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Modeling and Analyzing Digital Business Ecosystems: an Approach and Evaluation

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***Abstract*— Joint actions with other businesses are key to the survival of many companies today. Advanced collaboration technologies support companies in synchronizing their joint actions by forming digital business ecosystems (DBE). While such technologies are beneficial to companies, their use might also be potentially detrimental due to the increased complexity they add to the management of the BDE partners' collaboration and due to the partners' lack of knowledge in coping with this complexity. For companies to deal with the complexities in their dynamic environments, they need approaches for mapping out and analyzing their DBEs. Due to the newness of the DBE concept, how to model and analyze DBEs is hardly known. Yet, this is necessary, as partners in a DBEs want to know if their DBEs promotes or prohibits profit. This article proposes an approach to modelling and analyzing DBEs, based on the complimentary use of ArchiMate standards and quantitative methods such as the Analytical Hierarchy Process and linear programming. We carried out a first evaluation of the proposed approach by using an expert panel of practitioners. Our results indicate that the approach is easy to use from practitioner's perspective and that it can assist practitioners in executing their modelling and analysis tasks. However, more empirical evaluation research is needed in order to improve the approach's applicability in supporting companies in making DBE-related decisions.**

Keywords- digital business ecosystem, ArchiMate modelling, AHP, linear programming, empirical research method

I. Introduction

The past decades witnessed an increased collaboration among companies. Studies [1,2] indicated that collaboration is key to companies' survival. However, to the collaborating companies, the emergence of new collaboration support technologies often means adding up complexity in the process of managing the actual collaboration among their business partners. For organizations to cope both with these increased levels of complexity and with their dynamic business environments, they should embrace the opportunity for forming with other players a digital business ecosystem (DBE). A DBE is deemed crucial for partnering companies due to its high potential to add more value to their stakeholders [3] and to support value delivery to customers [2]. Although beneficial for organizations, research on DBE is still in its infancy. In turn, how to model, analyze, and evaluate DBEs is hardly known. At the same time, practitioners [35,36] recognize that DBEs are powerful tools for growth, as is the case of China's Alibaba, and Finland's Nokia. Hence, conducting research in this field would contribute not only to the theoretical understanding of DBEs but also to the practical needs of organizations.

This paper makes a step in addressing the gap of research on DBEs. It proposes an approach to modeling and analyzing DBEs. Its goal is to enable organizations to evaluate the advantages of being a member of a DBE. We achieve this through the complementary use of profitability and resource analysis methods and the enterprise modelling language ArchiMate [4] which provides the modelling support for DBEs.

Our work makes two types of contributions. From a research standpoint, we extend the body of knowledge on DBEs by providing model-driven means for DBE analysis. Plus, we investigate the suitability of ArchiMate for modelling DBEs and demonstrate its application. Next, from practitioners' standpoint, we provide practical means for managers in DBEs to check their DBEs' health and evaluate the possible improvement scenarios in their DBEs' design. Specifically, we will see that our approach could assist organizations in assessing their partner relationships in terms of profitability. Moreover, the resource analysis that we put forward, could help organizations with prioritizing and optimizing the resources in their DBEs. For the purpose of our work, we adopted the design science research methodology of Peffers et al. [5], which also shaped the structure of this paper. Sections II and III describe the state-of-the-art on DBE research and our proposed approach. Section IV demonstrates our approach in an example case. Section V is on our first evaluation. Section VI is on limitations and implications. Section VII concludes.

II. Background and Related Work

This section includes literature on the concept of DBE, on the advantages and disadvantages of participating in a DBE, from a company's perspective, and on the current modelling and analysis support for DBEs.

A. *Digital Business Ecosystems (DBEs)*

The concept of business ecosystem was introduced in [6] as "an economic community supported by a foundation of

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interacting organizations and individuals; this economic community produces goods and services of value to customers, who themselves are members of the ecosystem". The participating member organizations form mutually beneficial and symbiotic relationships that enable value co-creation which is greater than the value that the individual capabilities of one organization can bring [7]. Due to increased adoption of technology, the traditional business ecosystem concept evolved into a DBE [7]. Unlike traditional ecosystems, a DBE is supported by a network of software applications, services, and agents, as well as business models, knowledge, and laws [7]. To better understand the advantages and disadvantages of the DBE, we have performed a systematic literature review [21]. Due to space limitations, we do not report here our review results; instead, we just provide examples of publications included in our review [21] that help understanding the background and the related work used in this paper. Next to our review of scientific literature, we looked at industry reports by market observers (e.g. [37]) and consulting companies (e.g. [35,36]) on the topic. Both our literature review's findings [21] and the observations from [35-37] indicated the following most important advantage from forming DBEs: (1) a DBE provides business partners with the ability to respond quickly to their dynamic markets [2, 7-9, 35-37]; (2) a DBE enables knowledge sharing among partners [2,21]; (3) a DBE creates for an organization a new form of disruptive growth [35,36]; and (4) a DBE enables innovation processes within the partnering organizations [21,37]. However, for partners in a DBE to achieve these advantages, they should have a high level of readiness to participate in the DBE and should remain highly committed to the DBE [21,37]. Plus, partners must be aware of the possible intellectual property issues, which might surface only after joining a DBE. Drawing on these sources, it seems the decision to join DBE is far from risk-free and, in turn, should be treated with care. Furthermore, our literature review [21] indicated that the research on DBE is still in its infancy. We found that many researchers acknowledge its importance but so far little research output has been produced in a systematic way. Published research mostly dealt with the ways in which DBEs should be explored [10], proposing a framework and language for specifying DBEs [11], and investigating the research trends on business ecosystems [9].

B. *The Modelling Framework Chosen for our Work*

For the purpose of our research, we chose to use the V^4 ontological framework [11] as a starting point in the design of an approach for modelling and analyzing DBEs. We considered it very suitable because it resulted of a thorough investigation of the current business modelling approaches, from the perspective of ecosystems. Figure 1 shows the V^4 framework. V^4 includes four dimensions: value proposition, value architecture, value finance, and value network. Each is divided into several elements relevant to assess DBEs.

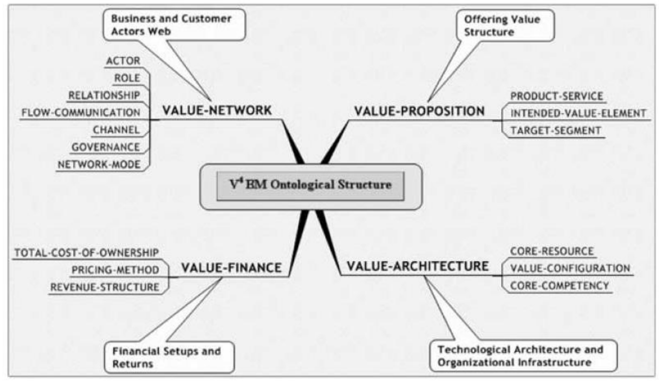

Figure 1. The V^4 Business Model Ontological Structure [11].

C. *Modeling Languages for DBEs*

We propose to model DBEs by using the Enterprise Architecture (EA) language ArchiMate, which is indicated by other studies as instrumental for modelling business strategy [27-29], value [30] and documenting DBEs [12].

TABLE I. MAPPING OF V^4 ONTOLOGY ELEMENT ONTO ARCHIMATE

V^4 Ontology	ArchiMate standard
Product Service	Product; Business service
Intended Value	Value
Target Segment	Stakeholder; Business actor
Actor	Stakeholder; Business actor
Business Role	Business role
Relationship	———————
Flow Communication	- - - - - - - - - -▶
Channel	Business interface
Governance	ArchiMate is focused on single organizations and lacks inter-organizational modelling aspects.
Network Mode	ArchiMate is focused on single organizations and lacks inter-organizational modelling aspects.
Value Finance	Value
Core Resource	Resource
Value Configuration	Business process; Business collaboration
Core Competency	Capability

Specifically in this work, we employ ArchiMate [4], a popular EA modelling standard, whose constructs help modelling the structure of an organization by using three layers: (1) Business layer (products and services offered to customers, the business processes that helped create the offering, and the actors that played a part in the business processes), (2) Application layer (application services which support the Business layer), and (3) Technology layer (infrastructure services that support the applications). Since its launch, the ArchiMate standard has added a few new concepts in the form of: (a) Motivation elements (focus on the motivation behind enterprise change), (b) Implementation and Migration elements (focus on the programs, portfolios, project management, and plateaus that can be used in gap analysis), (c) Strategy elements (focus on the strategy in the form of courses of action, capabilities and resources), and (d) Physical elements (focus on facilities, equipment, distribution networks and materials). Each of the modelling concepts is part of a layer, has a specific notation, and can have several relations with other concepts between and within layers.

We evaluated the suitability of ArchiMate for modelling DBEs by establishing a mapping between the ArchiMate modelling constructs [5] and the V^4 ontological components [10] (see Figure 1 and Table I). This mapping was necessary in order to make clear how ArchiMate fits with V^4 (our starting point in designing our approach).

To establish the mapping, we compared the definitions of ArchMate constructs and those of V^4. The comparison is presented in more detail elsewhere [21]. The mapping in Table I allows us to pinpoint to some limitations of ArchiMate. Specifically, the Governance and Network mode elements from V^4 cannot be modelled using ArchiMate as ArchiMate does not support inter-organizational modelling. However, those V^4 elements can be linked to the ArchiMate notion of architecture patterns. This observation encouraged us to adopt the position that the concepts of V^4 Governance and Network mode can be represented in ArchiMate by means of the construct of architecture patterns (such patterns would result from modelling DBEs).

D. *DBE Analysis Techniques and Methods*

Although analysis is deemed key to DBEs planning, often organizations overlook at as a critical success factor for a project, which in turn leads to project failures or even substantial losses to the interested parties [1]. Using appropriate analysis techniques is therefore necessary if one wants to reduce the risk of business failure in the future and to help DBE-related decision-making processes. Below we summarize a few analysis methods that can be used to assess DBEs, starting with profitability analysis. The purpose of conducting this type of analysis is to assess the future of the business [2] and the ability of a firm to control its expenses in order to generate an acceptable rate of return. This is of interest to stakeholders and also investors and creditors, to make better economic decisions. Specifically, the method that we employ in this work is cost-revenue analysis. Since this study's focus is on DBEs, this kind of analysis can help the partnering organizations to assess whether joining a DBE would bring a financial advantage. Plus, if an organization is already part of a DBE, this analysis can help them estimate this DBE's future economic performance, which can help with long-term business planning. Another analysis that we included in our DBEs assessment approach, is the resource selection analysis. As resources are crucial to most businesses, running a proper analysis is crucial to determine the organization's success. We will do this analysis by using the Analytical Hierarchy Process (AHP), which supports multi-criteria decision-making regarding resource allocation [3]. In this paper, we use a pairwise comparison matrix to calculate the priority between available alternatives. Once it is clear which resources should be prioritized, organizations can complement the resource selection analysis with a resource optimization analysis. The purpose of the latter is to discover the best distribution of the resources in order to produce the optimum results at minimum costs or to generate the highest revenues with the available resources. For this we decided to use linear programming, which helps describe our real-life problem at hand by means of a mathematical model consisting of linear relationships. It is used to identify the best outcome among available possibilities within some constraints. As this method was first applied to production planning, with the purpose of finding the optimum utilization of the industrial reserves (materials, labor, and equipment) [25], we considered it highly suitable for our context and therefore we included it in our approach.

III. MODEL-BASED ANALYSIS FOR DBES

This section demonstrates the proposed approach by applying it in the example case of Shopify, a Canadian e-commerce company that offers a cloud-based, multi-channel commerce platform for small and medium-sized businesses.

A. *Case Description*

Shopify engages in DBEs. The Shopify software is used by merchants (these are Shopify's primary customers), to run their business across all channels: web and mobile storefronts, physical retail locations, social media storefronts, and other marketplaces, such as Amazon. Shopify provides a hassle-free platform and expert support, while a merchant focuses on building and selling its products, instead of spending much time and resources in building an e-commerce website. As Shopify is a growing company, they also keep improving the services they provide to their clients. To come up with better services, Shopify is partnering up with a lot of companies to bring more features to merchants. One of the methods that Shopify uses is to cooperate with Stripe in order to provide a built-in payment method, which is known as "Shopify Payments". Plus, Shopify also supports external payment gateways by collaborating with other companies, such as Amazon Pay by Amazon and PayPal. Moreover, shipping and fulfilment are core processes for retail business owners. Hence, Shopify works together with third-party companies (e.g. Amazon, Rakuten, and Shipwire) responsible for the inventory management and the logistics of the merchants' goods. More detailed information on the partners will be provided in the next section. For now, let's assume that in order to improve their overall business and gain more financial benefits, Shopify wants to expand their business by learning from other notable e-commerce organizations, e.g. Amazon whose current success is attributable to their DBE. Thus, more insights into Shopify's current DBE could help them plan their next steps.

B. Demonstration

To get an understanding of Shopify's DBE, we employed the ArchiMate modelling language and represented the member organizations, their relationships and their value exchanges in Figure 2. Specifically, we use:

- The *business actor* concept to model the member organizations (e.g. Shipwire, Stripe);
- The *business role* concept to model the roles of the organizations within the ecosystem (e.g.: Fulfilment Service Provider, Merchants);
- The *application component* concept to model the software applications that are offered by the member organizations in the DBE (e.g.: 3rd Party Applications, Payment solution);
- The *Facility & Equipment* concept to model the physical aspects which help produce several goods offered by member organizations in the DBE (e.g.: Warehouse, Manufacturing machine);
- The *value* concept to model the exchanged values between the member organizations (e.g.: Distribution service, Subscription fee);
- The *flow relation* to model the direction of the value exchanges between the member organizations (e.g.: the relationship between Shopify and Merchants which points at the Merchants, and now represents value that is flowing from Shopify towards them);

We note that Figure 2 shows several values above the value exchanges labelled with "Fee". These represent monetary exchanges between partners. This information is useful for the cost and revenue analysis. The monetary values attached to relationships that indicate a flow from Shopify to another DBE member, can be considered costs. Respectively, the monetary values attached to relationships flowing towards Shopify, can be considered revenues. Using these cost and revenue figures, one can carry out a profitability analysis by subtracting the total cost from the total revenue. In what follows, we used publically available data from Shopify's annual financial report (2016)[1]. in order to demonstrate our approach. Figure 3 illustrates the results of the profitability analysis by using a simplified version of the model presented in Figure 1. The outcome of this analysis allows us to draw the conclusion that the DBE brings added value to Shopify, in the form of money. We note that the monetary values in Figure 3, are expressed in thousands of US$, e.g. $38,794 should be interpreted as $38,794,000. As a Software-as-a-Service vendor, Shopify must provide an excellent cloud service. In turn, for Shopify to be able to do this, they must consider the various resources needed for service provisioning: human resources (e.g. knowledge and expertise), intangible resources (e.g. service, applications), financial resources (e.g. pricing), and technological resources (e.g. cloud infrastructure). Moreover, Shopify provides a cloud software service, where the service itself is acquired from a third-party firm. Let's assume that Shopify focuses on improving their technological resources provided by the cloud service provider. Thus, the resource selection analysis is used to find out the best partner to provide the resources that Shopify needs.

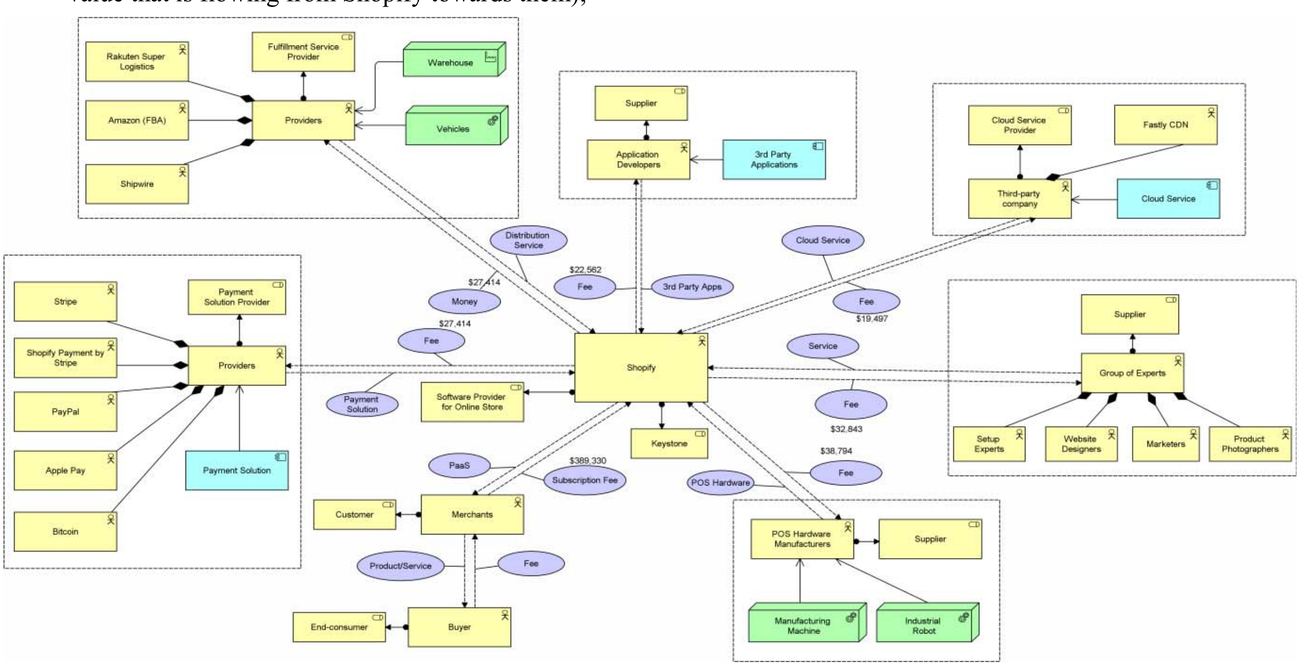

Fig. 2. Example (excerpt) ecosystem model of Shopify.

[1] Shopify quarterly financial report (last quarter of 2016), available at https://goo.gl/kaCWCD

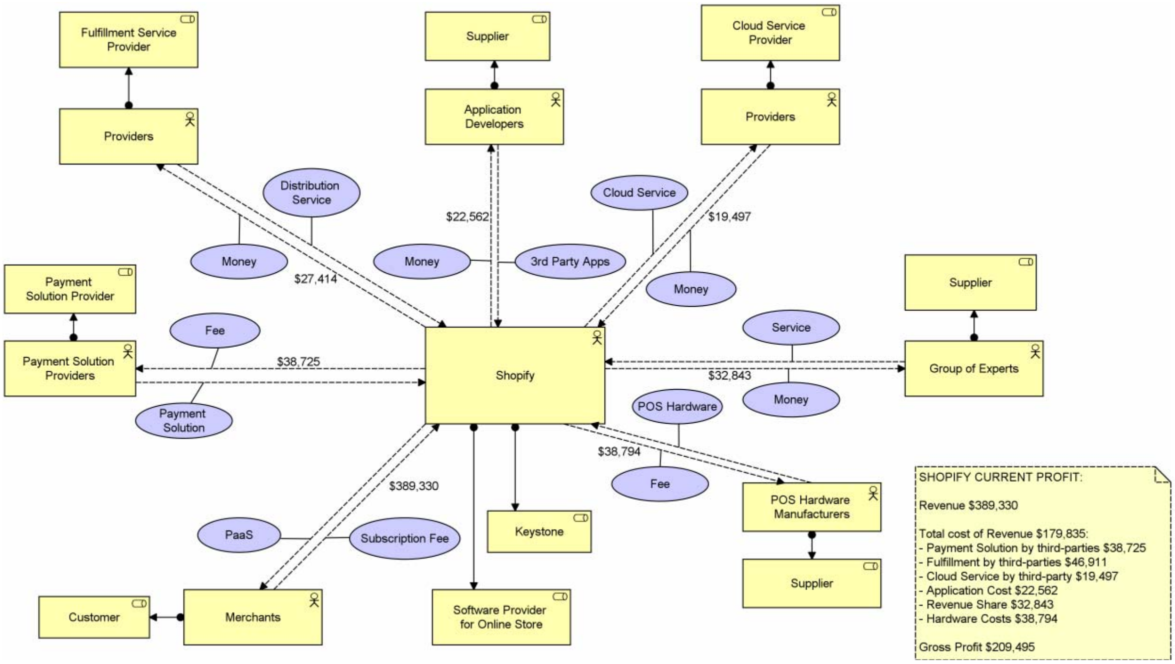

Fig. 3. Shopify model-based profitability analysis.

Next, we account for the availability of many cloud providers offering the cloud service, specifically in content delivery networks (CDN), e.g. Amazon Cloud Front, Google Cloud CDN, IBN CDN. Currently, Shopify collaborates with Fastly to offer web hosting to the merchants. Although they have already been using the service from Fastly, it should be assessed whether Shopify should continue cooperating with Fastly in the future, or if it is better for Shopify to find a new partner that can provide a better service. To get clarity on this, a resource selection analysis is needed. In our approach, we employ the AHP in order to find the best company to become a partner within Shopify's DBE (Figure 4). Based on the calculations in Figure 4, it can be concluded that if Shopify wants to focus on providing their service to merchants, the best company to partner with is Amazon Cloud Front, as they can provide the most suitable cloud service. It can also be said that it is better for Shopify to consider replacing Fastly CDN with the Amazon Cloud Front since it better aligns with the criteria of Shopify (Knowledge, Service, Pricing, and Cloud infrastructure).

To sum up, the resource selection analysis seems useful not only to help Shopify in assessing their current DBE, but also to explore new opportunities. In this example, Shopify might want to consider replacing a current partner with a new one that aligns better with their needs. Once this selection is done, Shopify can proceed with optimizing the allocation of this new resource, by identifying how it will be distributed among its customers, with varying needs.

AHP Method to find partner with the best cloud infrastructure resource

Importance of Criteria (Scale 1-10)

Resource	Knowledge	Service	Pricing	Cloud infrastructure
Knowledge	1.00	0.40	0.13	0.23
Service	2.50	1.00	0.11	0.13
Pricing	7.98	8.84	1.00	0.19
Cloud infrastructure	4.44	7.75	5.36	1.00
sum	15.92	17.99	6.60	1.54

Normalized matrix

					Weights
Knowledge	0.06	0.02	0.02	0.15	0.06
Service	0.16	0.06	0.02	0.08	0.08
Pricing	0.50	0.49	0.15	0.12	0.32
Cloud infrastructure	0.28	0.43	0.81	0.65	0.54
checksum	1.00	1.00	1.00	1.00	1.00

Evaluation of choices (Scale 1-10) (the highest score signifies the most desirable)

Fastly CDN	1.00	3.00	2.00	1.50
Google Cloud CDN	1.80	2.50	1.50	2.00
IBM CDN	2.50	3.00	2.50	1.50
Amazon Cloud Front	3.00	2.50	2.00	2.50
sum	8.30	11.00	8.00	7.50

Fastly CDN	0.12	0.27	0.25	0.20
Google Cloud CDN	0.22	0.23	0.19	0.27
IBM CDN	0.30	0.27	0.31	0.20
Amazon Cloud Front	0.36	0.23	0.25	0.33
checksum	1.00	1.00	1.00	1.00

Determining company with the best cloud infrastructrue

	Score
Fastly CDN	0.22
Google Cloud CDN	0.24
IBM CDN	0.25
Amazon Cloud Front	**0.30**

Figure 4. Shopify's resource selection analysis with AHP.

Objective: Maximize revenue

	Online Store	POS	Enterprise	
Decision Variable	500	175	243	**Max Revenue:**
Service Revenue	$ 1,500.00	$ 1,250.00	$ 2,000.00	$ 1,454,750

Assumption

Shopify has to provide the service to:

- less than 500 online store merchants
- exact 175 POS merchants
- more than 150 enterprise merchants

Bandwidth Required

	Online store	POS	Enterprise	Bandwidth used (GB)	Maximum Bandwidth	Number of Merchant
Cloud Server	100	75	350	148175	195,950	
Virtual Machine	150	100	500	214000	245,000	
Network Infrastructur	135	115	400	184825	185,000	
Online Store	1			500	<	500
POS		1		175	=	175
Enterprise			1	243	>	150

Figure 5. Shopify resource optimization analysis with linear programming

Moreover, the optimization of the resources is expected to affect the revenue and cost (which indirectly leads to a higher profit).

As assumed, Shopify is focused on developing its cloud infrastructure provided by Amazon Cloud Front. However, the needs of their three main customer groups (Online stores, POS retailers, and Enterprises) vary greatly. To determine the greatest amount of revenue that Shopify can generate while best satisfying the needs of their diverse customers groups, our method uses linear programming, see Figure 5.

Therein, the bottom part shows the information used to perform the resource optimization analysis. Also, we can see the current usage in terms of bandwidth for all the types of Shopify's customers (see the grey column). The usage is specified per technology type, based on historic data. The column labelled 'Maximum bandwidth' represents the maximum amount provided by the cloud provider. Next, the rightmost column indicates the constraints regarding the maximum number of serviceable merchants. E.g. the number of online stores cannot be more than 500. Finally, to determine the maximum amount of revenue obtainable by Shopify, the current amount of revenue per customer type is also needed, see the top part of Figure 5. Therein, the result of this resource optimization analysis indicates the maximum revenue obtainable by Shopify and also the optimum number of serviceable customers, per type (Figure 5). The colors used in Figure 5, highlight the realization of the different types of resources, per type of technology used.

By analogy, performing a similar analysis using linear programming will result in determining the lowest possible cost. For Shopify, this minimum cost can be $697,588. Thus, the maximum profit that Shopify can possibly earn is $757,163, based on the difference between the maximum revenue values they exchange. Plus, the complementary use of multiple analysis techniques for assessing Shopify's DBE, did bring insights into the profitability of the exchanges between Shopify and its DBE partners. The joint use of resource selection analysis and optimization analysis revealed the cloud infrastructure provider that seems to be the most suitable for Shopify, and also the way in which the resources of this provider could be best used to generate the greatest possible revenue at the lowest possible cost for Shopify. ($1,454,750 − as shown in Figure 5) and minimum cost ($697,588).

The Shopify example illustrated the application of ArchiMate for modelling of a DBE and the execution of follow-up quantitative analyses. The models showed Shopify's DBE in terms of actors, their roles, their resources, and the values they exchange. Plus, the complementary use of multiple analysis techniques for assessing Shopify's DBE, did bring insights into the profitability of the exchanges between Shopify and its DBE partners. The joint use of resource selection analysis and optimization analysis revealed the cloud infrastructure provider that seems to be the most suitable for Shopify, and also the way in which the resources of this provider could be best used to generate the greatest possible revenue at the lowest possible cost for Shopify.

IV. Evaluation

We evaluated our proposed approach by performing an expert panel study [17] with four practitioners from the Dutch enterprise consulting sector. The practitioners were research-minded and enthusiastic about their participation. We set up the study as a workshop and implemented the nominal group technique [26], which suits a research context with a small number of participants (3 to 5). We started by introducing our approach and demonstrated it by using the Shopify case. Each practitioner had time to ask clarification questions about the approach. Next, each participant was asked to fill in a survey in order to provide his/her feedback on the approach. The design of our survey was inspired by the Unified Theory of Acceptance and Use of Technology (UTAUT) [18]. We chose it because of its suitability to our evaluation setting: as per [18] the UTAUT is meant to investigate the user acceptance of artefacts, be it technologies, approaches or models. We composed a questionnaire (Table II) that adapted 14 UTAUT statements, grouping them in five categories: performance expectancy (PE), effort expectancy (EE), facilitating conditions (FC), self-efficacy (SE), and behavioral intention to use (BI). A 5-point Likert scale was used to rate the statements, with 1 meaning the lowest value ("don't agree"), 5 meaning the highest value ("agree"), and 3 being a neutral response.

Table II shows the descriptive statistics for those 14 statements: minimum (Min), maximum (Max), average (Avg.) values, and the standard deviation (Std. dev.). As we see, all 14 statements received an average rating of at least 3, from our study participants. This is indicative to conclude that the respondents were mostly neutral, and in some cases positive. Next, the majority of Std. dev. values are lower than 1, which indicates that the respondents provided similar ratings. Thus, following [26], we could conclude that on most statements, the opinions of the respondents were similar and ranging from neutral to positive. In Table II, statement SE2 received the highest average rating, which indicates that the respondents would use the proposed approach if built-in assistance is provided to help them with using it. Thus, we could possibly suggest that if we provide guidelines for using our approach, this would be beneficial, as in turn it can encourage users to use it.

Three statements (EE2, FC3 and SE2) received the highest rating, which indicated that one respondent considered that our approach is easy to use, and it fits with their way of working. Since the respondent that provided this answer had a high level of ArchiMate modelling knowledge, his rating could reflect this situation. Moreover, the respondent who provided the lowest ratings for three statements (FC1, FC2 and FC3), had little knowledge of ArchiMate. This makes us think that knowledge of ArchiMate could be a prerequisite for using our approach in practice. Furthermore, the standard deviations which have a score greater than 1 correspond with the three statements which have received the lowest score. This indicates that the large disparity can be traced back to the answers of those respondents that considered to have insufficient knowledge for using our approach.

V. REFLECTION ON LIMITATIONS AND IMPLICATIONS

We evaluated the possible limitations [5] of our approach. First, we included three types of analysis deemed a good fit for analyzing DBEs. However, these three are only a small subset of all possible analysis techniques which would fit the DBEs context. We think that more empirical research is needed to try out alternative analytical techniques. Second, we are conscious about the assumption made in the AHP method regarding the evaluators' knowledge of the options. The AHP assumes that all options are crispy clear, which may not be realistic in all cases, e.g. evaluators may have deep knowledge on a single option (e.g. one partnering company in a DBE) or a subset of alternatives but not on all. It is hard to make pairwise comparisons in this case as one would need knowledge about all the alternatives. To cope with this situation, we think that evaluators should first clarify for themselves the criteria that they would use for the pair-wise comparisons, and these criteria's impact on the business. A team of evaluators typically works this out at the consensus-building stage [26], preceding the AHP application. Third, our approach rests on ArchiMate. However, as per our first evaluation, not all organizations know ArchiMate well. It might be the case that a company has already a history of using other enterprise modelling standards, e.g. ARIS, and therefore has no reason to adopt yet another notation. We take this point from our evaluation very seriously and set out to investigate if a more simplistic modelling language can be used. Moreover, another solution to this situation could be the use of techniques for transformation of enterprise models [19]. However, currently the rates of adoption of the model transformation technology and the resources this takes, are not known. We therefore think that more research is needed to understand the viability of this idea within the use of our approach. Fourth, our approach was applied to the Shopify example and may not

TABLE I. DESCRIPTIVE STATISTICS FOR THE EVALUATION WORKSHOP

Questionnaire statements	Min	Max	Avg.	Std. dev.
PE1: Using the proposed approach would help me improve my job performance.	3	4	3,5	0,577
PE2: Using the proposed approach enables me to accomplish tasks more quickly.	3	3	3	0
PE3: Using the proposed approached increases my productivity.	3	3	3	0
EE1: It would be easy for me to become skilful at using the proposed approach.	3	4	3,75	0,5
EE2: Overall, I believe that the proposed approach is easy to use.	3	5	3,75	0,957
EE3: Learning to use the proposed approach is easy for me.	3	4	3,75	0,5
FC1: I have the knowledge necessary to use the proposed approach.	1	4	3	1,414
FC2: I have the resources necessary to use the proposed approach.	1	4	3	1,414
FC3: I think that using the proposed approach fits well with the way I like to work.	1	5	3,5	1,732
SE1: I would use the proposed approach if I could get help from someone if I got stuck.	3	4	3,5	0,577
SE2: I would use the proposed approach if there is built-in guidance for assistance.	3	5	4	0,816
BI1: I intend to use the proposed approach in the future to help me completing my job.	2	4	3,25	0,957
BI2: I predict that I would use the proposed approach in the future in my job.	2	4	3	0,816
BI3: I plan to use the proposed approach in the future for helping me in my job.	3	4	3,25	0,5
Average PE statements	**3**	**3,33**	**3,17**	**0,192**
Average EE statements	**3**	**4,33**	**3,75**	**0,652**
Average FC statements	**1**	**4,33**	**3,17**	**1,520**
Average SE statements	**3**	**4,5**	**3,75**	**0,697**
Average BI statements	**2,33**	**4**	**3,17**	**0,758**

be generalizable to other contexts. Following [20], we think that it might be possible to use our approach in a similar way in those contexts similar to Shopify, e.g. companies committed to the ongoing improvement of mutually beneficial DBEs with their most important partners. However, in order to get more insights into the use of our approach to other similar contexts [20], future research is needed. Fifth, our very first evaluation used a panel including four practitioners only. One might think that the number of practitioners is too low and this poses a generalizability threat. Despite the fact that the nominal group process counters threats due to a small number of practitioners and gets still realistic results [26], we consider our findings only indicative. Improving generalizability is our most urgent issue and we plan follow-up panels with more practitioners in a variety of contexts.

We also reflected on the practical implications of our approach. We think that our approach could be used in at least two ways. First, managers in DBE-related projects could consider our approach as a practical means for analyzing decision scenarios and using the resulting analysis in a review with stakeholders. Our approach offers a transparent way for stakeholders to trace alternatives to critical cost-related parameters. Second, senior leaders in a company might use our approach to understand if their own DBE is promoting growth, or prohibiting it. Of course, in both situations, we consider that our approach would be only one of the many that a DBE manager or a senior leader would use to make a sound and well thought-out decision.

VI. CONCLUSIONS

We proposed an approach to modelling and analyzing DBEs. Using a realistic example case, Shopify, we demonstrated that the approach allows to make explicit the actors participating in a company's DBE, these actors' roles, the resources the actors can offer, and the values they exchange. It leveraged ArchiMate for the purpose of modelling DBEs, and profitability analysis, resource selection analysis, and resource optimization analysis, for the purpose of analyzing BDEs. As we saw in the Shopify case, combined, these analytical techniques provide organizations with a multifaceted view of resources they possess or want to acquire. We evaluated our approach through an expert panel. This very first evaluation indicated that the approach can be potentially useful to practitioners, if they have some knowledge of ArchiMate modelling. However, we are conscious of the fact that our expert panel included four experts only. Our future work therefore includes empirical studies with more practitioners in various business sectors.

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