The Business Model of Digital Ecosystems: Why and How You Should Do It

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Abstract. Digital ecosystems and platforms require a business model, which is a model of how a business creates, delivers, and captures value. We argue that the business model should be a *networked* business model, as ecosystems and platforms are connected networks of organizations and consumers. Furthermore, we emphasize that a business model should be a *conceptual* model that is expressed using a (semi) formal language. This is not only needed in order to create an unambiguous and shared understanding of the ecosystem at hand; it is also a prerequisite for software-assisted analysis and for the use of other design techniques, e.g. for business process engineering, and ICT architecture design. We explain these two requirements concerning business modelling using a series of industry strength cases.

Keywords: digital ecosystem · platform · e^3*value* · network · conceptual model

1 Introduction

The notions of 'business model' and 'digital ecosystem' are closely related: Every network of actors requires a way to be financial sustainable on the long term for all actors involved. However, the idea of 'business model' is understood in very different ways: In the field of business development, a business model refers to how parties can earn money, hence the focus is on the 'business' first. In Computer Science, the emphasizes is more on the *conceptual model*, which is a formalization of the ecosystem at hand, usually with the aim to create a shared understanding and to enable (automated) analysis.

In this paper, we argue that a business model should consider the *network* as a first class citizen. Each business model contains at least two actors: A buyer and a seller, and hence it can be considered as a network. However, in reality, both digital ecosystems and platform, and so their business models, are far more complicated, as they contain many more actors than just two. This already holds for centrally led platforms, such as Meta, Alphabet, Amazon, and Netflix, which are all conglomerates of a large number of parties. Moreover, there are also ecosystems that are physically organized as networks of actors by their nature: For example the electricity network, telecommunication, railway, and

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international clearing of intellectual property rights on music all have a strong network orientation.

This paper is structured as follows. In Sect. 2, we first introduce the notions of 'ecosystem' and 'platform'. Thereafter (Sect. 3), we define the concept of 'business model' and we discuss two different techniques for representing a business model, namely the Business Model Canvas and e^3value. We explain both techniques briefly using the same example, namely AirBnb. Then we discuss two requirements regarding business models of digital ecosystems. First, in Sect. 4 we argue that in a business model of digital ecosystem, the network should be the first class citizen. Second, we claim that business models should be *conceptual* models, to allow for creation of shared understanding and further software-assisted analysis (Sect. 5). Finally, Sect. 6 presents our conclusions.

2 Ecosystems and Platforms

In our upcoming book about digital business ecosystems [12], we define the notion of ecosystem as follows: 'A business ecosystem is a system of economic actors that depend on each other for their survival and well-being'. This definition is based on the analysis of the biological ecosystem concept by [13]. The biological ecosystem metaphor was actively introduced by [7,8] and later used actively by [3,4].

There are number of remarks in place regarding this definition. First, a business ecosystem consists of many *economic* actors (meaning entities who decide themselves to do economic transactions or not) who form a *network*, where the actors are the nodes, and the economic value transfers are the edges. Second, in a business ecosystem, actors have a *dependency* relation with each other. This means that if an actor defaults, on the longer term the whole network default, provided that no counter measures are taken.

In reality, all economic activity takes place in a business ecosystem; already if there is one buyer and one seller, there is a business ecosystem. Consequently, the list of examples is endless. However, some ecosystems emphasize the networked idea more than others. For example, energy networks, the Internet, railways, and postal services are networked in terms of their production- and delivery processes, and often also in terms of the transfer of economic value transfers.

However, there are also business ecosystems where one specific actor plays a very dominant role. Although perhaps suggested differently by the recent big US-tech firms, such centralized ecosystems already exist for a long time. A *platform* is a shared infrastructure of a value network on top of which members of the value network create additional value [12]. Although not all platforms have a dominant actor (a counter example is OpenBazaar, which is a full decentralized trading platform), many platforms are centrally operated and led. Examples are Facebook, Twitter, NetFlix, Google, Spotify, Amazon and many other companies whose ambition it is to create a centralized, dominated platform. Therefore, if we speak about platforms, very often this refers to *centralized* platforms. Platforms have an *infrastructural* aspects, meaning that they provide products and/or services that are shared by other services. The latter service create *additional* products or services, *on top of* the infrastructural services or products. Android is a platform operated by Google, and others (Facebook, LinkedIn and not in the least Google itself) provide value added services on top of it.

3 Business Models

3.1 Definition

Ecosystems and platforms require a *business model*. Over the past years, the notion of 'model' as part of the concept of 'business model' has received an own interpretation, which is not the same as 'model' in the conceptual modeling field. In the latter, 'model' refers to the idea that, for some reasons, it is useful to develop an abstraction of reality. Reasons to do is to create a clear, well understood, and agreed set of requirements that can be the starting point to develop an information system. Conceptual modeling comes with notations, techniques and methods to produce the models, that are rather formal and leave no room for different interpretations. The notion 'business model' is more loosely defined; it is about how money is earned. Business models are often expressed very informally, even by means of unstructured natural text. This results unavoidably in many interpretations by different stakeholders. Clearly, the focus is more on 'business' than on 'model'.

We define 'business model' differently: 'A business model is a *conceptual model* of how a business creates, delivers, and captures value' [12]. As in our view, business models are always networks, multiple actors are involved. In our interpretation, the idea of 'conceptual model' is very important. We argue that a business model should be (re)*designed*, just as an engineer designs a bridge or an electronics circuit. For designing a business model, a language to express the business model (e.g. e^3*value*), and tools to analyze the business model (e.g. discounted cash flow analysis, fraud assessment, sensitivity analysis) are needed. In other words, we extend the idea of conceptual modeling, which is well known and successful in the Computer Science discipline, to the business domain.

We also argue that a business model is about an *ecosystem* (or a platform as a special case) and is not restricted to *single focal* enterprise and its direct environment. This is because a business model as strong as its weakest actor; in other words, if some actor goes out of business after a while, the whole ecosystem is affected.

3.2 Techniques

There are many techniques to express a business model. We discuss two of them: The Business Model Canvas (BMC) [10] and e^3*value* [1]. Figure 1 represents the business model of AirBnb as a BMC. Because AirBnb is an example of a centralized platform, the business model is actually about the *focal actor* AirBnB. A BMC consists of nine blocks (key partners, key activities, value proposition, customer relationships, customer segments, cost structure, and revenue streams), and illustrates the focal actor AirBnb and its direct environment in terms of partners (including suppliers) and customers. Although the importance and acceptance of the BMC by the industry is impressive, there are a number of shortcomings. First of all, the formalization is weak as it only consists of nine boxes. This makes it difficult to analyse and evaluate a BMC with software tools. At the same time, the BMC simplicity is likely its strongest point: it not difficult to understand what is meant by the nine boxes, so the BMC is easy to learn and apply. Secondly, the BMC ignores the *network* aspect, as it takes a focal actor and its environment only.

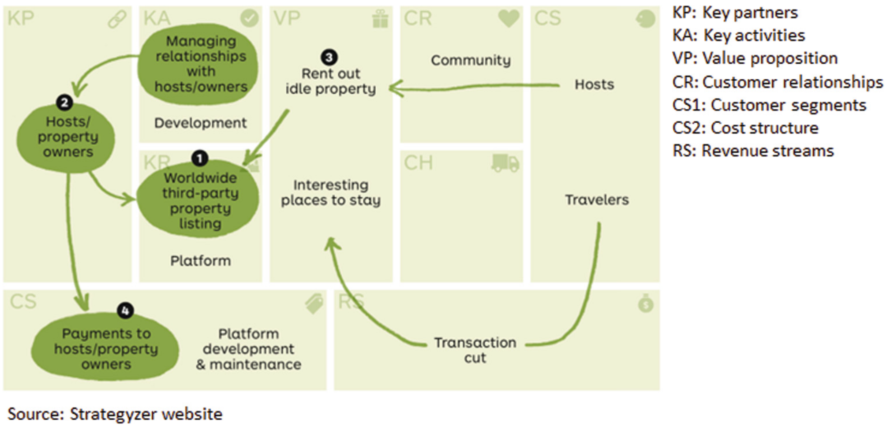

Fig. 1. AirBnb expressed as a BMC

Figure 2 models the same case, namely AirBnb as an e^3value model. There is no focal actor; all actors are equally important. The e^3value shows the primary value transfers (stay for money), and the secondary value transfers that facilitate that stay (specification of stay, list of possible stays, reservation, money). From the model can be seen that AirBnb earns money by offering reservations. Additionally, the model shows how we model mediation in e^3value: the primary transfer (stay for money) is triggered by the customer need of the visitor (stay) and is independent from AirBnb. However, mediation is modeled as a case of *matching*, where the visitor and a host both have a need, namely 'stay' and 'visitor' respectively. These needs are matched by AirBnb. Finally, the model shows an additional actor, namely a financial service provider (Paypal). The model is more complex than the corresponding BMC. The expressive power of e^3value is higher than the BMC, but e^3value is more difficult to learn and apply correctly. The same holds for the level of formality; because e^3value models are a formalization of a business model, it allows for automated analysis tools, such as economic value flow analysis and fraud assessment [5]. Finally, the e^3value model shows the network, and could easily be extended with other actors such as handyman, energy providers, etc.

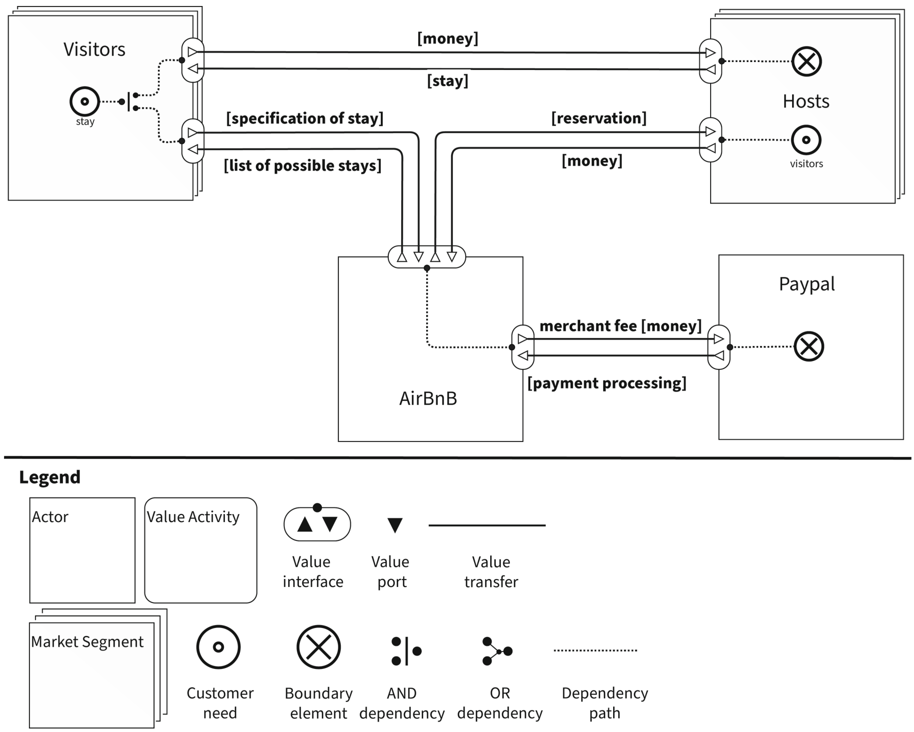

Fig. 2. AirBnb expressed as an e^3*value* model

4 Digital Ecosystems: Consider the Network as First Class Citizen

This paper is about two requirements concerning the business model of a digital ecosystem: (1) a business model should have a network orientation instead of a single/focal actor perspective, and (2) a business model should be a *conceptual* model. We will elaborate these requirements in this section and the next section.

Our interpretation of 'network' is following: 'A network consists of nodes and edges between nodes' (following the definition of a *Graph* in Computer Science). Nodes and edges are generic constructs that may refer the nearly everything. In our case, the understanding is more restricted: A node actor is an entity that is responsible for its survival and well-being [1]. The edges are value transfers, which express the willingness of two actors to transfer a value object from the first to the second one [1]. For the sake of completeness, a value object is something that is of economic value for at least one other actor in the network and that satisfies a need directly or indirectly (through another value object) [1].

Why is this network perspective so important? We give three motivations. First, ecosystems always *are* networks. There does not exist an ecosystem consisting of one actor. That would be an ecosystem that exists for the sake of the one actor, and that is meaningless. There are at least two actors, e.g. a customer and a supplier. There are cases where a focal actor is important, for example in the case of the many tech-firm based ecosystems. The GAFA (Google, Apple, Facebook and Amazon) ecosystems are all examples of ecosystems with one dominant focal actor. Nevertheless, to understand these GAFA ecosystems well, it is useful to take a network perspective, not in the least because the focal actors absorb important parts of the ecosystem they participate in.

Additionally, there exist ecosystems that are networks by their *nature*. For example, the electricity energy *network*, is a collection of nodes and edges, and these edges may also refer to energy transmission lines between nodes (e.g. electricity generators and consumers). In the electricity ecosystem there is some concentration into large organizational entities, but while considered on a continental scale, it usually contains a number of such entities, instead of one such as in the GAFA case.

In the following section, we give examples of ecosystems that have a network flavour: (1) international clearing of intellectual property rights on music, and (2) the circular economy.

4.1 International Clearing of Intellectual Property Rights on Music

Figure 3 gives a compact e^3*value* model of international clearing of intellectual property rights on music, specifically the Public Performance Right (PPR) (see for more information about the case [2]). If users play music in a public venue, e.g. a restaurant, they need to pay to collecting societies for doing so. These collecting societies collect fees for the parties they represent, e.g. the artists and producers. Note that in this paper, we only focus on clearing rights on recordings; there are other rights, such as the author rights on works, that we do not consider.

A collecting society pays money to right holders based on the recordings played. In Fig. 3, an envisioned future scenario is represented, namely that restaurants pay for each recording they play (referred to as pay-per-play). A recording has multiple right holders, in this model of two classes, namely artists and producers. The AND dependency represents that right holders of both classes are paid. Typically, per class, there are multiple right holders on a recording, here we assume four artists and two producers.

The e^3*value* model in Fig. 3 has a specific feature, namely a market segment (collecting society), which exchanges objects of value with itself (both annotated with #1). A collecting society pays directly an artist (this happens if the collecting society clears the rights for that artist), *or* pays to an another collecting society (who operates on behalf of that actor), who in turn pays that specific artist. The same holds for producers. Note that in e^3value, value transfers with the same actor are forbidden, as it makes no sense to sell products or services to itself. There is however one exception to the rule, namely if value transfers (directly of indirectly) connect to the *same* market segment, as is the case in Fig. 3. In this specific instance, the transfer between the same market segment means: *select another actor in the market segment to exchange value objects with.* Since market segments are sets of actors, at the actor level there are only transfers between *different* actors.

It is obvious that this IPR case has a clear network orientation, as *national* collecting societies operate in a network to clear *international* property rights.

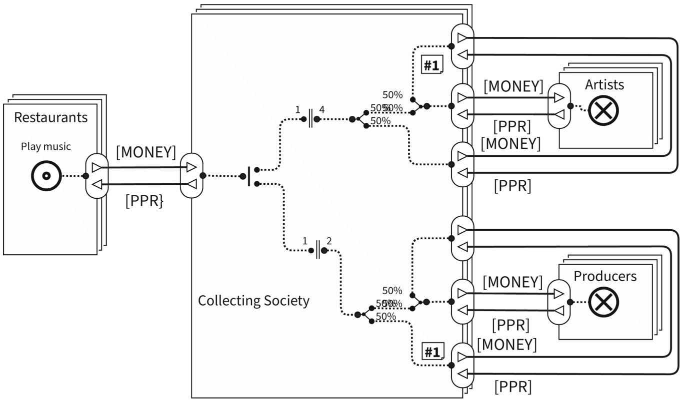

Fig. 3. International clearing of intellectual property rights on music expressed as e^3value model

4.2 The Circular Economy

A special case of a networked ecosystem is a circular ecosystem. Figure 4 presents an anonymized version of such an ecosystem. In brief, the company 'Widget Engineers' build widgets and uses components to do so. If the 'Widget Engineers' creates a widget, a disposal fee is paid to the 'Disposal Fee Foundation', in return for compliance with a national that prescribes. Once the widget is end-of-life, the 'Disposal Fee Foundation' pays a logistic provider to transport the widget from the customer to the 'Disassembler'. The 'Disposal Fee Foundation' also pays a fee to the 'Disassembler', who breaks the widget into raw materials again, which are sold the component supplier. Circularity can be seen due to the subsidizing scheme, and that pieces of the widget are broken down into raw materials, which are used to manufacture new widgets. We argue that to understand a circular business model, understanding of the network is critical.

Finally, focus on the network can be motivated to design ecosystems where (decision) power is fairly distributed, to avoid emergence of GAFA like companies.

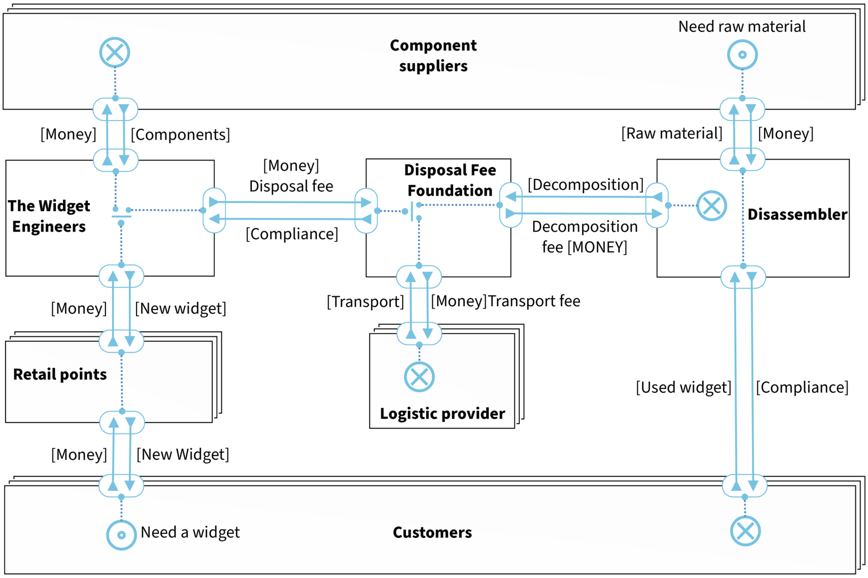

Fig. 4. A circular economy ecosystem expressed as e^3*value* model

We argue that if checks and balances are properly designed in a network of stakeholders, it is more difficult to take over and monopolize that network.

5 Digital Ecosystems: Conceptual Modeling

The notion of 'model' in 'business model' is usually not very well defined, but can be seen as some abstraction from reality, focusing on the essentials of businesses. We argue that a business model should be seen as a *conceptual* model. Conceptual modelling is the activity of formally describing some aspects of the physical and social world around us for purposes of understanding and communication [9].

There are a number of reasons why a (semi) formal description of reality is important, one of them a precise and shared understanding of that reality by all stakeholders involved. As an ecosystem implies a multi-stakeholder effort by definition creating such understanding is far from trivial. Conceptual models are then a required addition to text-only descriptions of the ecosystem at hand. However, in this paper, we want to put forward a second argument for the formalization of business models, and that is software-assisted analysis. We discuss three examples of this.

5.1 Net Value Flow Analysis

If an e^3*value* model is properly quantified, the model can be used to derive *value flow* sheets (see Table 1 for an example). Figure 5 shows an e^3*value* model where

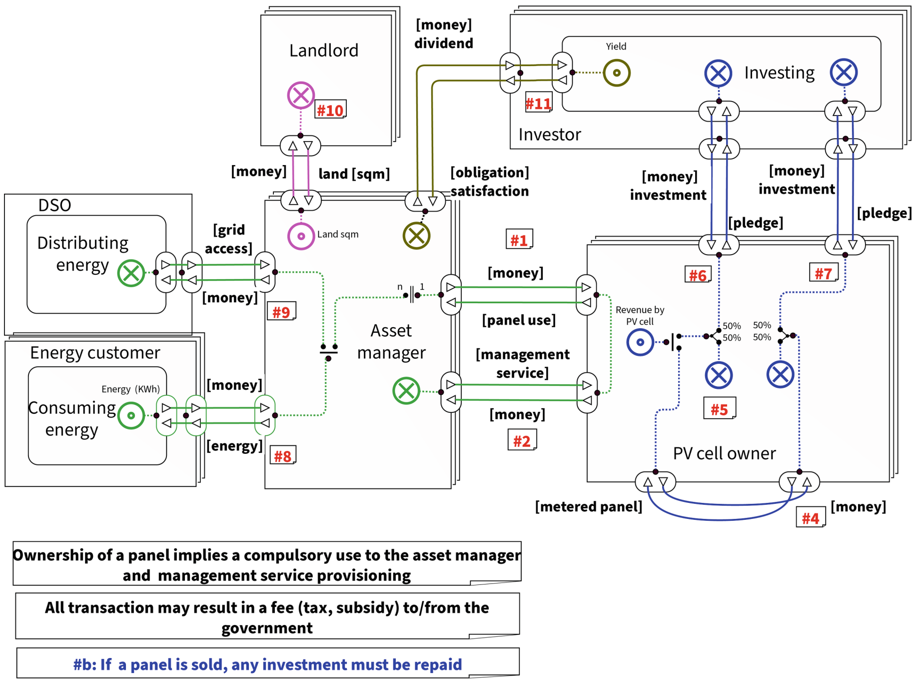

Fig. 5. e^3value model for photo-voltaic panels

people own, sell, and buy photo-voltaic cells. These cells are physically hosted by an asset manager, in a solar farm. The asset manager rents land from a land manager, often a farmer. Generated energy is sold to customers.

Table 1 shows the incoming value flows (money for use of the panel) and outgoing money flows (management service for money) for the green value path. If the e^3value is property quantified (e.g. the number of customer needs, the number of customers, and the pricing formulas for the money flows), such a value flow sheet can be automatically generated by the software tooling. This also allows to change parts of the quantification and to quickly see the effects (we call this sensitivity analysis).

Table 1. Net value flow sheet for the PV cell owner

Value Interface	Value Port	Value Transfer	Occurrences	Valuation	Economic Value	Total
Management service,MONEY			3333		−3333	
	in: Management service	(all transfers)	3333	0	0	
	out: MONEY	[money]:MONEY	3333	1	−3333	
MONEY,Panel use			3333		32167	
	in: MONEY	[money]:MONEY	33333	9.65	32167	
	out: Panel use	(all transfers)	3333	0	0	
total for actor						28833

5.2 Business Process Design

For the e^3value model in Fig. 5, it is also possible to derive a process model, such as the BPMN model in Fig. 6. Although e^3value models and BPMN models have some overlap (e.g. the actors), there are also significant differences. Consequently, it is not possible to derive BPMN models from e^3value models automatically. We consider this more as manual task, assisted by guidelines (see e.g. [11]). Moreover, a BPMN model usually exposes more operational details than the associated e^3value model. This is because the BPMN model shows how the e^3value is put into operation, e.g. how value transfers as stated in an e^3value are actually performed. Also, an e^3value model does not show a control flow, e.g. the time ordering of the value transfers, whereas a BPMN modes. This adds an additional level of detail, which can not be derived from the e^3value model.

5.3 Fraud Analysis

Another analysis possibility is fraud analysis. Normally, an e^3value describes an *ideal* world, that is a world where everyone behaves as specified by the e^3value model. An important construct is the value interface, which prescribes that *all* value ports in a value interface exchange an object of value, or *none* at all. For example, in Fig. 7, if user A buys a subscription s/he always pays for it, and vice versa. In case of business development, it is already sufficiently difficult to understand what happens if everyone behaves honestly, rather than to assume that someone may commit a fraud.

However, in reality, people commit frauds, e.g. behave in a *sub-ideal* way. For example, some value object may not be transferred at all, or may be damaged or the wrong one. Also, some value transfers may happen that are hidden for some parties in the e^3value model. Finally, parties may collude to commit a fraud (see e.g. [5,6]).

In Fig. 7 [5], a sub-ideal model is shown, which is known as revenue-sharing fraud. In brief, the revenue-sharing fraud works as follows. First, the subscription

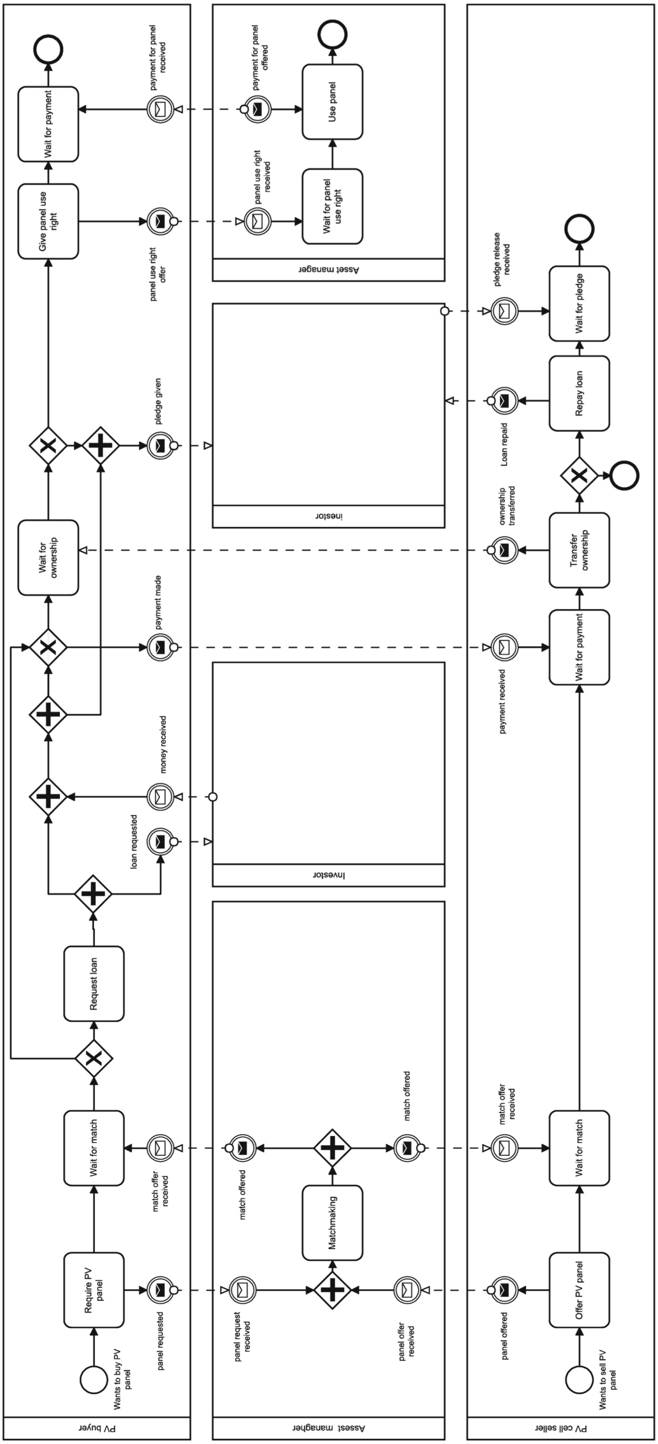

Fig. 6. BPMN model for photo-voltaic panels

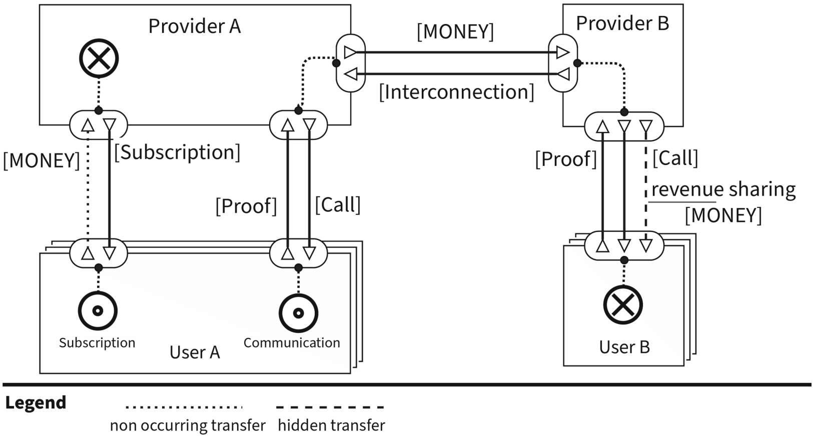

Fig. 7. Fraud in telecommunication networks

of user A is not paid for, hence the money flow is a *non-occurring* value transfer. There are several ways to accomplish this, which we do not elaborate further on. Now, suppose that user A wants to call user B, and user A has a subscription at provider A, and user B has a subscription at provider B. If user A wants to set up a call with user B, two telecommunication providers are needed. Provider A receives the call from user A, and asks provider B to interconnect, since provider B hosts user B. In telecommunication terminology, this service is called interconnection, and provider A pays provider B a fee for that service. Finally, provider B delivers the call to user B.

The fraud is that user A and user B collude, e.g. in reality are the same person. If user A calls user B many times, user B can ask provider for a revenue sharing deal, e.g. receiving part of the interconnection fee that provider B obtains from provider A. This revenue sharing deal is not visible for provider A, hence it is a hidden transfer. Moreover, because user A found a way not to pay for its subscription, provider A pays for this fraud only, via the interconnection fee.

The model in Fig. 7 can be automatically generated via software tooling [5] that uses as input an ideal e^3value model, and trust assumptions. The software tool uses heuristics about fraud, and is able to rank frauds, e.g. based on their impact on the victim.

6 Conclusions

In this paper, we argued by using a series of real life case studies that the business model should (1) consider the business *network* as the first class citizen, and (2) use a *conceptual* modelling approach.

Concerning the emphasis on the network, we observe that each ecosystem or platform is a network, as it minimally consists of a consumer and a supplier, exchanging things of economic value with each other. However, most ecosystems and platforms in practice are far more complicated than just two parties. This holds for the well-known big-tech platforms, but also for ecosystems where the (physical) network plays an important role. Examples include the electricity network, circular economy networks, and international clearing of intellectual property rights.

We also claim that business modelling is about *conceptual* modelling. The first argument is that for business development, a precise and shared understanding of the ecosystem or platform is needed. Creating an unambiguous and common representation is exactly the goal of conceptual modelling. Furthermore, (semi) formalization paves the way for automated analysis, e.g. net cash flow analysis and fraud analysis. Moreover, it can be used as point of departure for business process engineering, and the design of an ICT architecture.

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