Extraction Mechanisms in Digital Business Models

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***Abstract*—Digital business models contain technology-enabled perverse incentives that may result in an extractive economy, in which one dominant player obtains so much value from other players that most of them can barely survive. We identify five mechanisms enabled by digital technology that can be used to implement an extractive business model, illustrated with examples. Next, we propose a design approach to digital business modeling that prevents these mechanisms. We illustrate our design approach with an example in the music sector.**

***Index Terms*—Digital business models, e^3value , governance design, digital business ecosystems**

I. Introduction

Digital business models contain perverse incentives that enable value extraction at scale. For example, sellers on Amazon Marketplace complain of the high cost of selling [1], which is created by Amazon's control of the product search function, payment function, and advertising function of the marketplace, and by the information advantage given to Amazon Retail to compete with third-party sellers on Amazon Marketplace.

Similarly, Uber drivers complain about Uber's high take rate, while their income is barely enough to make a living. This is enabled by algorithms for dynamic pricing and dynamic wage determination [2].

We define an **extractive business model** as a model in which one party extracts a price for a good or service that satisfies a customer's need, where the price is derived from its control of the good or service, in the (near-)absence of competition [3]. The extracted price is added to the fair economic value of the good or services for customers. Economists call this markup "rent", meaning rewards over and above those justified by the requirements of an efficient economy [4].

In the case of Amazon, its Marketplace gives exclusive access to a global consumer market, and there is no competing service that provides this access on that scale. Third party sellers pay a high price to get access to this market in the form of transaction fees, payment for placement of their product in search results, advertising fees, fees for logistics, Amazon's enforcement of low pricing, and competition from Amazon Retail which is accused of accessing sales data of all its competitors on Marketplace [5, page 202].

In the case of Uber, the platform provides drivers and riders exclusive access to each other. The platform has used venture funding for decades to undercut prices of competing taxi services, driving them out of business [6]. In the resulting near-monopoly, its matching algorithms set prices and wages at extractive levels [2].

An extractive business model does not necessarily generate a profit for the extractor immediately. Amazon and Uber have been loss-giving for years. This is because value extraction is often preceded by substantial investments to build a near-monopoly position, e.g. by offering products and services for a substantially lower price than competitors, thereby destroying competition. Some business models never get profitable, for anyone, due to this race to the bottom.

Extractive business models have been around for as long as there were customers who were captive. Musicians have been complaining for more than 50 years that record labels extract so much value from their music that they, the musicians, cannot make a living from their recordings [7]. Yet, beginning artists had few other options other than contracting with a record company. And landowners have been extracting money from tenants throughout history, who usually had no options to move elsewhere.

But digital business models are special, because they contain mechanisms that enable value extraction at a scale never seen before in history. Amazon Marketplace has millions of sellers globally [8]. Uber operates in over 10 000 cities [9].

Digital business models are not necessarily extractive. Extraction is a design choice enabled, but not enforced, by digital technology. In this paper we investigate what it is about digital technology that enables this choice. We identify five digital extraction mechanisms enabled by digital technology. Using these mechanisms, a business can create a situation of monopoly in which it can extract rents from its customers for a service they cannot afford to miss.

Second, we investigate how these extraction patterns can be avoided when designing a digital business model. Legislation like the European Digital markets Act (DMA) have declared many extraction patterns in the digital economy illegal. The path to enforcing the Act and eliminating the extraction patterns is long and arduous. However, our goal in this paper is different: How can we *design* non-extractive digital business models upfront, before they are put into operation? Our goal is to avoid extraction mechanisms in new business models, not to eliminate them from existing, implemented ones.

Hence, in this paper we ask two research questions:

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- What mechanisms in digital business models enable extraction?
- How can we design business models to avoid these mechanisms?

We review existing work in the next section. Section III identifies five patterns of digital value extraction. Section IV introduces the concepts to define our design approach, and presents the approach. Section V illustrates our approach with a real-life example. The example business model is about a new ecosystem in the music sector, which is currently under design by us. We discuss further work in section VI.

II. Related work

Three important investigations of extractive business models in the digital economy are (1) an investigation by USA Congress [1], (2) a study of the UK Competition and Markets Authority of the business model of ad-funded digital platforms [10], and (3) a report by the European Commission on competition policy for the digital economy [11].

These studies take an economic and legal point of view but do not analyze the core digital mechanisms that enable extraction. They prepare for legislation that will *prohibit* currently existing unfair exploitation mechanisms in the digital economy and ignore the design point of view that we take.

Rebecca Giblin and Cory Doctorow analyze extraction mechanisms in the music industry and point at what they call chokepoints in value networks as the culprit [7]. A chokepoint is a single node in a value network that lies on the path connecting buyers and sellers. A chokepoint is a monopoly, a single seller of something buyers want to buy, or a monopsony, a single buyer of something sellers want to sell.

Doctorow explains chokepoints in terms of non-interoperability, the property of product or service that they only work with products of a single manufacturer or provider [12]. Chokepoints enforce non-interoperability enforced by technical incompatibility as well as by a web of legal intellectual property restrictions. Doctorow's wants to eliminate currently existing extractive digital business models by reverse engineering the interfaces to create competitive alternative services. This includes claiming back the right to repair a device manufacturered by someone else. In this paper we identify several mechanisms in addition to non-interoperability, which can be used during business ecosystem design.

Value networks with chokepoints and extractive business models that exploit them lead to unhealthy ecosystems. Reeves and Pidun [13] provide a useful set of criteria to assess ecosystems health, but do not relate ecosystem health to the concept of (non)extractive business model. They also provide a useful catalog of ecosystem governance decisions, but do not indicate which decisions need to be made to design a non-extractive ecosystem.

We conclude that there is room for a technical analysis of digital extraction mechanisms and a design approach to digital business models for new ecosystems that avoids these mechanisms.

The concept of extractive business model corresponds to what economists call "rentier capitalism", an economic organization in which an economic entity earns revenue by virtue of *owning* an asset rather than *creating* an asset. Our definition of an extractive business model is taken from Christophers' definition of rent [3]. We will see that extractive digital business models are based, among others, on ownership claims of data, profiles, access, and interfaces.

This paper builds on our earlier work on digital business ecosystems [14]. We consider digital business models always as *networks* of organizations (e.g companies) and end-users (e.g. customers), which make up a business ecosystem. We will therefore interchangeably speak of extractive business model and of extractive business ecosystems. We give precise definitions in section IV.

III. Digitally enabled extraction mechanisms

Extractive digital business models are based on one or both of two fundamental properties of software technology:

- *Zero marginal cost of reproduction and distribution.* This is the economists term for the fact that one additional unit of software (or any other digital content) can be copied without loss, and can be distributed over the internet at (nearly) zero cost.
- *Universality.* Computers are universal machines: They can execute any valid (and terminating) program. Similarly, a Turing-complete programming language can execute any terminating algorithm.

These two properties are supplemented by two phenomena in the digital economy that do not derive from software properties but that have contributed to extractive business models: (1) lavish technology funding which made storing, processing and analyzing large data volumes possible, and (2) a legal environment where property, copyright, patent and trademark law are interpreted in favor of tech companies [12]. We mention this where it is relevant below.

Revisiting our definition of "extractive business model" in section I, we break it down into three elements that all should be present in order to do value extraction:

1) customers attach value to an asset (a good or service),
2) the extractor has exclusive control of the asset and
3) there is (almost) no competition.

The value attached by a customer to an asset (1) may derive from customer goals and needs, or may derive from hype and collective delusion.

Control over an asset (2) may derive from legal and technical sources, such as property law and technical knowledge.

Absence of competition (3) can be realized by acquiring or eliminating all but very few competitors (e.g. by price reduction, forcing competitors out of business), or by increasing the cost for customers to switch to a competitor (the so-called switching costs). A situation where there are only two or three providers of an asset is considered a (near) monopoly. And a situation in which there are more competitors, but switching costs are far above what customers are willing or able to pay, is effectively an absence of competition.

We will now discuss five ways to do value extraction, including their possible mitigation (**M**s).

A. Scalable, proprietary data collection

In theory, one of the promises of the digital economy is to remove switching costs. In other words, a customer should be able to switch to another supplier with hardly any costs to do so. This holds for a number of ecosystems, including telecommunication and energy, which is usually heavily regulated by the government.

However, in many other sectors, companies artificially raise switching costs substantially by treating collected data as a proprietary resource. And because data is collected at near-zero marginal cost, it can be built up at scale. Data collection companies argue that the data is theirs, because they collected it, and that customers cannot take it with them when switching to another provider. This creates a switching cost for customers, rather than taking it away. This is an extraction mechanism.

For example, users who create their own playlist in Spotify will lose it when moving to another streaming provider, which increases the cost of switching to another streaming provider. Similar switching barriers have been created on social networks (users lose their friends list when switching platforms), game platforms (users lose the history of gaming on the platform) and other digital service providers.

The legal presumption of this mechanism is that data created by the customer is owned by the digital service provider. This is easy to realize by moving customer data to a jurisdiction where they have no obligation to hand over this data to the data creators, their customers.

M1. One way to prevent this mechanism when designing a non-extractive business model for an ecosystem is, then, to agree among the stakeholders that data is owned by its creator, in this case the customer, via legal contracts.

B. Scalable, opaque profiling

In the digital world, data collection is scalable to any size which, using machine learning, can be used to create a customer profile based on earlier customer interactions, and on interactions with similar customers. Because of the low marginal costs of data collection, and also because of lavish funding of computing power, profiling based on machine learning is economically scalable.

One way profiles can be used commercially is to *personalize services,* which increases switching costs if the customer cannot take their profile to a competitor. For example, Spotify creates personalized playlists based on the listening behavior of a user and of others similar to the user, and the user cannot take their personalization to a competing streaming provider.

This is different from the impossibility to take your unprocessed personal data, such as playlist you entered, to a competing provider. The provider spent computational resources to create profiles and similarity relations, which provides justification for the claim that the profiles are their property.

Data collection about people for profiling them creates legal and political problems regarding privacy and control of indivduals [15]. Here we want to focus on a different problem, namely how it contributes to an extractive business model. The problem is that profiling and the services based on it is *opaque*. There is no way to inspect the quality of the profiles. Because personalization is perceived by the customer as valuable, losing it when switching to a competitor increases expected switching cost. So it is a mechanism of extraction.

This is more pronounced in the second way profiles can be used commercially: personalized matching on a platform. Take targeted advertising, a service offered to advertisers by Alphabet (the owner of Google) and Meta (the owner of Facebook). Alphabet and Meta have a monopoly on ad matching markets, in which they match targeted advertisements to the profiles they have of readers of web pages [16].

The targeted advertising market is exceedingly opaque [10]. The little evidence we have suggests that in many cases targeted advertising using profiles does not perform better than random targeting [17]. In 2020, Procter & Gamble slashed $200M from its digital advertising budget and reported a 10% *increase* in reach [18]. Some authors compared targeted advertising to the subprime mortgage crisis, predicting a subprime attention crisis [19].

In this as well as other online profile-based markets, opacity is a business model [20]. Marketplaces (Alphabet and Meta in this case) create fees for profile-based matching of which the value for customers (advertisers in this case) may be much lower than the marketplaces make them believe. This is an extraction mechanism because profile-based marketplaces control access to an asset (in this case user attention) on which they have a monopoly, and which customers (advertisers) want.

M2. For the design of a new, non-extracting, value network that contains a profiling service (which itself is a business model design choice), we must ensure that the service is transparent to all stakeholders, using independent auditing.

C. Programmed non-interoperability

Another way to increase switching cost is to make digital services non-interoperable. Because computers are universal machines, non-interoperability is a lot easier to realize in the software world than in the physical world. The manufacturer and developer can design the software to be non-interoperable with all rivals.

For example, by embedding software in printers, HP can ensure that its printers only reliably operate with HP cartridges, and refuse other cartridges. This is an arms race, as other manufacturers can reverse engineer the HP cartridge interface and sell clones. HP can respond legally (copyright infringement) or technically (change the algorithm that verifies cartridges), and distribute it in a software update. This an extraction mechanism as HP has made its ink nearly two times more expensive whiskey [21] than the competition.

Another example is that today's messaging apps are not interoperable. Users who would switch to another app would lose the ability to communicate with friends who stayed on

the old app. In the case of ad-funded apps, preventing users to switch to another app keeps the asset (user attention) under control of the app provider and enables extraction of additional value from advertisers.

M3. The EU's DMA intends to end this in the existing app ecosystem [22]. To prevent unfair exploitation of non-interoperability in *new* value networks, rules need to be designed that enforce interconnection standards in the ecosystem. These rules concern an ecosystem of competitors, which means they need to be enforced by an independent ecosystem governance entity.

D. Scalable network effects

A network effect is the phenomenon that the value of a product or service depends on the number of users of the product or service. The effect can be positive or negative. Increasing the number of users of a social network increases its value for users, because there are more people to talk with. Increasing the number of sellers on a marketplace increases the value of the marketplace for buyers but tends to decrease the value for sellers. Increasing the number of cars on a road decreases the value of the road for drivers, because there will be more traffic jams.

The special thing about network effects in the digital world is that they are infinitely scalable. For example, online marketplaces can scale to any number of sellers and buyers; but a physical shopping mall can host a maximum number of sellers and buyers. A shopping mall experiences a positive network effect but this does not scale beyond a physical limit.

If a physical service depends on a digital service, then the inherent scalability of the digital service does not help scaling up the physical service. Uber can match any number of rider requests with any number of drivers. That part of its service is infinitely scalable. But a taxi service is a physical service. The number of taxi drivers in a city is not infinitely scalable because physically, available space is finite. In addition, beyond a certain number of drivers in a city, adding more does not noticeably improve the time riders have to wait for a ride. So the scalability of Uber's service in each city is limited.

In the digital economy, digital platforms experiences infinitely scalable positive network effects. A platform is a service that connects two or more market segments as an intermediary. Marketplaces connect buyers and sellers, ride hailing apps connect riders and drivers, and social network connect readers and writers of posts, which are the same people in different roles. Ad-funded social network connect a third side, advertisers, who show their ads to readers of content.

Positive network effects at scale can lead to an extractive business model because they can force nearly all competitors to a platform out of the market. Facebook and Uber grew this way.

Positive network effects are not restricted to software platforms, but the scale they can achieve is. Investors hope to fund starting platforms so that they reach a tipping point, a market size beyond which users on one side attract users on another side, in a positive feedback loop. Until they reach their tipping point, platforms are usually loss-giving because they need to subsidize all sides in order to attract users [23]. For example, when it started, Uber guaranteed a minimum income to drivers and gave credit points to riders who could not find a ride [6].

But reaching a tipping point is not sufficient for a platform to generate positive revenue. Uber was loss-giving until 2023, long after it had reached its tipping point. It is likely that its profit has been achieved by extreme value extraction from riders and drivers [2]. This is an extractive revenue model, which we want to avoid.

M4. Eliminating extraction from an existing value network requires complicated legal action, such as the EU Digital Market Act [22], which are costly and time-consuming to develop and enforce. The solution idea to prevent chokepoint mechanisms in *new* value networks is to design a collaborative governance structure for networks that prevents power to accumulate in chokepoints.

E. Cross-layer competition

Layering is a basic architecture structuring technique that we see in almost all digital systems of any size. Figure 1 shows the layered architecture of Android with ride hailing apps running on top.

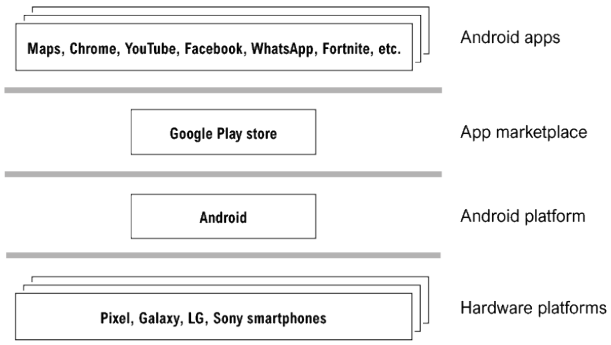

Fig. 1. Layered software architecture.

We can refine this picture to show more detail, but as illustration this suffices. The lowest layer is hardware, but all higher layers are software. This is a characteristic feature of software, due to the fact that computers and programming languages are universal: Software layers can be stacked, with lower layers providing services to higher layers. Android provides services to the Play Store and the apps; the Play Store provides services to apps.

A layered architecture for the *digital systems* that make up a service, defines a layered architecture in the ecosystem of *economic entities* that own these systems. The ecosystem stack corresponding to the digital stack in figure 1 is shown in figure 2.

The diagram shows a vertical integration of Google that gives it a powerful position over its competitors. The core Android operating system is open source, but most device manufacturers bundle this with software owned by Google, for which they have to obtain a license, including Google Search,

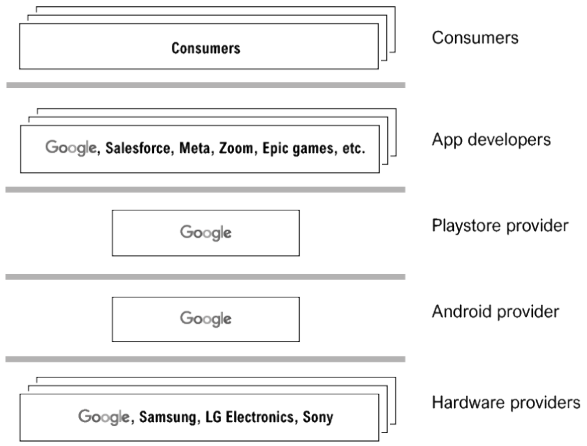

Fig. 2. Layered ecosystem architecture.

Google Music, Google Calendar, Google Play Store and other Google services, including payment services. Google demands shortcuts to these apps on or near the main home screen. It competes with other apps in the app store that provide these services, from a position of unfair advantage.

Device manufacturers who only install the Google Play Store and no other app store, receive a larger share of search revenue than manufacturers who do install another app store. This provides an incentive for manufacturers to install the Play Store as the only app store on their devices.

This means that Google operates a marketplace for apps, the Playstore, where users can buy and download apps, and requests its own apps to be pre-installed, default, non–removable and visible on the home screen. All payments for these apps, and all in-app payments during the entire lifetime of the app, must use Google payment services. Google takes a percentage of any payment during the lifetime of the app.

This pattern is widespread in the digital economy. Amazon marketplace hosts third-party sellers, as well as Amazon Retail and handles all payments in the Marketplace, asking a transaction fee. Amazon (Retail) thus competes with its (Marketplace) customers.

Google and Facebook operate ad marketplaces where content publishers can sell empty space to advertisers, but they are content publishers themselves too.

The general pattern is that the owner of some marketplace demands to handle all transactions on the marketplace, asks a fee for this, and also owns one of the entities trading on the marketplace. Other manifestations of this pattern are the enforcement, by a platform owner, of the placement of its own apps as defaults on a home screen and self-preferencing in product search.

The core problem in this pattern is cross-layer ownership of economic entities, so that the platform owner can compete with its customers (app developers, competing sellers, advertisers). This is similar to a shopping mall owner who owns a shop in the mall, owns and operates all the cash registers in the mall, asks a fee for doing the transactions, and competes with all other shops in the mall. In the physical economy this is simply prohibited.

M5. When designing a new value network, cross-layer ownership should be prohibited. Or, in case it can not be avoided, it should be subject to governance in which not only the layer owner is involved, but also other actors participating at the same layer (or adjacent layers).

IV. Collaborative ecosystem design

We need a few definitions of terms that until now we have left undefined.

A. Definitions

A **business ecosystem** is a set of economic entities that depend on each other for their economic survival and well-being [14]. Examples are the ride hailing ecosystem, the online marketplace ecosystem, and the social networking ecosystem.

The economic entities in an ecosystem are natural or legal persons responsible for their own economic survival and well-being, and include enterprises, consumers, non-profits, and even government institutions.

All business ecosystems consist of several networks, one of which is a **value network,** which we define as a network of economic entities that exchange value objects with each other. **Value objects,** in turn, are objects of economic value, such as products, services or outcomes of consuming services.

A value network is important to analyze value extraction in business ecosystems, because the subject of a value network *is* the creation, distribution, and consumption of valuable products or services. As such, a correct, and preferably quantified, value network should expose the result of value extraction behaviour. However, it tells nothing about how the value network emerged, and who controls the value network. We have made many business models of value networks to prove that they exhibit significant value extraction behaviour. However, such a model does not tell how extraction became possible. For this, we need another construct, the **governance network**, which we define as a network of entities in the ecosystem that try to influence the direction in which the ecosystem evolves. Examples of entities in the governance network of an ecosystem are law-givers, regulators, standardization bodies, lobby organizations, labor unions, stakeholder groups, as well as PR entities who try to influence the perception of the ecosystem by stakeholders, by distributing messages on online and offline media.

Many of the entities in a value network may also participate in the governance network of an ecosystem, because they all want to influence the direction of evolution of the ecosystem, even though different stakeholders may push in different directions.

Designing a value network is by definition a governance activity, because the design activity is an attempt to influence the direction of evolution of one part of an ecosystem, namely its value network. Unlike physical systems, business ecosystems contain stakeholders who may join or oppose the design activity. Some stakeholders may think that the design is ready

to be implemented, others may disagree, resulting in a never-ending ecosystem design process, that is part of its governance.

The final concept to introduce is that of a business model of a value network. The **business model** of a value network is a conceptual model of the way in which the network creates, delivers and captures value. This agrees with the standard definition of business models [24] except that we look at business models of a *value network* rather than of one *economic entity* in the network. The ride hailing business model shows how a network of drivers and platforms deliver value to riders; the online marketplace business model shows how a network of sellers, payment providers, logistics companies, advertisers, and marketplaces provide value to consumers.

Business ecosystem design consists of the design of a business model for its value network and of rules for its governance network. Design decisions can be made in such a way that the business model is extractive. Our goal is the opposite, to identify the design decisions that result in a non-extractive business model.

B. Non-extractive business model design

We proposed an approach to business ecosystem design earlier, emphasizing ecosystem architecture [25]. Later we restructured this approach to something we call the **business model wheel** (figure 3) [14]. We here summarize it here.

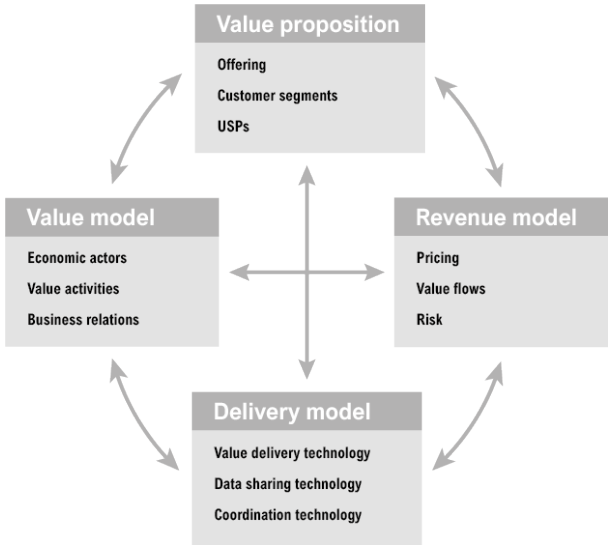

Fig. 3. The business model wheel.

In the business model wheel, business model design consist of four activities.

- **Value proposition design.** What are the customer market segments? What does the network offer to them and what are the unique selling points for each segment?
- **Value model.** Who participates in the network, what value do they contribute (value activities) and what legal relations do they have?
- **Revenue model.** What value objects are transferred among network participants? What are their prices? What are the risks that a participant cannot generate their expected revenue?
- **Delivery model.** What is the operating model of delivering value to the customer? How do network participants coordinate their activities? What data is passed around? What technology investments are needed?

Any networked business model requires these decisions. In extractive business model design processes, these decisions are made by one party (often implicitly), optimizing its own growth and, after growth has been achieved, profit [26]. In non-extractive business model design, these decisions must be made collaboratively, to properly reflect the interests of each stakeholder involved.

C. Non-extractive governance design

A non-extractive business model requires non-extractive governance of the value network at hand. This is the task of the governance network. Note that the above also applies to governance of the governance network itself (called meta-governance, [27]). The business model of a value network shows the *effects* of value extractive behaviour, *caused* by (lack of) governance that enables such behaviour.

An important task of the governance network is to decide about the business model of that value network. How can these business model decisions be made to prevent extractive business models to arise? To this end, and to avoid the extraction mechanisms listed in section III, we propose a number of design rules (**DR**s), amongst others based on the earlier identified mitigation. Not coincidentally, most of the design rules follow recent legislation of the EU, specifically the Digital Market act (DMA) and the Digital Services act (DSA).

- *Collaboration.* In extractive business models, design decisions are made by one party, optimizing its own growth and, after growth has been achieved, profit [26]. In a **collaborative** ecosystem design process, the business model of its value network is shared and agreed upon by all participants of the network. There should not be a misunderstanding among participants about what value is created by the network, how it is delivered, and how participants generate revenue from this, even though the financial information in the model, such as pricing, revenue per participant and expenses of participants are confidential. If we omit quantitative information, the remaining model is qualitative, does not contain secrets, and should be shared and agreed upon by all participants of the network.
  Once they agree on the qualitative network, each participant can assess their own expected economic survival and well-being in the network by doing financial simulations. In other words, all participants share a conceptual model of the network, and every participant will be able to make a reasoned assessment of the chance of generating positive and sufficient revenue from participating in the network to survive and thrive.

In extractive business model design, one participant designs a network so that it can scale up and eventually make a profit, even though others can barely survive. In collaborative business model design, all participants aim not only to survive, but also to thrive.

DR1. Non-extractive business models require collaborative design and governance.

- *Continuous process.* Ecosystem design is a never-ending activity. A collaborative decision structure should be designed that prevents exploitation of this power to the detriment of other participants. If the value network grows to a size that would generate outsize profits for one participant, for example for the platform on which it is based, giving this participant the ability to acquire outsize power, then this decision structure can be used to prevent extractive exploitation of this power.

  More generally, the estimations of participants may be based on incorrect assumptions, or assumptions that will become invalid after a while. Then the design may have to be adapted, collaboratively.

  DR2. Ecosystem design, including the value- and governance network is a continuous process.
- *Entering and leaving the value- and governance network.* In value extraction networks it is expensive for competitors to enter the network. Often, this is achieved by designing a value proposition that requires very high investments and low variable expenses for the service provider. Leaving the network, specifically for customer, is difficult due to high switching costs.

  We assume that each participant should have the choice to enter or to withdraw from the design if they choose to do so. This limits the applicability of collaborative design to situations where economically independent entities collaborate to design a value network. Situations where participants have no choice but to participate, are not collaborative.

  DR3. Barriers to enter and leave the value- and governance network should kept low.
- *Data collection and ownership.* To prevent proprietary data collection, the designers need to agree that data is owned by its creator. A grey area is here a party that enriches data of others. For example, this discussion is visible in the music sector where new content is created based on existing recordings using machine learning techniques

  In order to prevent value extraction, users should be able to take the data they entered with them, for example when they move to another service provider. See also M1.

  DR4. Data should be owned by its creator.
- *Scalable profiling.* If the designed value network contains a profiling service, we must at least ensure that the service is transparent to all stakeholders, using independent auditing. In the current practice, this is often solved by regulation, e.g. the General Data Protection Regulation (GDPR) of the EU. See also M2.

  DR5. Profiling should be transparent and auditable.
- *Interoperability.* To prevent unfair exploitation of non-interoperability, obligations need to be in place, e.g. enforced by relevant legislation, about interfaces, protocols, and data semantics. This specifically holds for infrastructural services such as messaging and user-contributed content sharing. These rules apply equally to competitors in the ecosystem, which means they need to be enforced by an independent ecosystem governance entity. See also M3.

  DR6. Services should be interoperable.
- *Scalable network effects.* To prevent positive network effects to create participants with monopoly power, these participants should be placed under a collaborative governance entity, that periodically assesses the business model of the value network. Decision rights need to be allocated to a group of stakeholders that are mandated to represent the interest of the value network as a whole and not of one powerful participant in the value network. See also M4.

  DR7. Ecosystem business models should be periodically be re-evaluated for harmful network effects.
- *Cross-layer competition.* Cross-layer competition should be prevented, preferably by legislation. There can also self-regulation, for example taking the shape of a governance board in which a representation of the value network's are included. To avoid conflicts of interests, in collaborative governance no entity should be allowed to (indirectly) own a competitor of its customers.(see also DR2 and M5)

  DR8. Cross-layer competition is not allowed.
- *Conflict resolution.* Any network of stakeholders who must coordinate, will generate conflicts. The question is which authority resolves conflicts, which jurisdiction is applicable, and who executes the conflict resolution. In practice, the party that executes the conflict resolution task can take a powerful position in the value network. The resolution should either be done by a joint task force of the actors in the value network, or be outsourced to a trusted third party, with no stake in the value network.

  DR9. Conflict resolution should be a collaborative task, or be outsourced to a trusted third party.

To test these design rules, we would need to design several ecosystems according to them, design other ecosystems in violation of them, and then compare the results. Obviously, such a set of experiments is impossible to do. Instead, we illustrate them with the design of the Music360 ecosystem, described below.

V. MUSIC360

In the Horizon Europe Music360 project, we aim to understand the value of music better, specifically for professional users of music (e.g. restaurants, shops, and offices), right holders (e.g. musicians, text&song writers, and publishers), and policy makers. To do so, a comprehensive data collection platform will be developed (the Music360 platform provider in

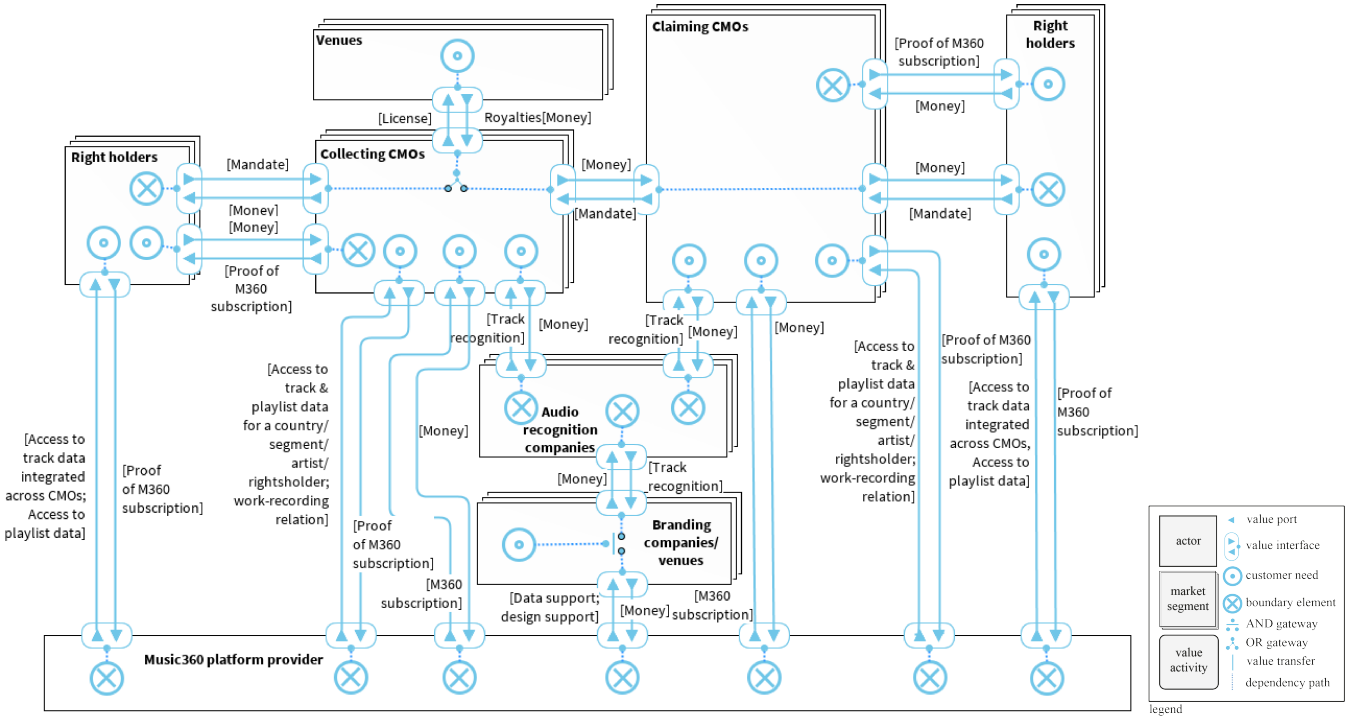

Fig. 4. The value network of Music360.

figure 4), that provides insights concerning the value of music to interested party.

Apart from developing the information technology for the platform, an important result will be a business ecosystem, which avoids value extraction behaviour. Currently, we are in the process of designing the business model for the Music360 ecosystem (see figure 4) and of designing an appropriate governance model.

We argued that in order to prevent value extraction, special attention should be paid to (avoidance of) value extraction mechanisms in the business model of the value network at hand. For explanatory purposes, we first present the Music360 business model, and thereafter discuss how we addressed specific value extraction possibilities.

A. The Music360 business model

We briefly explain the current state of the business model, which resulted from three online workshops and one physical-presence workshop. Key parties are the Collective Management Organizations (CMOs). These are national entities who *collect* money from venues (e.g. restaurants) in their country and divide the collected money: either to right holders (e.g. artists) in the same country, or to a *claiming* CMO abroad, which represents the right holders of that specific country. The amount of money to be paid to a CMO by a venue depends on a number of criteria such as the square meters of the venue and the function of music. What is often unknown are the specific recordings played by the venues. To divide the collected money, the number of seconds a recording was played at the top-25 radio stations in a country is counted for a year. The number of seconds is then used as a distribution key. This leads to a sub-optimal distribution since it can happen that a local artist is played very often in some venues, but not played by the major radio stations at all. In such a case, the local artist will not be paid. The Music360 platform aims to solve this by collecting data, e.g. using the services of audio recognition companies. These install a hardware device in a venue that takes samples of the music played, identifies the recordings, and reports it to the platform. Also, information is collected from background music streaming providers who play recordings in the shop based on pre-defined profiles to create a brand image based on music.

The Music360 platform provides a wealth of information about the recordings, the underlying works, their right holders, their earnings, detailed information regarding the place and time a recording was played, the effect of played music on the revenue of a venue, and much more. In sum, this results in a rich and interesting database that is a potential target for value extraction. One of the goals of the project is to prevent such value extraction, already during the design process of the platform.

B. Value extraction preventive decisions

To contribute to a fair ecosystem, the following governance decisions have been made.

- *Collaboration.* The current plan is to install a board with representatives of the international performers organization, the international authors organization and representatives of specific sectors (e.g. retail, catering, etc.). The rules of engagement of this board will be defined such

that monopolization will be difficult (e.g. by means of distributing voting power).

- *Continuous process.* The Music360 digital business ecosystem is under design and so will it be the coming few years. The structure of the value network is a first attempt and likely will change over time. The same holds for the quantification of revenues and expenses for all actors involved. The envisioned governance embedding of the Music360 value network in international organizations representing the performers, authors and venues enforces a continuous process, as this is the way how these organizations work themselves. From their members, representatives are selected that are assigned to working groups, each addressing a topic. These working groups meet periodically, and can (re)design the business model of the Music360 value network.
- *Entering and leaving the value- and governance network.* The platform will be open to new entrants. Members of the platform will pay a subscription fee, depending on their size to the platform to cover costs. This opens up participation for everyone, and not only the rich entities. It is not the intention of the platform to become a for-profit organization. Instead, it will have more the nature of a foundation. Competition will be allowed. For example, there can be multiple audio recognition companies.
- *Data collection and ownership.* Parties remain in control of their own data. A strongly decentralized IT architecture has been designed that allows data owners (e.g. CMOs) to control which data is shared with who. This is implemented as a distributed access control system. Also, the platform will provide facilities for making data available to third parties (e.g. for calculations) without disclosing the actual data. This can be achieved by means of homomorphic encryption and/or secure multi party (SMP) technology.
- *Scalable profiling.* It is not the goal of Music360 to develop a profiling service. Consequently, no specific measures are taken to prevent value extraction.
- *Interoperability.* Parties providing data are required to implement the open Music360 API, which is a collection of REST services that disclose a highly decentralized database with a shared data model of the industry. The data model is open, based on industry standards (e.g. DDEX) and practices of the CMOs, and managed by the board (see below). This reduces the risk of proprietary APIs and hence reduces switching costs.
- *Scalable network effects.* In the Music360 platform, there is certainly a potential network effect. The aim of the platform is to offer right holders a complete view of the value aspects of their music. Currently, each right holder has to consult the portals of each national CMO, and typically there is more than one per country, each clearing different types of intellectual property rights. So the more CMOs participate in the Music360 platform, the more valuable the platform becomes for the right holders. This opens the door for value extraction, e.g. by asking higher access if the service becomes more valuable. We plan to address this by letting the collaborative governance entity to decide about the access price for the platform. With respect to the access price, note that the music sector is characterized by only a small number of right holders that earn a substantial amount of money, whereas a very long tail of right holders have modest earnings, if at all. Consequently, the fee to be paid by the right holders for platform access will be low, and the fee to be paid by the CMOs will be relatively high. This can also be seen from figure 4. Effectively this means that the famous right holders pay more than the lesser know right holders.
- *Cross layer competition.* The Music360 governance board should deal with the issue of (cross) layer competition. Some CMOs are rather large entities that can take over functions from other actors. An example is the audio recognition service. Most CMOs outsource this, others have their own facilities, or own a company doing so. This should be carefully monitored, as our rule DR8 simply states that cross-layer competition should be avoided at all times.
- *Conflict resolution.* The to be appointed board will play an important role in international conflict resolution. At the national level, the CMOs will do this too, since they already perform conflict resolution as part of their normal business process. Note that in many cases, CMOs are foundations or alike, and often have already constructs in place to prevent value extraction (e.g. a board with members from the labour union of performers and authors).

In general, the value extraction risk is clearly with the platform entity. A number of measures have been taken to prevent this by design, including a board with a representation of all stakeholders, the use of open standards, access to data controlled by the owners of the data, and if data needs to handed over for processing, facilities to do in a secure and privacy respecting way.

VI. Discussion and further work

The development of the Music360 digital business ecosystem is in full swing and thus not finished. Moreover, this design process should be continuous, as argued for earlier. It is too early to conclude that our design rules are effective. However, we can make the following observations (**O**s):

- *O1. A useful lingua franca for discussing value extraction.* Understanding of the mechanisms underlying value extraction, as well as knowing possible mitigation strategies, was useful while designing the business model for the Music360 network and governance requirements. It at least provides the terminology to discuss the issue of value extraction with all stakeholders involved.
- *O2. Addressing value extraction should start already early in the design process.* The task to think about value extraction should go hand-in-hand with developing the business model for the value network. It effects the actor and also their role. And obviously it influences the embedding of the value network in a governance network.

Therefore, it should not be postponed until the end of the initial value network design.

- *O3. A model-based approach for collaborative governance would be useful.* We have used a model-based approach for understanding the value network, namely e^3*value* . That helped in understanding the network of some complexity. Similarly, a model-based approach for understanding the governance would be helpful. In [28] a proposal is presented that can be useful here.

In sum, we identified five mechanisms in digital technology that enable the design of an extractive business model. We see these mechanisms in many business model of the digital economy. Examples are everywhere.

The EU actively addresses value extraction by means of legislation, for example the DMA and DSA acts, and recently the AI act. Moreover, the EU fines companies that do not comply to the imposed regulation, for example the Apple playstore. In the USA, there is the ACCESS Act proposal [29].

We consider penalties and legislation important for addressing value extractive behaviour. Our aim in this paper however was to show how these value extraction mechanisms can be avoided *by design* in the first place, rather than trying to eliminate them decades after they have been implemented.

Our approach is collaborative. Collaborative design is possible when economically independent parties come together to create a value network. But sellers on Amazon and drivers for Uber are not economically independent. They do not have the choice to join another marketplace or ride hailing app, that is more fair. Their choice is to submit or to starve.

To enable collaborative modeling, we are currently working on enabling collaborative editing of the e^3*value* tools. In particular,we will add secure multiparty computing to share quantitative simulations without revealing confidential information.

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