Business Models for Open Digital Ecosystems of Trustable Assistants

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Abstract: Digital ecosystems (DEs) are self-organizing, robust and scalable environments where various stakeholders interact to solve complex problems. The idea of building digital ecosystems is not new. Thus, we can currently draw on an extensive body of literature on the topic. Although academics have addressed the technical and architectural challenges of building digital ecosystems as well as their desirability regarding innovativeness and privacy, research on how to ensure the economic viability and thus sustainability of such DEs remains scarce. In this study, we address this void in the literature and focus on the economic challenges of building open DE. We discuss this topic in the context of an open DE for trustable assistants in the Internet of Things (IoT) and vet the research question: "which are the business models an open DE must support to be economically viable?" Based on a structured research analysis we identify seven business models, which are most likely essential to the economic success of the analysed DE.

Keywords: open digital ecosystems; business models; internet of things, smart assistants, trustable assistants, stakeholders, research project

1 Introduction

Advancements in technology and artificial intelligence abet the development of a plethora of intelligent assistants (IA) such as Siri, Alexa, and Google Now. Aiming to support their user in daily activities, IAs perform an array of helpful tasks. However, no matter how sophisticated they might be, IAs are currently still far from being ingenious, proactive, and context-sensitive companions. One of the reasons is that to date; existing IAs are largely limited to the proprietary platforms of their vendors or operators. The segregation of IAs hinders the IAs' ability to combine data and services across vendors and data sources, and thus the achievement of the IAs full potential. To overcome the problems arising from proprietary operated IAs, the research project ENTOURAGE[3] is designing an open digital ecosystem (DE), which ensures interoperability across vendors and operators of IA, smart devices, smart services, and other data sources. A particular focus of the project is to enable trustable IAs that are secure, privacy-friendly, and give their users a high level of control over their data. This requires the development of open standards, technical architectures, and flexible interfaces, but also suitable business models and market mechanisms to ensure the economic sustainability of the newly formed

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ecosystem [En17]. Aligned to the concept of viable security systems [ZR12], economic viability is only one goal of ENTOURAGE. However, if ENTOURAGE is not economically viable and therefore not successful on the market, users might have no choice but to use less secure and privacy friendly solutions.

DEs and business models have received plenty of attention in practice and academia. Thus, we can build on a variety of research studies on both – business models and technical considerations of developing DEs. Previous studies discussed, for instance, non-technical challenges and prospects of DEs (e.g. [KGH16], [LBB12]), their self-organisational-, scalability-, and sustainability characteristics (e.g. [BC07], [SWK16]), architectural and technological issues related to building DEs ([BC07], [RKK10]), or lessons learned from DE related projects (e.g. [DIM11]). In addition, there is also research focusing on certain types of DEs, such as software ecosystems (e.g. [JC13], [MH13]), platform ecosystems (e.g. [SS12], [So18]) or business ecosystems (e.g.[RMK09]) – just to name a few.

Yet despite the variety of research on this topic, there exist only sparse attempts to address business models within the context of designing trustworthy and economically viable DEs. Subsequently, efforts to design such DEs (e.g., ENTOURAGE Project), have little guidance and must revert to a costly and time-consuming trial and error approach [Le12].

The goal of this study is to find a practical framework supporting practitioners in designing successful DEs by identifying the essential business models that can ensure the economic viability of DEs. We do this by employing a structured methodology that combines and translates insights from related academic work on DEs, business models, value co-creation networks, strategic management and e-business into the context of an open DE for intelligent assistants. Therefore, this study presents at first a brief overview of the open DE that ENTOURAGE is aiming to build. Then, it describes the methodology employed to perform a rigorous analysis identifying the set of business models essential for the DE's economic success. After that, it presents the results of the analysis and concludes with a discussion of the research approach and contribution.

2 Research Setting

2.1 Building an Open DE for trustable IAs in IoT

Existing IAs are currently, to a large extent, limited to the proprietary platforms of their vendors or operators. This current state of separation of IAs, platforms and other IoT objects follows vested economic interests. As manufacturers of IAs and smart devices have invested many resources into developing IAs and IoT devices, they wish to exploit the valuable user and sensor data gathered by such IAs and devices and monetize them. This segregation of proprietary systems hinders the combination of complementary data and services across vendors and data sources, and thus the achievement of the full potential of IAs. To overcome the problems arising from proprietary operated IAs, the research

project ENTOURAGE designs an open DE allowing for interoperability of IAs across vendors and operators, smart devices, smart services, and other data sources. By building such an ecosystem, the IAs will be able to receive data from different sources, aggregate it, and process – but controlled by the user. While users can control data flows as well as enjoy comprehensive and ubiquitous assistance by combining IAs from various domains and vendors, firms can draw on benefits such as market creation, market expansion or access to complementary competencies or business models [Le12].

Another essential argument promoting an open DE for IAs are privacy concerns, which arise from proprietary settings. To support their user with context relevant and useful assistance, IAs need to store and process contextual and personal information [MZH17]. Yet, the pervasive collection and evaluation of personal data by one single platform or proprietary DE raise some serious privacy concerns, which again might hinder the adoption and diffusion of IAs [MZH17]. Such concerns can be ruled out by designing a neutral, well-balanced open DE that possesses the necessary trust enhancing control mechanisms (e.g., privacy apps, which ensure IAs' compliance with the ecosystem's privacy rules). Because in an open DE none of the participants enjoys a monopoly position, and companies who participate in open an trustworthy DEs must comply with its privacy and security rules, such DEs offer users the possibility to combine several services and IAs and enjoy trustworthy ubiquitous support with high levels of privacy.

The arguments presented so far explain that building and maintaining a functional and economically successful DE for IAs can provide benefits to all parties involved. However, designing such an ecosystem remains a challenge, especially because of the dynamics such ecosystems face.

2.2 Challenges related to DE's Economic Viability

An open DE for IAs is a dynamic multi-agent environment in which the value co-creation process relies heavily on the exchange of data and services between different actors. Therefore, the ecosystem can be regarded to be a type of a multi-sided market between data providers, operators of IAs, end users, and other actors (e.g., big data analysts, platform operators, and vendors of technical devices). As the literature on multi-sided markets suggests, their success depends heavily on the successful coordination of the demand of the distinct actors who need each other in some way [Ev03]. Thus, the first step in building the appropriate economic framework for a trustworthy open is to analyse the structure of its prospective participants. Moreover, because DEs are subject to network effects and the attractiveness of the ecosystem for one group (e.g. IA operators) increases (decreases) with increasing (decreasing) numbers and activity levels of the participants of another group (e.g. data providers, end users), it is imperative to answer the question: which business models must the ecosystem accommodate so that potential participants are motivated to initially join and remain active within the open DE?

Existing economic theories suggest that potential DE participants can be motivated through appropriate incentives, which can be developed by first studying the relevant

participants and subsequently assessing their motives and business strategies. The initial analysis of the ecosystem's potential participants revealed that they could be split into two distinct groups: individuals and organizations. While the individuals refer to persons subscribing to the IAs and services provided by the ecosystem, organizations refer to entrepreneurs, corporations or other entities – usually profit driven. Per se, human motivations have been studied exhaustively in behavioural sciences (Rafaeli & Ariel, 2008), and there is a well-understood set of incentives addressing individuals. Hence, the focus of this study lies on commercial entities.

We draw on the literature on entrepreneurship (e.g. [PM06]) according to which, an entrepreneur's actions are either directly or indirectly linked to the final goal of creating profits. Hence, we postulate that prospects of profits remain the primary incentive for organizations. Further, we stress that understanding how companies make money - i.e., by examining their business models - is vital for designing an open, attractive, and ultimately economically successful DE.

2.3 Business Models Theory

In general, business models are "industry and context-dependent" [Le12], so that research on this topic has developed largely in silos. Nevertheless, existing literature presents an increasingly consistent understanding of the purpose and role of business models within an organization. As scholars agree, (1) business models articulate how businesses create and deliver customer value, and make profits; and (2) they are - as a potential source of competitive advantage - very important but not a guarantor for success.

Given the importance of business models for an organization's success, scholars proposed several taxonomies to identify and explain the business models of successful companies. One popular taxonomy is the one proposed by Gassmann, Frankenberger, and Csik [GFC13]. This taxonomy stems from a comprehensive analysis of initially 250 business models that have been implemented during the past 25 years, across various industries and business contexts. It identifies 55 core business models that combined, make up to 90% of all business models analysed. For a list of the business models this taxonomy, please refer to the Appendix. We use this taxonomy to identify the business models, which an open DE must accommodate in order to ensure its economic viability. To this end, we pursue a comprehensive four-step research approach.

3 Research Approach

Our research approach follows the insight that a successful DE must – amongst other things – be capable of accommodating all its participants' business models. It follows three logically coherent research sub-questions: (1) Who are the key participants within the ENTOURAGE ecosystem? (2) What are the business models they could employ in the

ENTOURAGE context? (3) Which business model pool must ENTOURAGE accommodate to ensure its economic success? Following these three research sub-questions, our research approach consists of the steps visualized below (Figure 2).

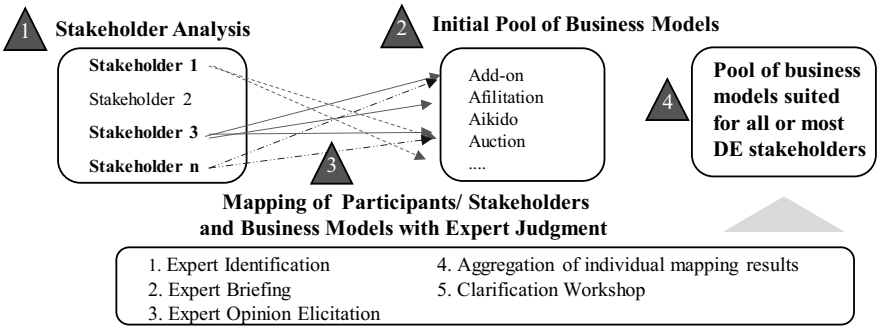

Fig. 1: Overview of the research approach adopted in this study

3.1 Stakeholder analysis

To start, we identify the business model-relevant participants in the ENTOURAGE ecosystem by conducting a stakeholder analysis. Stakeholder analysis is an established socioeconomic method successfully employed in Information Systems [Po99]. As a systematic tool, the stakeholder analysis allows researchers to generate detailed knowledge of the relevant actors within a firm, organization or network. Furthermore, it allows researchers to elicit and understand the stakeholders' business strategies, their motivations, interrelations, and their power to influence their network.

The stakeholder analysis carried out in two workshops with all partners engaged in the research project[4] revealed that the relevant active stakeholder groups within open DEs that require specific business models are: platform operators; information providers; hardware providers (i.e., multinational companies, large enterprises or small and middle-sized companies); and developers (i.e., algorithm developers, assistance developers, smart services developers).[5]

3.2 Methodology for Mapping of Business models and Stakeholders

Our analysis builds on the work by Gassmann and colleagues as an initial pool of business models. This follows our literature review that revealed the comprehensiveness of this

[4] The consortium partners all have different research as well as business priorities and (academic) background knowledge. Accordingly, the results of the stakeholder analysis unify the technical, economic, legal and data privacy as well as security perspective on ENTOURAGE.

[5] Besides those active stakeholders, others like legislators and end users are passive stakeholders for open DEs. Relevant for this work are the listed active stakeholders that require specific business models for open DEs.

taxonomy, as well as the fact that those 55 business models exhibit a high potential to be adapted and enhanced for other business contexts [GFC13].

The mapping process of business models to relevant ecosystem participants (Step 2) is based on the expert judgment methodology, which relies on the estimates of people considered experts in the area of interest [LS03]. Following the general process of standard expert judgment survey, we first selected a panel of five experts.

To avoid dependency issues arising when experts have similar backgrounds, training, or experience, we deliberately selected the experts based on their knowledge in the area of IAs, business models, knowledge of electronic markets in general. Furthermore, we made sure to select experts with different experience backgrounds (i.e., academia, practice) and various industries (e.g., automotive, consulting, research hub).

After the selection process, the panel was briefed. To avoid response bias, we ensured that the experts understand the context and the goals of the survey. We did this through a meeting in which we provided a brief recall on the ENTOURAGE ecosystem, the research question of this study, and the 55 business models by Gassmann et al. [GFC13]. The ENTOURAGE scenario was explained to the experts through a use case demonstrator. Subsequently, we explained how to use a mapping template they were required to fill in.

The mapping template ensures a structured elicitation of the experts' judgment on the topic as well as the feasibility of aggregating the experts' opinions later in the study. On the horizontal dimension, it lists the 55 business models, on the vertical dimension, the relevant participants. Experts were asked to rate each business model regarding its suitability for the relevant ecosystem participants on a scale from 0 to 2. If a business model is entirely applicable for a stakeholder, the expert should rate it with 2 points. Partial suitability is marked with 1, no suitability with 0 points (see Table 1).

Business Models *Stakeholders*	**Add-on**	**Affiliation**	**Barter**	**Cross-Selling**	**Crowd-funding**	**…**
Stakeholder 1	2	0	0	…	…	…
Stakeholder 2	1	1	2	…	…	…
…	…	…	…	…	…	…

Tab. 1: Exemplary template for ranking the business models for stakeholder-suitability

After the briefing stage, the experts were asked to provide their ranking based on their experience, to their best knowledge, in accordance with the methodology explained during the briefing and within two weeks. After receiving the rankings of all five experts, we analysed their opinions, noted all opinion discrepancies and conducted a clarification workshop. The goal of the workshop was to clarify discrepancies and discuss the preliminary results. The deliverable compiled in this meeting was the final aggregated mapping of business models and relevant stakeholders: a pool of business models with high relevance for the ecosystem's economic success.

Keeping in mind that the ecosystem's stakeholders actually pursue not only one but several business models, the ecosystem's potential to accommodate all its participants' business models might involve high expenses. Under the premise of limited resources to building DEs, it is important to take a holistic perspective on the matter and identify the business models pursued by the majority of ecosystem participants. In line with this notion, the analysis results elaborate the set of business models suited to the majority of the ecosystem's stakeholders.

4 Analysis Results

Table 2 (next page) lists the 55 business models in the order resulting from the expert judgment survey. The results let us distinguish three groups of business models.

We consider the **first group** to contain the fundamental business models for open DEs like ENTOURAGE. Without distinguishing between specific stakeholders, they might be regarded as a good starting point for creating an economically viable open DE. As they were all rated with the maximum score, we list these seven business models in alphabetical order and discuss them in the context of open DEs:

In the '*add-on'* business model the core offering is priced competitively, while the value is generated through sales of additional offerings [GFC13]. This strategy helps participants in open DE to attract customers and encourage them to use the ecosystem through low initial participation costs. As the DE is subject to network effects this is particularly important in its early launch phase where it is vital to success to reach a critical mass of customers within a short period of time. Once the customers are participating in the ecosystem and benefit from its advantages, they might be more willing to invest into add-on features and services, which in turn will generate significant revenue for the ecosystem's participants on the offering side.

The '*affiliation'* business model is very well suited for an open DE, as different ecosystem participants profit from each other, building up a symbiotic relationship. In this business model, one participant focuses on supporting others in selling their products or services. From its ecosystem partner, the affiliate receives some compensation for invoking transactions for him [GFC13]. Even if an ecosystem participant cannot profit directly or only to a limited degree from interacting with his customers, it, at least profits from other ecosystem partners' revenues. In other words, an ecosystem stakeholder selling not its own but the products or services of another affiliated partner(s) can benefit from the performed transaction(s) by raking in a commission for each transaction he enabled.

In the '*freemium'* business model a basic version of the core offering is given away for a price of zero. This strategy aims at attracting many customers into the ecosystem. Within this business model, the revenue is generated by the customers who are willing to pay for an extended version of the core offering or to receive additional features or services [GFC13]. In fact, the freemium business model pursues a similar idea as the 'add-on'

business model and is as well an excellent DE launch strategy. However, compared to the 'add-on' business model, the freemium business model is well suited for ecosystem stakeholders that have either very low or zero marginal costs for production or replication of their product or service.

Business Models Group 1	
1*	Add-on
2*	Affiliation
3*	Freemium
4*	Hidden Revenue
5*	Leverage Customer Data
6*	Open Business Model
7*	Revenue Sharing
Business Models Group 2	
8	Customer Loyalty
9	Make More of it
10	Orchestrator
11	White Label
12	Barter
13	Cross-Selling
14	Layer Player
15	Direct Selling
16	Ingredient Branding
17	Crowd-Funding
18	License
19	Experience Selling
20	Mass Customization
21	Crowd-Sourcing
22	Lock-in
23	Pay per Use
24	Solution Provider
25	Auction
26	Two-Sided Market
27	Digitalization
28	Supermarket
29	Open Source
30	Robin Hood
31	Flat Rate
32	Long Tail
33	Peer-to-Peer
34	Shop-in-Shop
Business Models Group 3	
35×	Aikido
36×	Cash Machine
37×	E-Commerce
38×	Fractionalized Ownership
39×	Franchising
40×	From Push-to-Pull
41×	Guaranteed Availability
42×	Integrator
43×	No Frills
44×	Pay What You Want
45×	Performance-based Contracting
46×	Razor and Blade
47×	Rent Instead of Buy
48×	Reverse Engineering
49×	Reverse Innovation
50×	Self-Service
51×	Subscription
52×	Target the Poor
53×	Trash-to-Cash
54×	Ultimate Luxury
55×	User Designed
	* (full score) and × (score of zero) in alphabetic order

Tab. 2: 55 business models [GFC13]; ranking based on the expert judgment survey considering suitability for preselected open DE stakeholders

Another popular business model amongst the analysed ecosystem participants is '*hidden revenue*'. Similar to the 'affiliation' business model, this business model is based on the idea that third parties cross-finance the free or low-priced offerings that attract customers

to the ecosystem. Thus, the ecosystem partner attracting users is not required to generate direct revenue from its users. Instead, another ecosystem partner who is profiting from a growing network of users and other participants will reimburse the ecosystem partner attracting the users. In this business model, the stakeholder activities such as generation of revenue and increasing the customer base are separated. A common example of the hidden revenue business model in practice is financing through advertisement [GFC13]. Further, it is noteworthy, that this business model is especially convenient for providers of offerings, which are valuable to the ecosystem as a whole, but for which the users display only a low willingness to pay.

The '*leverage customer data*' business model monetizes customer data for the company's interests. To be more specific, this business model envisions using the private data of its customers to optimize processes or create better offers for users with a high potential future customer value. Alternatively, this business model also allows that revenue is generated from directly selling customer data to third parties [GFC13]. The latter is particularly interesting in an open DE, which on the one hand facilitates the interaction between ecosystem participants and potential third parties buying customer data, but is, on the other hand, sensitive to any potential violations of the users' privacy. Mainly due to the new European General Data Protection Regulation (GDPR) business models based on the analysis and sale of customer data might have to be scrutinized more closely.

The creation of value in the '*open business model*' substantiates on collaborating with other participants in the ecosystem. To open and extend the business, the ecosystem participants develop new ways of working together [GFC13]. At its core, this business model emphasizes the need to search for new collaborative ways to generate value through openness as opposed to protecting closed, proprietary platforms and businesses. Within this business model companies do not follow monolithic product development, production and diffusion processes, but rather share the mentioned business process steps with various partners. For instance, if a DE stakeholder develops a novel product idea, it can allow a specialized partner to produce the innovative product cheaper and faster than otherwise. Further, it can allow another specific company to bring the final product to the market. Within this business model, the stakeholder who developed the innovative product idea profits from either selling the original, innovative product idea or by giving the ideas to others free but with sales commissions for every product sold.

Finally, the '*revenue sharing*' business model envisions that partners form a symbiotic relationship make profits through extending the value creation across partners. Arising profits are then shared among the stakeholders involved. These stakeholders can include strategic partners or even rivals [GFC13]. This scenario goes in line with the understanding of an open DE, which encompasses competing actors who all profit from a growing network offering and a greater variety of products and services.

In addition to this group of business models, the **second group** identified, entails 27 business models, which are only partially suited for open DEs. The business models within this group were (a) either judged by the experts as suitable for specific stakeholders but unsuitable for others, (b) or have been rated by all experts only as partially ideal for the

ecosystem's stakeholders or (c) have been rated by the experts with varying scores for various stakeholders. Anyhow, a detailed analysis of these business models will follow, as it would exceed the scope of this study. For a detailed view, please refer to Table 2, where the 27 Business models appertaining to this group are ranked according to their score.

Finally, the **third group** identified consist of the remaining 21 business models, which were rated by all experts as unsuitable for the DE at hand.

5 Discussion

The goal of this study was to identify the business models an open DE's must accommodate in order to ensure its economic viability. To this end, we conducted a comprehensive analysis and identified a set of seven business models that are particularly important for the success of the DE. A careful consideration of these seven business models reveals that they can be classified in two groups: The first group, consisting of the 'add-on' and 'freemium' are business models that focus on quickly growing the customer basis to the necessary critical mass of the DE. These business models are attracting masses of users by providing the basic version of the core offering for a very low price or even for free, while the revenue is generated through additional or premium offerings. The second group comprising the 'affiliation', 'hidden revenue', 'open' and 'revenue sharing' business models focus on the symbiotic nature of open DEs. Within this group of business models revenue is not generated directly from customers but rather produced and shared among ecosystem participants. Finally, we note that the business model 'leveraging customer data' partly fits into both groups: offerings are priced competitively or free of charge, while the customer data is either used to offer tailored premium services or sold to other ecosystem participants.

In addition to the seven fundamental business models fitting all the business relevant stakeholders of the ecosystem, our study identifies an additional set of 27 business models, which are only partially suited for open DEs. Though not valuable at first sight, this information is of high practical relevance, as amongst these 27 business models, there are some, which are suitable for a particular stakeholder group but not applicable to other stakeholder groups. Considering that ecosystem imbalances can cause adverse network effects on the ecosystem, the knowledge about which business models are suitable for specific stakeholders but not to others can be vital to the ecosystem's survival. Further, it can be a tool to re-establish the ecosystem's stakeholder balance. Assuming that, for instance, hardware providers are underrepresented in the ecosystem, and thus the utility of the ecosystem for the user group is diminished, users might start to leave the ecosystem. This, in turn, will begin a negative feedback loop where many other stakeholders might abandon the ecosystem. To stop such adverse network effects, ecosystem designers must avert imbalances within stakeholder groups. One potential way to prevent such imbalances is to enable the ecosystem to accommodate and support the business models suitable for

the underrepresented stakeholder group, and to luring them this way into the ecosystem, and ultimately re-establish the vital stakeholder balance.

In sum, it is noteworthy that the results presented in this paper are ultimately based on the open DE the ENTOURAGE research project is aiming to build. Nevertheless, we are convinced of the practicability and replicability of this study in the context of similar endeavours. Thus, we invite fellow academics to address the topic of the economic viability of open DEs from perspectives previously unconsidered and extend this study by validating the business models identified in this study against a set of real-life use cases from the open DE in question. Further, being well aware of the controversy and scepticism towards the use of expert judgment in academia, we argue that for the research question at hand, no other framework or method proposed by the literature would have been suitable. Thus, we suggest that for the extension of this study researchers should again consider employing the expert-judgment method and ask a selected panel of experts to rate distinct business models in the context of various DE real-life scenarios.

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