responsibility [39, 40], the data privacy [12], or the compliancy [13].
- **Method** (of value creation). The method is an abstract concept that gathers a set of method elements ordered in steps and achieved in order to create value. E.g., a process based approach [41], a risk assessment [42], the method chunk [20], the method by design [19], model driven [21].
- **Object** (concerned by the value). The object concerned by the value is the IS element that is better after this value being delivered. E.g., an actor, a process, a data, a server [15]-[17].

In the following, we explain the value creation model and propose three fundamental value co-creation schemas. Based on combinations amongst the latter, more complex VCC schemas may also be designed (e.g., by considering more than one dimension, or for tackling co-creation implying more than two actors). These combinations are not considered in the paper but are available in [10]. The value creation model presented in Fig. 3 includes nine additional concepts which are dedicated to express the three value creation dimensions.

The nature of the value has characteristics that define the value, the latter concerns an object, is created by a method, and is measurable:

- **Characteristic of the Nature of the Value.** This concept expresses the different elements that characterize the nature of the value, or the pillars that found this nature (e.g., availability, confidentiality, portability, etc.).
- **Object**. The object concerned by the value is the IS element that is better after this value being delivered. (e.g., an actor, a process, a data).
- **Measure**. The measure corresponds to a property on which calculations can be made for determining the amount of value generated.

The method of value creation has a goal, is composed of method elements organized by method steps:

- **Goal**. The goal corresponds to the expected operation on value created by the method (e.g., create value, assess or evaluate value generated, optimize the value).
- **Method element.** The elements of the method correspond to unitary tasks that constitute the method. (e.g., analysis, collection of information, reporting…)
- **Method step.** The method steps consist in the organized and coherent articulations of the method elements (e.g., if-then-else, process elements ordination…)

The objects concerned by the value are impacted by the method. They composed the information system which is characterized by a context and expressed by a language:

- **Information system.** The information system that encompasses the objects concerned by the value.
- **Context**. The context represents the surrounding of the IS (e.g., the sector of the business entity that is concerned by the IS, the rules and regulations related to this sector, etc.)
- **Language**. The language represents the vocabulary used to express the information system of a specific context.

C. Generative mechanism of value cocreation

The second contribution of [10] consists in three generic schemas of VCC, built upon the three dimensions of value creation model: nature of the value, method of value creation, and object concerned by the value. The three generic schemas are: (1) Method-based VCC: In this first schema, the method is shared by the companies but the nature of the value and the object of value created are different. In this co-creation case, VCC activities achieved by two companies may generate different types of value nature, concerning different objects evolving in different contexts. As a result, the co-creation described in these first schemas happens because enterprises share and achieve activities together that contribute to value creation (e.g., two companies that create value using a shared process-based approach). (2) Object-based VCC: This co-creation concerns a unique object that creates value of different natures for different entities. It concerns for instance two companies that collaborate to co-create value but this value may be of different nature for each of them (e.g., one company that generates quality and one company that creates security regarding a joint network). (3) Nature-based VCC: In this third schema, the nature of the value co-created is shared by the companies but the object of value created and the value creation method are different. The VCC activities at the level of each company may be achieved by using different methods and may concern different types of objects from different contexts. However, these different activities concern VCC of the same nature (e.g., two companies protecting the privacy of their customers with different methods).

IV. CASE STUDY

This section presents the Smart Airport Network case study used along the paper to assess the first iteration of the value creation metamodel (VCC#1), to improve it based on the issues detected and to validate the improvement in the frame of cocreation with the airport's passengers.

A. Case study description

The case study exploited to validate and enhance the VCC#1 concerns the optimization of the passenger flow at a large European airport with around 20 million passengers per year. The information and background concerning this case study are collected from a public description of the Smart Airport Turnaround pilot that is developed as part of the European lighthouse initiative TransformingTransport (see the pilot's design deliverable [43]). The pilot involves a large European airline with around 12 Mio passengers per year, whose main hub is at the aforementioned airport. Thereby, the airport and the airline aim to share their data about passengers to jointly turn this available data into integrated intelligent information. At the airport and airline side, the objective is to allow significant savings in operational efficiency. Concretely, three main results are expected: (1) decrease number of passenger losing the connecting flight, (2) facilitate a better scheduling of daily operation and resources required, and (3) enable a better understanding of the impact of each process on the airport performance. These results potentially impact both the airport business model and the passenger's experience.

On the passenger side, the objective is to improve the passenger travelling experience, which results mainly in less missed connections and decreased passenger waiting times.

The following functional requirements were identified by the pilot to achieve the above objectives:

- Req.1: Predict time of passenger arrival to the terminal
- Req.2: Predict time of passenger arrival to the processing stations and their demand
- Req.3: Elaborate passenger movement heat maps based on demographics
- Req.4: Identify passenger movement models and patterns
- Req.5: Assess and predict time to reach the gate
- Req.6: Identify transfer passenger late arrivals

Concretely, two main outcomes are expected from the pilot to achieve these objective: an operation management predictive optimisation module and a descriptive passenger system. Each of both being structured in sub objectives. We focus in this paper on one concrete sub-objective, which consists in reducing the delays in departure flights caused by late passengers. Due to the many possibilities which can affect a passenger's transit in the airport, passengers may arrive at the boarding gate later than the scheduled boarding time. This delay implies a reduction of revenue for the parties involved, a reduction of the SLA expectations, and a negative perception of the airport and airline. To anticipate these flight delays, the airport together with the airline try to identify the passengers and their movement in the airport and to carry out preventive actions to facilitate passengers in reaching their gate on time. Practically, this sub objective is achieved by realizing the above functional requirements 1, 2, 4, 5 and 6.

Fig. 3, modelled with the e3value language proposed by Gordijn et al. [33], portrays the exchange of value between involved stakeholders (depicted by the links between the actors). The airport systems support the complete operations of the airport, including in particular arrival and departure control system (such as assignment of planes to gates), on-site check-in, baggage handling, and security control. The airline management systems supports the activities of the airline companies in offering transport services to its customers and in particular supports ticketing, online check-in and passenger management. Both airport and airline systems are essential for supporting the execution of the air transport. As part of the aforementioned pilot, these systems continuously provide data to facilitate proactive decision-making based on the real context. The real-time operation module developed by the pilot provides this proactive support based on real-time information about passenger flow from the airport and airline systems. The operation module only uses anonymous passenger data to trace passenger flow, and does not use any personal-related information. Passenger movement is traced by means of when a passenger passed each of the different check-points (booking, ticketing, check-in, baggage drop-off, security, and boarding). Note however, that this passenger movement is never matched with the personal data of passengers in the airline system.

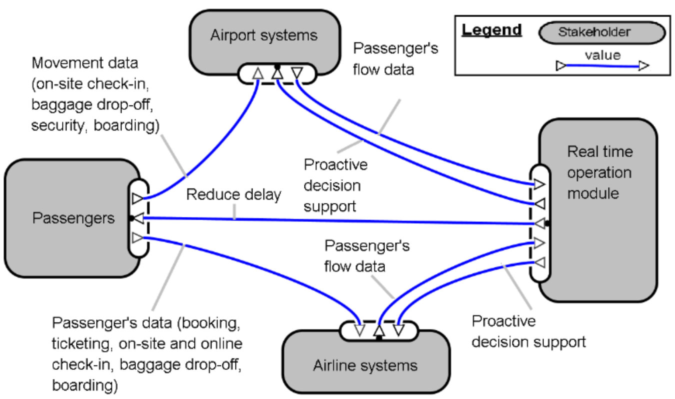

Fig. 3. Value exchange between the airport stakeholders

The value cocreation of this case follows the method-based cocreation schema proposed in Sec. III.C. Indeed, the airport/airline and the passengers are involved in the same method for VCC. This method consists in analysing the data provided by the passengers using big data based predictions technique. This method generates saving in operational efficiency at the airport/airline side and generates improvement of the travel experience at the passenger's side.

B. *Case study modeling and analysis*

To validate and improve the first iteration of the value creation metamodel using this case study, the process that we follow consists in modelling this smart airport case according to VCC#1, to identify modelling issues (Sec. IV.C.), and to discuss and improve the metamodel accordingly (Sec. V).

The information gathered from that case study allows instantiating most concepts of the value cocreation metamodel but not all. Moreover, a semantic translation is required to align the metamodel semantic and the language used to express the case. Table I displays the instantiations the VCC metamodel concepts at the beneficiary of the airport/airline and of the passengers. To extract data from the case study and to populate table I, the following mapping were performed: (1) the types of value generated for the case beneficiaries correspond to the pilot objectives, (2) the characteristics of that value is extracted from the concrete results expected, and (3) the method elements correspond to the functionalities of the pilot, expressed in [42] through the list of requirements.

TABLE I. CASE STUDY CONCEPTS INSTANCES

Value creation metamodel	**Stakeholder**	
	Airport/Airline	**Passengers**
Object	Operation	Travel experience
Value	Financial	Quality
Nature of the value	Saving in operational efficiency	Improvement of the travelling experience
Characteristic of the nature of the value	Decreased number of passenger losing the connecting flight, Better scheduling of daily operation and resource required, Better understanding of the impact of each process on the airport performance	Less missed connections and decreased of passenger waiting times
Measure	Amount of money saved	Number of missed connection and waiting time
Context	Athens International Airport	Transfer to/from airport
Language	n/a	n/a
Information system	Airport/Airline systems	Mobile devices (e.g., for electronic boarding passes, etc.) and computer (for online check-in)
Method	Big Data based predictions	Big Data based predictions
Goal	Proactive decision support	Improved travel support
Method element	(1) Collect required information, (2) Predict time of passenger arrival to the terminal, (3) Predict time of passenger arrival to the processing stations and their demand, (4) Predict processing times of stations	(1) Provide anonymous data about passing of check-points / movement (2) Exploit prediction to improve travel within the airport

C. *Models analysis and issues detections*

The instantiation of the VCC#1 metamodel following the Smart Airport Turnaround Pilot allows detecting modelling issues at both, the airport/airline and the passenger's sides:

- The method used at the airport and airline side to support proactive decision making consists in exploiting big data to make predictions. The first element of this method is about collecting the required information (in our case passenger behaviour) to perform predictions. No modelling mechanism allow expressing this information nor allow associating a method element to that information.

- Actors involved in Smart Airport pilot instances in both cases play an important role during the cocreation of value, should it be to provide anonymous data about movement (passengers) or in using those data for prediction purpose (airport/airline). VCC#1 metamodel does not allow expressing the stakeholders involved in the value cocreation process.
- The sequence of method elements used to create a method is an information expressed through the method step concept at the VCC#1 metamodel level. In practice, the instantiation of this concept is hardly achieved because it requires to enumerate the method elements in a precise order.
- The concept of language is relevant to express the elements of the information system, including the method that creates value, the resources used by this method, and the value created that all compose this information system. However, in practice, the language is not an information used at the level of the design of the value cocreation, but at the level of the deployment of this cocreation at each stakeholder levels.

As a summary, by instantiating VCC#1 at the airport, we observe a lack of semantics to express some dimensions of the value creation like the lack of relation between the value generated, the stakeholder that generates it and the one that benefit from it, or the impossibility to model the resource that are used by the method that create value. This shortcoming and the lack of accuracy associated to the modelling of the value proposition at the company level impact the VCC mainly in regard to both elements explained in the introduction: (1) the communication amongst IS designers from different companies and (2) the generation of an incomplete VCC opportunities portfolio by the pattern matching tools like JSMF [22].

V. LESSON LEARNED AMD METAMODEL IMPROVEMENT

According to the DSR, the analysis of both instances of VCC#1 (airport/airline and passengers) has allowed detecting a number of issues at Sec. IV.C. This section suggests a revision of it (VCC#2) to improve the problems detected. Concretely, two new concepts have been integrated in the VCC#2 metamodel (stakeholder and resource), one concept has been removed (language), one concept was replaced by an association (method step), six associations have been added, and the definition of the context has been improved:

The **stakeholder** which is a human or an organization that is involved in the creation of value at three level. First he **performs** the method that generate value (e.g., the airport performs the Big Data based prediction), second he **generates** resources used by the method (e.g., the passengers provide personal data related to their position in the airport), and third he **benefits** of the value created (e.g., the passengers benefit of a travel experience of quality or the airport/airline benefits of operational efficiency saving).

The **resource** which **is a type** of object from the IS that is generated by a stakeholder and that **is used by** an element of a value creation method. Resource are typically information and data (e.g., passengers location), but could also consists in computing resources, funding, man power, etc.

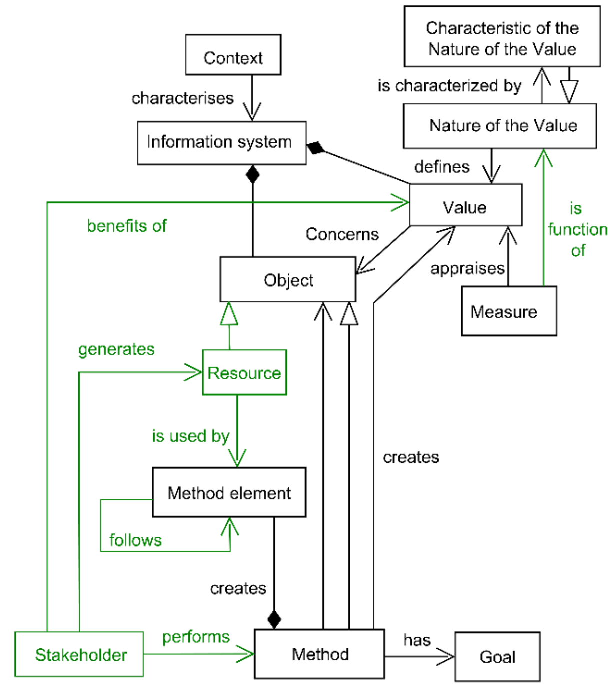

Fig. 4: Iteration #2 of the value creation metamodel (VCC#2)

Although modelled in the first iteration of the metamodel, the concept of **language** in which is expressed the information system appeared useless or erroneously considered during the cocreation case study at the airport. Indeed, the language is a structuring element that provides the vocabulary used during exchange between information systems designers. However, because the latter could also express other dimensions of the value model, i.e., the method or the value nature, it is removed from the VCC#2 metamodel and will be considered, in the following, at the VCC method level rather than at the conceptualisation level.

For modelling reasons, it is inappropriate to instantiate the **method step** concept. As a consequence, this element has been removed and replace by an iterative association named **follows** from, and to, the method element. Modelling this model element using an association rather than a concept provide a best visibility on the flow of method elements.

An association named **is function of** has been added between the concept of measure and the type of value. This new relation allows expressing that the value is measured by the intermediary of its characteristics, like e.g., the quality of the travel experience is measured based on the number of missed connections and based on the waiting time, and the efficiency of the operation is measure based on the amount of money saved.

Finally, the definition of the **context** in VCC#1 consisted in the surrounding of the IS. This definition has been refined to include (1) the dimensions of constraint on the system in which the value is created and (2) the definition of the border of this system (e.g., the airport premises, the passenger journey…)

VI. VALIDATION

The metamodel that we have designed must be useful to discover cocreation opportunities during business exchange.

Therefore, our approach consists in modelling the different value propositions provided by the parties involved in the business exchanges, in injecting these models of value proposition in the JSMF models management tool, and in detecting cocreation opportunities using model patterns matching technics.

For some types of cocreation, we observed that VCC#1 was appropriated (see examples in [41] and [42]) and relevant, but because of some modelling issues detected in Sec. IV.C, some other cocreation opportunities like those proposed by the airport in the pilot, were undiscoverable (and by the way, inoperable) by the pattern matching tool.

Acknowledging this, the validation of VCC#2, improved according to the leading case, will consist in (1) modelling both stakeholders value proposition following the VCC#2 metamodel, (2) detecting and figuring out where equivalent patterns exist and may be shared by the stakeholders, and (3) analysing value cocreation opportunities:

1. *Value proposition modelling:* Fig. 5 represents the value created at the airport/airline side and at the passenger side following the information collected within the leading case and summarized in Table 1. The value created is operational saving at the airport/airline side and quality of travelling experience at the passenger's side.
2. *Patterns equivalence detection:* The grey box of fig. 5, (framed by the dashed line) represent the common pattern from both stakeholder's value propositions potentially detectable be the JSMF platform. This pattern corresponds to the resources used by the big data analysis method and which is generated by the passengers.
3. *VCC opportunity analysis:* The detection of the new pattern associated to the generation and the usage of specific resources during the value cocreation process (previous point) illustrates that the VCC#2 metamodel offers additional possibilities to operate value cocreation pattern matching than VCC#1. Aside improving the detection of VCC opportunities, VCC#2 also allows expressing the stakeholders that benefit of the value generated, that generate the resources and that performs the method. This information is worth to be considered to clarify the role of each stakeholders along the deployment of the cocreation and the resource that are required therefore.

VII. Conclusions and Future Works

Value cocreation is a driver and an incentive of enterprises network business exchanges. This value cocreation may be achieved following different dimensions of the value: its nature, the object that it concerns, and the method that create it. In practices, we observed that many languages are often exploited by the IS designers of these companies to exchange information about the VCC or to discover new VCC opportunities using pattern matching tool. Acknowledging the issues generated by this profusion of languages, our research aims at building an abstract value creation metamodel (language) to support the design of VCC.

Practically, this language is designed in the frame of the design science theory and, as a consequence, following an iterative approach based on case studies. This paper presents the second iteration of that metamodel, generated on the basis of a real case study in the field of a Smart Airport network.

As future work, first we foresee further investigating the integration of real business cases modelled following the VCC#2 metamodel in the JSMF model management tools and therefore, the development of complementary model matching techniques. Secondly, we will apply the model to address the concern of the engineering of the organisational resilience [44]. To that matter, the VCC#2 metamodel will required to consider stakeholders outside the network of enterprises and evolving in an independent context, with specific constraints (like those from public administrations). Considering this enhancement of the VCC metamodel introduces new challenges associated to three complementary research fields, to know: the economy (how to anticipate unexpected events), the crisis management (how to face these events), and the knowledge management (how to learn from these events).

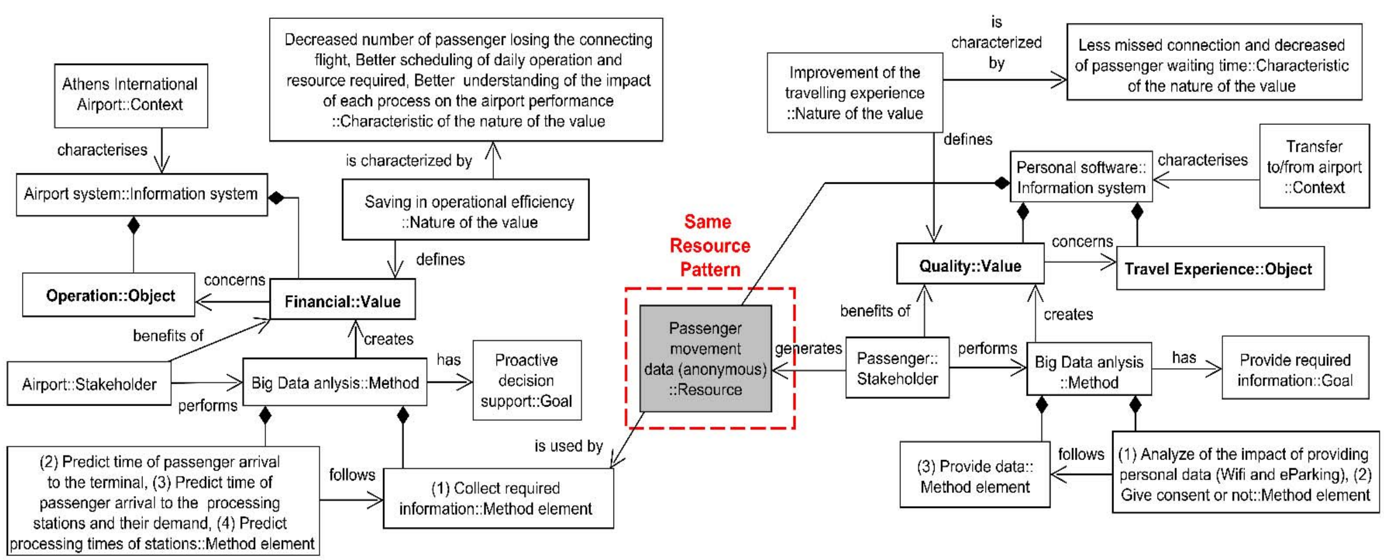

Fig. 5. Value cocreation model extracted from Smart Airport Turnaround pilot

REFERENCES

[1] S. L. Vargo and R. F. Lusch, “Service-dominant logic: continuing the evolution,” Journal of the Academy of marketing Science, vol. 36, no. 1, pp. 1-10, Mar. 2008.

[2] S .L. Vargo and R. F. Lusch, “Evolving to a new dominant logic for marketing,” Journal of marketing, vol. 68, no. 1, pp. 1-17, Jan. 2004.

[3] V. Ramaswamy, Co-creating value through customers' experiences: the Nike case" Strategy & leadership 36, no. 5 (2008): 9-14.

[4] B. Leavy, "Collaborative innovation as the new imperative–design thinking, value co-creation and the power of “pull”." *Strategy & Leadership* 40, no. 2 (2012): 25-34.

[5] V. A. Zeithaml, “Consumer perceptions of price, quality, and value: a means-end model and synthesis of evidence,” The journal of marketing, pp. 2-22, Jul. 1988.

[6] A. F. Payne, K. Storbacka, and P. Frow, “Managing the co-creation of value,” Journal of the academy of marketing science, vol. 36, no. 1, pp. 83-96, Mar 2008.

[7] H. Hastings and J. Saperstein, “A practice-driven service framework for value creation,” in 15th Conference on Business Informatics IEEE, 2013, pp. 145-152.

[8] K. Storbacka, R. J. Brodie, T. Böhmann, P. P. Maglio, and S. Nenonen, “Actor engagement as a microfoundation for value co-creation,” Journal of Business Research, vol. 69, no. 8, pp. 3008-3017, Aug. 2016.

[9] P. Frow, S. Nenonen, A. F. Payne, and K. Storbacka, “Managing Co-creation Design: A Strategic Approach to Innovation,” British Journal of Management, vol. 26, no. 3, pp. 463-483, Jul. 2015.

[10] C. Feltus, and E. H. A Proper, Conceptualization of an Abstract Language to Support Value Co-Creation, 12th Conference on Information Systems Management (ISM'17), Federated Conferences on Computer Science and Information Systems, Prague, Czech Republic.

[11] C. Calero, J. Ruiz, and M. Piattini, “Classifying web metrics using the web quality model,” Online Inf. Review, vol. 29, no. 3, pp. 227-248, Jun. 2005.

[12] C. Feltus, E. Grandry, T. Kupper, and J. N. Colin, “Model-Driven Approach for Privacy Management in Business Ecosystem,” in 5th International Conference on Model-Driven Engineering and Software Development, 2017.

[13] R. M. Foorthuis, F. Hofman, S. Brinkkemper, and R. Bos, “Assessing business and IT projects on compliance with enterprise architecture,” in Procs. of GRCIS, 2009.

[14] A. Dix, “Human-computer interaction: A stable discipline, a nascent science, and the growth of the long tail,“ Interacting with Computer, vol. 22, no. 1, Jan. 2010. 13-27.

[15] A. Josey, M. Lankhorst, I. Band, H. Jonkers, and D. Quartel, “An Introduction to the ArchiMate® 3.0 Specification,” White Paper from The Open Group, Jun. 2016.

[16] G. Berio and F. Vernadat, “Enterprise modelling with CIMOSA: functional and organizational aspects,” Production planning & control, vol. 12, no. 2, pp. 128-136, Jan 2001.

[17] A. W. Scheer, and M. Nüttgens, “ARIS architecture and reference models for business process management,” Business Process Management, 2000, pp. 376-389.

[18] M. Langheinrich, “Privacy by design—principles of privacy-aware ubiquitous systems,” in International Conference on Ubiquitous Computing, 2001, pp. 273-291.

[19] A. Cavoukian, "Privacy by design: The 7 foundational principles. implementation and mapping of fair information practices." *Information and Privacy Commissioner of Ontario, Canada*, 2009.

[20] J. Ralyté, “Towards situational methods for information systems development: engineering reusable method chunks, ” in Procs. of 13th International Conference on Information System Development. Advances in Theory, Practice and Education. 2004.

[21] F. Bénaben, J. Touzi, V. Rajsiri, S. Truptil, J. P. Lorré, and H. Pingaud, “Mediation information system design in a collaborative SOA context through a MDD approach,” in Procs. of MDISIS, 2008, pp. 89-103.

[22] J. S. Sottet, and N. Biri. (2016), JSMF: a Javascript Flexible Modelling Framework. FlexMDE@MoDELS 2016: 42-51.

[23] R. Hevner, S. T. March, and J. Park, “Design science in information systems research,” MIS quarterly, vol. 28, no. 1, 2004.

[24] K. Peffers, T. Tuunanen, M. A. Rothenberger, and S. Chatterjee, “A design science research methodology for information systems research,” Journal of management information systems, vol. 24, no. 3, pp. 45-77, Dec. 2008.

[25] M. K. Sein, O. Henfridsson, S. Purao, M. Rossi, and R. Lindgren (2011) Action design research. MIS Q., 35(1), pp. 37-56, ISSN 0276-7783.

[26] C. Feltus and E. H. A Proper, Towards a Security and Privacy Co-Creation Method, 12th International Conference for Internet Technology and Secured Transactions (ICITST-2017), IEEE, Cambridge, United Kingdom.

[27] S. T. March, and G. F. Smith, (1995) Design and natural science research on information technology. Decision Support System, 15(4):251-266.

[28] ISO-IEC 25010: 2011 Systems and Software Engineering-Systems and Software Quality Requirements and Evaluation (SQuaRE)-System and Software Quality Models. ISO.

[29] C. Grönroos, “Service logic revisited: who creates value? And who co-creates?,” European business review, vol. 20, no. 4, pp. 298-314, 2008.

[30] L. Lessard (2015), "Modeling value cocreation processes and outcomes in knowledge-intensive business services engagements." Service Science 7.3, pp. 181-195.

[31] E. K. Chew, “iSIM: An integrated design method for commercializing service innovation,” Information Systems Frontiers, vol. 18, no. 3, pp. 457-478, Jun. 2016.

[32] J. Gordijn, H. Akkermans, and H. Van Vliet, “Designing and evaluating e-business models,” IEEE intelligent Systems, vol. 16, no. 4, pp. 11-17, Jul. 2001.

[33] J. Gordijn, H. Akkermans, and H. Van Vliet, “Business modelling is not process modelling,” In International Conference on Conceptual Modeling, 2000, pp. 40-51.

[34] H. Weigand, “Value encounters–modeling and analyzing co-creation of value,” in Conference on e-Business, e-Services and e-Society, 2009, pp. 51-64.

[35] I. S. Razo-Zapata, E. K. Chew, and E. Proper, “Visual Modeling for Value (Co-) Creation,” in 10th International Workshop on Value Modeling and Business Ontologies, 2016.

[36] H. Alves, C. Fernandes, and M. Raposo, “Value co-creation: Concept and contexts of application and study,” Journal of Business Research, vol. 69, no. 5, pp 1626-1633, May 2016.

[37] K. R. Ranjan and S. Read, “Value co-creation: concept and measurement,” Journal of the Academy of Marketing Science, vol. 44, no. 3, pp. 290-315, May 2016.

[38] M. Galvagno and D. Dalli, “Theory of value co-creation: a systematic literature review,” Managing Service Quality, vol. 24, no. 6, pp. 643-683, Nov. 2014.

[39] C. Feltus, E. Dubois, and M. Petit, (2015) “Alignment of ReMMo with RBAC to manage access rights in the frame of enterprise architecture,” in 9th Int. Conference on Research Challenges in Information Science IEEE, pp. 262-273.

[40] C. Feltus and M. Petit, “Building a Responsibility Model Including Accountability, Capability and Commitment”, Fourth International Conference on Availability, Reliability and Security (“ARES 2009 – The International Dependability Conference”) IEEE, 2009, Fukuoka, Japan.

[41] H. Becker, “Social impact assessment: method and experience in Europe, North America and the developing world,” Routledge, Jan. 2014.

[42] I. Manuj and J. T. Mentzer, “Global supply chain risk management,” Journal of business logistics, vol. 29, no. 1, pp. 133-155, Mar. 2008.

[43] “Smart Airport Turnaround Pilot Design”, TransformingTransport Deliverable D8.1, March 2017; https://transformingtransport.eu/sites/default/files/2017-08/D8.1%20-%20Smart_Airport_Turnaround_Pilot_Design_v1.0.pdf

[44] E. Hollnagel, D. W. David, and N. Leveson. “Resilience engineering: Concepts and precepts”. Ashgate Publishing, Ltd., 2007.