



# A Formal Basis for Business Model Evaluation with Linguistic Summaries (Work-in-Progress Paper)

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**Abstract.** Given its essential role in understanding, explaining and structuring digital innovation, we see the increased prevalence of the business model concept as a unit of analysis in IS research. In contemporary, fast-paced markets, business models are volatile in nature and should be continuously innovated to accommodate new customer needs and technology developments. Business model innovation can be considered as an iterative process to guide business models from ideation towards implementation, in which the proper evaluation of business model prototypes is essential. For this evaluation, we need normative guidance, tools and rules to understand the relative performance of a new business model design. In the early design phases, this implies dealing with high levels of uncertainty. A few techniques and methods have been proposed for this purpose, but these lack the formal basis required for systematical application and development of automated evaluation tools. As a novel approach, we have earlier proposed the application of linguistic summarization to support early-phase, soft-quantitative business model evaluation. In this paper, we focus on a structural formalization of this approach as the basis for the development of well-defined user guidelines and automated evaluation tools. In doing so, we bridge the existing gap between qualitative and quantitative business model evaluation. We demonstrate the formalization by means of a running case inspired by a real-world project in the highly dynamic urban mobility domain.

**Keywords:** Business models · Business model evaluation · Linguistic summarization · Formal model

## 1 Introduction

Factors such as digitization, globalization and rapid technology change cause evolution of contemporary markets at an accelerated pace [1, 2]. Although these factors provide organizations promising opportunities with respect to digital innovation and customer engagement, organizations increasingly are forced to adapt their current business logic to enable the adoption of new IT developments and the adherence to shifting customer needs. It is therefore not surprising that we see the increased prevalence of the *business model* concept in IS research [1, 3]. A business model describes the logic of how value

is created and captured, the internal and external resources used to enable value creation and the organizational and technical architecture deployed to support the business model [4, 5]. Business models bridge the gap between business strategy [6] and operational business process models [7] as they concretize strategy and provide the context for the underlying process models. As such, given their pivotal role in business conceptualization and their descriptive and explanatory power, they are often used as a unit of analysis to understand the impact of IT or digital innovation and to structure its implementation [1, 8].

The adaptation or *innovation* of business models to accommodate or integrate digital innovation is a complex, non-linear design process and requires several iterative design and evaluation tasks [9]. Normative guidance, technological rules and methodological support can aid both research and practitioners in understanding or conducting business model innovation [10]. Although tools and methods have been proposed in research to support or guide business model design [11–13], limited support is present, particularly from an engineering or methodological perspective, for the *evaluation* of business models [1, 14]. This issue is even more apparent for the early phases of business model innovation, for which business model design decisions often are high-level in nature and uncertain [15, 16], resulting in difficulties with respect to quantifying or even merely assessing the potential risks and outcomes as a part of business model evaluation. As a result, qualitative evaluation approaches are advocated to support early-phase business model innovation [17]. Although qualitative techniques such as focus groups or expert judgment are frequently used [18], these techniques are informal and lack structure to be systematically applied. On the other hand, we see the use of performance criteria or metrics as a more formalized approach to qualitative business model evaluation [19, 20]. However, these techniques lack methodological guidance on how these should be catered to the specific characteristics of business model designs, and they often require quantitative support to be effectively used.

As a novel technique, we have proposed the use of linguistic summarization as a means to derive and specify ‘soft’ key performance indicators (SKPIs) that describe performance characteristics of specific business model designs [21]. These SKPIs are expressed in soft-quantitative terms, which makes them suitable to support early business model evaluation, when ‘hard’ quantitative data on a business model is not yet available. So far, the technique has been proposed in an informal way. To support systematic application and the development of tooling towards business model evaluation, we make the next step in this paper: we focus on the formalization of the approach, linking formal specification of business models and formal specification of the type of linguistic summaries that we use (*intentional linguistic summaries*). On this basis, we show how the formal model is a basis for the development of support for our approach. Accordingly, the research question for this paper is as follows:

*“How can the application of linguistic summarization to support soft-quantitative business model evaluation be formalized and how can this formalization be applied?”*

The answer to this question helps bridging the currently existing gap between the fully qualitative evaluation business models (which relies heavily on intuition of designers)

and the fully quantitative evaluation of business models (which requires far more data than is typically available in the early stages of business model design). Bridging this gap is of interest to both the business model research community and the design and use of business models in business practice.

The remainder of this research-in-progress paper is structured as follows. In Sect. 2, we discuss the research background on business models, business model evaluation and linguistic summarization. Section 3 introduces the running example that we use for the remainder of this paper to illustrate the application of linguistic summarization. Section 4 details the formalization to our approach. We illustrate how formalization supports the practical application of our method in Sect. 5 through ILSs with respect to the running case. Section 6 concludes the paper, expressing the avenues for future work and the outlook of our research.

## 2 Related Work

In this section, we describe related work in three fields of research that form the basis for our work: business model design, business model evaluation and linguistic summaries.

**Business Model Design.** Business models are increasingly used in IS research as a means to explore how digital innovations or IT-enabled innovations may impact the current business logic [1, 11]. Given its pivotal role between business strategy and operational models [7], the concept of business model often serves as a bridge to support business-IT alignment. Many componentizations have been proposed to structure the business model construct [22]. For instance, from an IS perspective, Hedman and Kalling [3] componentize business models into levels related to the market or environment, the offerings of the business model, the architectural structure and the resource deployed. Through detailing each level, organizations obtain a better understanding of what business logic is followed, how resources can be integrated or deployed and how this may influence or support customer offerings.

Several tools have been proposed to guide the design of business models. For instance, Osterwalder and Pigneur [11] propose the widely popular Business Model Canvas (BMC), which represents a graphical template consisting of nine building blocks that address various elements of business model design. The BMC takes an organization-centric, resource-based perspective and focuses explicitly on customer-supplier interactions and relationships. However, we see that as organizations increasingly transition towards service-orientation and collaborative networks [23–25], tooling towards networked, service-dominant business model design is proposed. For instance, Zolnowski et al. [26] propose the Service Business Model Canvas, which adapts the original BMC to accommodate the modelling of service business. Similarly, Grefen [27] and Turetken et al. [12] describe and evaluate the Service-Dominant Business Model Radar (SDBM/R), which through its circular template accommodates an explicitly networked perspective of business model design.

**Business Model Evaluation.** Business model evaluation is an essential activity to support design decision making either to reduce uncertainty and risk with respect to a business model design, to motivate the continuation of business model innovation or

to support the selection of a specific design configuration or alternative [15]. Business model evaluation is argued to positively influence business model innovation [28]. Although some tools exist with respect to business model evaluation, either qualitatively-oriented [20, 29] or quantitatively-oriented [13, 30, 31], limited normative guidance has been investigated for structuring business model evaluation, especially in the context of business model innovation [1, 32]. Simmert et al. [14] propose a process-oriented, multi-step evaluation approach to support business model improvement. Although it provides initial structure towards business model evaluation, the techniques used for evaluation (focus groups and quality criteria) are informal and hence provide limited support for detailed structure of application.

**Linguistic Summaries.** Linguistic summaries (LS) are statements with a specific format (template or protoform) that are used to describe data in brief natural language constructs and that can be automatically generated [33]. LS allow to more easily comprehend a set of data [34]. Linguistic data summaries are quantified propositions with two protoforms (or templates): a simple protoform,  $Q y's are P$ , exemplified by “most cars are new” and an extended protoform,  $Q Ry's are P$ , exemplified by “most fast cars are new”.  $Q$  is the linguistic quantifier, e.g. *most*.  $P$  is the summarizer, an attribute together with a linguistic value, e.g. *new car*.  $R$  is an optional qualifier, another attribute together with a linguistic value, which narrows down the scope of universe, e.g., *fast car*. *Intentional linguistic summaries* (ILSs) [21] are quantified statements with the same structure as linguistic summaries:  $Q y's are P$  and  $Q Ry's are P$ . The main difference is that ILSs are not created from existing data, but capture intentions that the stakeholders want to be true. In other words, they specify desired constraints over future data. We use this construct to specify constraints over future effects of business models.

### 3 Running Example

We demonstrate the application of linguistic summarization to support business model evaluation by means of an illustrative case study. The case concerns a business model design that emerged from the urban mobility business domain as the result of a workshop with industry practitioners. The business model design was generated as an initial solution to address challenges of increased traffic problems in the city of Amsterdam at days when large public events (such as pop concerts or soccer matches) are organized in the city [35]. As a result of these large events, which often start around peak hours, a significant inflow of traffic users (event visitors that travel by car) is generated in this period, causing many severe traffic jams. Therefore, the city explored together with partners such as parking providers, event providers and road authority a collaborative solution aimed at decreasing the negative traffic effects of these large events.

The solution that emerged from the workshop constituted a service platform that enables event visitors to use their event ticket to receive free parking tickets at predetermined arrival times. Receiving free parking tickets encourages event visitors to arrive at the specified time, as parking is expensive in Amsterdam. The arrival times consequently can be set in such a way that it balances the load to the road infrastructure. To offer the

solution, the resources of partners such as platform providers, municipality, road authority, parking provider and event location and event providers were integrated. To further stimulate the financial viability of the collaboration, retailers were involved as they may significantly benefit from event visitors arriving early in the city. The SDBM/R technique was used as the tool for business model design [12, 27, 36]. The resulting business model design to accommodate the solution is presented in Fig. 1. In this business model radar (which we label TJFERC), we see the central value (*value-in-use*) of the business model in the center of the radar and the involved customer (Large City) as one of the eight involved business *parties* (the actors in the network) – each having one ‘slice’ of the radar, labeled in the outer ring. Apart from the customer, the *orchestrator* party (Mobility Broker) and six other parties are present. A party can be a *core party* (i.e., essential for the functioning of the business model and operation of the offered service) or an *enriching party* (i.e., bringing non-essential added value). The three rings around the central value detail for each party (from the center outwards) the value that each party contributes to the central value-in-use (its *actor value proposition*), the activities it has to perform to create this value (*value coproduction activities*), and its *costs* and *benefits* (both financial and non-financial). Note that each business model only has a single *value-in-use*, which is construed from the set of actor value propositions. As a consequence, to generate a different value-in-use, a different set of value propositions would be needed (which in turn results in a different business model design).

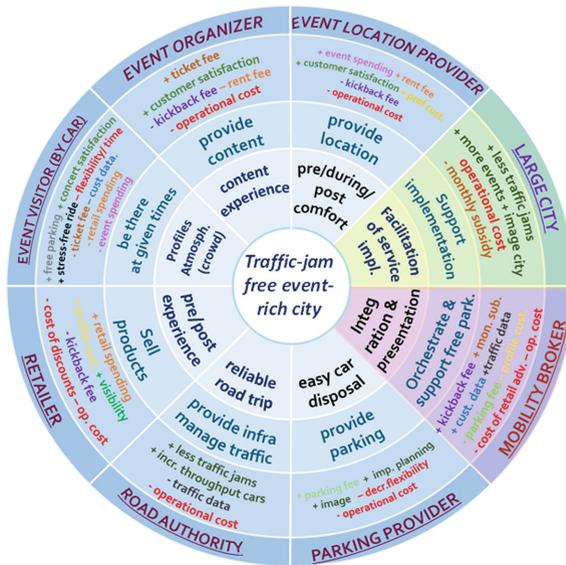


Fig. 1. Business model design draft to address event induced traffic challenges in the inner-city.

To support the evaluation of the business model design, we generate ILSs per party of the business model. ILSs represent operationalized, strategic preferences or summaries per party that are specifically catered to the business model design. As such, each business

model design, depending on its contents, may result in different ILSs. The ILSs serve as the basis for communicating under what conditions a party is willing to participate in the business model. By assessing whether the ILSs can be achieved, the viability of the business model can be evaluated [21]. The ILSs are presented in a pre-specified structure (named *protoforms*), as usual in research into linguistic summarization [34]. Although the ILSs are initially soft-quantitative in nature, the structure of the summaries allows the ILSs consequently to be further quantified through concrete membership functions of the linguistic summaries [33, 34]. We will demonstrate the ILSs for this example in Sect. 5.

## 4 Groundwork for the Formal Approach

In this section, we describe the groundwork for the formalization of our approach. We do this by formalizing the two main elements of the approach: business model radars (SDBM/R) and intentional linguistic summaries (ILS). In Sect. 5, we integrate these two formalizations to become the ‘formal spine’ of our business model evaluation approach.

### 4.1 Formalizing the SDBM/R Concept

To formalize the SDBM/R concept (which we call *business model radar* or *BMR* from now on for easy readability), we identify that this concept has an overall structure that is independent from the number of involved parties, and a structure per party. Hence, we provide the formalization in two steps: the radar and the parties.

A *business model radar* (BMR) is a business model specification with the following formal type and constraint:

$$BMR = \langle name: L, value: ViU, cust: P, orch: P, parts: \{\langle part: P, core: BOOL \rangle\} \rangle \\ parts \neq \emptyset$$

Here, *name* is the name of the business model from the set of *labels* *L*, *value* is the value in use of the business model from the set of *values-in-use* *ViU*, *cust* is the *customer* from the set of *parties* *P*, *orch* is the *orchestrator party* from *P*, and *parts* is the set of *other parties* of type  $\{\langle P, BOOL \rangle\}$ , i.e., a set of pairs of parties and an indication whether a party is a *core party* in the business model. The structure states that exactly one customer party is present and exactly one orchestrator party. The additional constraint specifies that at least one other party must be present – this to make it a true networked business model and not a dyadic relation.

A BMR instance *b* therefore has the following format:

$$b = \langle l, viu, p_1, p_2, \{\langle p_3, b_3 \rangle, \dots, \langle p_n, b_n \rangle\} \rangle n \geq 3$$

A *party* is the specification of a role in a business model radar with the following type:

$$P = \langle name: L, avalp: \{AVP\}, acopa: \{ACA\}, aben: \{AB\}, acost: \{AC\} \rangle \\ avalp, acopa, aben, acost \neq \emptyset$$

The set *avalp* contains the set of *actor value propositions* of a party (a party can have more than one actor value proposition), *acopa* the set of *actor coproduction activities* (a party can have more than one activity), *aben* the set of *actor benefits*, and *accost* the set of *actor costs*. All of the four sets need to be non-empty for a business model to be viable: each actor needs to contribute to the central value-in-use, each actor needs to perform at least one activity to generate this contribution, and each actor needs to have both benefits (its reason to participate in the business model) and costs (not to be a ‘free rider’ to the other parties).

The above shows that this simple formalization already provides a nice set of correctness criteria for business models specified in the SDBM/R technique, which can be automatically checked. These criteria are of a syntactical nature though and specify nothing about the intended business effects of the business model. To enable this, we use intentional linguistic summaries.

## 4.2 Formalizing the ILS Concept

To use it in the business model context, we operationalize the concept of intentional linguistic summary (ILS) into the concept of *intentional soft quantified statement* (ISQS). In general, an ISQS specifies a desired characteristic of a set of objects of a specific type in a universe of discourse (UoD) in soft quantified terms. We first discuss the overall formal structure of the ISQS concept. Then, we detail each of its components.

The set of ISQS *QS* has the following type (following the structure of a protoform of linguistic summaries [33]):

$$QS = \langle \text{quant}: QF, \text{obj}: \{OB\}, \text{oqual}: \{OQ\}, \text{ochar}: \{OC\} \rangle$$

Here, *quant* is a *soft quantifier* of type *QF*, *obj* is the set of *quantified objects* of type *OB*, *oqual* is the set of *object qualifications (features)* of type *OQ*, and *ochar* is the set of *object characteristics (features)* of type *OC*. Object qualification *oqual* can be a feature describing all objects in a UoD.

An ISQS instance *qs* therefore has the following format:

$$qs = \langle qf, ob, oq, oc \rangle$$

In the above specification, *QF* is the enumerated set of *soft quantifiers*, which state the intended fraction of the set of quantified objects. Usually relational quantifiers are used (i.e., describing the proportion within the set), like *most*, indicating *above 50%*. Seldom, absolute quantifiers (i.e., referring to the absolute object count) are used, e.g., *around 5*, *more than 7*. An often used set of soft quantifiers is the following, and we will use it in our work for soft quantification of business models:

$$QF_{ou} = \{ALL, ALMOSTALL, MANY, SOME, FEW, ALMOSTNONE, NONE\}$$

We use only a part of the expressiveness of the linguistic summaries model to stay pragmatic. Therefore, we define the elements of *QF<sub>ou</sub>* to have a fuzzy ordinal relation denoted with the fuzzy comparison operator  $\succ$ :

$$ALL \succ ALMOSTALL \succ MANY \succ SOME \succ FEW \succ ALMOSTNONE \succ NONE$$

The elements of  $QF$  indicate the *desired proportion* of a set, modelled using a fuzzy set. An *actual proportion* of a subset may therefore satisfy two adjacent soft quantifiers, where adjacent is defined by the fuzzy ordinal relation specified above.

The set of *quantified objects*  $OB$  is the powerset of objects in the  $UoD$  over which we want to state soft quantifications:

$$OB = \{\{O \in UoD\}\}$$

Consequently, a *set of quantified objects*  $ob$  is a set of elements in the  $UoD$ :

$$ob = \{o \in UoD\}$$

A *feature* of an object is a tuple of type  $F$  that contains the feature label and the set of linguistic value labels:

$$F = \langle \text{featureLabel}: FL, \{\text{linguisticValue}: LV\} \rangle$$

For instance

$$f = \langle \text{"color"}, \{\text{"red"}, \text{"blue"}, \text{"green"}, \text{"black"}, \text{"yellow"}\} \rangle$$

Linguistic value labels can be made precise and represented as fuzzy sets, with  $\mathbb{M}$  as the membership function:

$$\mathbb{M}: OB \times FL \times LV \rightarrow [0, 1]$$

The membership functions do not have to be defined for intentional soft quantified statements at the early design stage, allowing the linguistic value labels to have more intuitive definition and meaning and be made more precise in later design stages.

The set of features of an object is given by the function *ofeat* that takes an object:

$$\text{ofeat}: UoD \rightarrow \{F\}$$

Every feature is associated to an enumerated set of possible values. In principle, a feature can possibly have multiple values with different membership values – but we abstract from them. For example, we take object  $c \in Cars$ :

$$\text{ofeat}(c) = \{\langle \text{"color"}, \text{"red"} \rangle \langle \text{"speed"}, \text{"fast"} \rangle \langle \text{"class"}, \text{"luxury"} \rangle\}$$

The set of *object qualifications*  $OQ$  consists of pairs of a feature label and a linguistic value. More complex situations are allowed, where multiple feature labels and linguistic values can be combined with conjunctions. For pragmatic reasons, we focus only on the simple case in this work.

$$OQ: FL \times LV$$

We have a function *oqmem* which for the sets of objects in the  $UoD$  and a feature combined with a linguistic value identifies subsets of the  $UoD$  of which the elements have the same type, plus a feature label and a feature value:

$$\text{oqmem}: OB \times FL \times LV \rightarrow OB$$

An *object qualification*  $oq$  is applied to a set of qualified objects to constrain this set to a subset under consideration.

The last element in the ISQS structure is the set of *object characteristics*  $OC$ .  $OC$  contains pairs of a feature label and a linguistic value, similar to  $OQ$ . In general case, more complex expressions of feature labels and linguistics values are possible, but for reasons of pragmatism, this is beyond scope of the current formalization.

$$OC: FL \times LV$$

$OC$  is intended predicate over  $QF$  objects resulting from  $oqmem$ .

With the above formalism, we can precisely describe an ISQS in a structured way that is fit for tooling. To make things easier to interpret for humans, we can obviously generate a textual representation of an ISQS, using the natural language format that is typical for linguistic summaries. An ISQS instance  $qs_1 = \langle qf, ob, oq, oc \rangle$  can for example be:

$$qs_1 = \langle MANY, Cars, \langle color, red \rangle, \langle speed, fast \rangle \rangle$$

This can be textually represented as “MANY red cars ARE fast”. A simplified ISQS instance  $qs_2 = \langle qf, ob, oq, oc \rangle$  can for example be:

$$qs_2 = \langle SOME, Cars, \langle any F, all V \rangle, \langle speed, fast \rangle \rangle$$

In this case  $\langle any F, all V \rangle$  is a feature describing all objects in a  $UoD$ . This can be textually represented as “SOME cars ARE fast”.

## 5 Integration for Business Model Evaluation

In this section we discuss how we combine the formalisms of business model radars and intentional linguistic summaries into an integrated formalism for the specification of soft-quantified characteristics of business models. We also show illustrative examples for the BMR example presented in Sect. 3.

To generate intentional linguistic summaries for specifying intentions of business models, we use ISQS templates that represent typical characteristics of business models. The templates presented in this paper are important representatives of this class, but the presented set is certainly not yet complete. For instance, we wish to expand this set such that it covers all elements of the business model design. Moreover, we aim to explore what operation elements per ISQS suit best under what conditions. As this paper presents work in progress, we aim to construct a complete set and test this in the real-world practice of business model design and evaluation.

Given a BMR instance  $b$  (following the structure introduced in the previous section):

$$b = \langle l, viu, p_1, p_2, \{ \langle p_3, b_3 \rangle, \dots, \langle p_n, b_n \rangle \} \rangle$$

we want to specify ISQS instances over this BMR instance and create a soft-quantified BMR with the following type (which combines the two formalizations of the previous section):

$$SQBMR = \langle bmr: BMR, sq: \{QS\} \rangle$$

So in short, an instance  $s$  of the type  $SQBMR$  is a soft-quantified business model radar, i.e., the next step after drafting a non-quantified BMR in the ideation process of creating new business models. The set of soft quantifications  $sq$  attached to a business model  $b$  contains a number of ISQSs that describe the desired soft-quantified behavior of  $b$  when it will be executed in practice.

This formalization allows the precise specification of the nature of these ISQSs to obtain a structured soft-quantification and to reason about the set of ISQSs. To do so, the ISQSs are organized in categories that we describe in the subsections below in detail: the customer with its value-in-use, its benefits and its costs, and the core parties with characteristics that vary by the nature of the party. As the orchestrator essentially also represents a core party, we can use the same templates for this role. For now, we do not include characteristics of enriching (non-core) parties in the set of ISQSs for business model evaluation, as these parties are not essential for the operation of the business model. After we have described the categories of ISQSs, we present an initial discussion on the soft-quantified intentional validity of business models.

## 5.1 Customer

From a customer-oriented perspective, we create a set of ISQS templates that describe the most important aspects of a business model for evaluation from the customer perspective, i.e., the value-in-use, the benefits and the costs. Note that based on this template the respective stakeholder (in this case the customer) can select the objects that are most appropriate to express its strategic goals or motivation to participate.

**Value-in-Use.** We create a soft quantification over the value-in-use for the set of customers of a business model, stating that the majority of customers indeed receives this value-in-use:

$$qs_0 = \langle qf, p_1, \langle any\ F, all\ V \rangle, f(viu) \rangle$$

*with*  $qf \in \{ALL, ALMOSTALL, MOST\}$

Note that the value  $\langle any\ F, all\ V \rangle$  for the object qualification function means that all objects are included.  $f(viu)$  is a linguistic label for a feature of the value-in-use.

For the running example of Sect. 3, the value-in-use is *traffic-jam free event rich city*. A feature of this value-in-use is the amount of traffic jams and their classification. Traffic jams can be characterized by, e.g. three linguistic labels into three classes: heavy, medium and small. In this case, the ISQS can be as follows:

$$qs_0 = \langle MOST, large\ city, \langle any\ F, all\ V \rangle, \langle few\ traffic - jams, heavy \rangle \rangle$$

which can be transformed to textual format for easy reading:

$qs_0$ : *Most large cities have few heavy traffic-jams caused by the events.*

where *most* is the quantifier ( $qf$ ), *large city* is the customer ( $p_1$ ), and *few traffic-jams caused by the event* is the feature label for the value-in-use, and *heavy* is its linguistic label.

**Benefits.** We create a soft quantification over the benefits for the customer, stating that desired benefits occur often:

$$qs_{1a} = \langle qf, p_1, \langle any F, all V \rangle, f(p_1.aben) \rangle$$

$$with qf \in \{ALL, ALMOSTALL, MOST\}$$

For the running example we use the above template to create the following ISQs describing the benefits of the customer (large city):

$$qs_{1a} = \langle MOST, large\ city, \langle any\ F, all\ V \rangle, \langle less\ traffic - jam, heavy \rangle \rangle$$

$$qs_{1a'} = \langle MOST, large\ city, \langle any\ F, all\ V \rangle, \langle more\ events, big \rangle \rangle$$

$$qs_{1a''} = \langle MOST, large\ city, \langle any\ F, all\ V \rangle, \langle image\ of\ city, positive \rangle \rangle$$

Those ISQs can be represented in textual form as:

*qs<sub>1a</sub>: Most large cities have less heavy traffic jams.*  
*qs<sub>1a'</sub>: Most large cities have more big events.*  
*qs<sub>1a''</sub>: Most large cities have positive image of the city.*

**Costs.** We make a soft quantification over the costs for the customer, stating that unacceptable costs do not occur often:

$$qs_{1b} = \langle qf, p_1, \langle any F, all V \rangle, f(p_1.acost) \rangle$$

$$with qf \in \{NONE, ALMOSTNONE, FEW\}$$

For the running example this can be the following ISQS

$$qs_{1b} = \langle NONE, large\ city, \langle any\ F, all\ V \rangle, \langle monthly\ subsidy, large \rangle \rangle$$

and in textual format:

*qs<sub>1b</sub>: None of the large cities is paying a large monthly subsidy.*

Through use of the template, a customer consequently is able to translate strategic motives into concrete, business model specific conditions to participate, which can be used for evaluative purposes.

## 5.2 Core Parties

The core parties are essential for the functioning of a business model. Consequently, we make soft quantifications over the costs/benefits for each core party, stating that an acceptable cost/benefit ratio occurs often:

$$qs_k = \langle qf, p_k, oq, f(p_k.aben, p_k.acost) \rangle \text{ for } 3 \leq k \leq n \text{ if } b_k$$

$$with qf \in \{ALL, ALMOSTALL, MOST\}$$

For the running example we have created a set of example statements. For the parking provider an ISQS is:

$$qs_{k1} = \langle MOST, parking\ provider, \langle any\ F, all\ V \rangle, \langle parking\ planning, significantly\ improved \rangle \rangle,$$

or in a textual format:

*qs<sub>k1</sub>: Most parking providers have significantly improved planning on most events.*

The retailer is mostly focused on the financial aspect, therefore a good ISQS is:

*qs<sub>k2</sub>: All retailers make an acceptable profit on most events.*

For the visitor the concert experience and memories are the most important, leading us to the following ISQS:

*qs<sub>k3</sub>: Most visitors have a very high concert satisfaction.*

For the event organizers and the event location providers the focus is also on customer satisfaction:

*qs<sub>k4</sub>: All event organizers (location providers) have a high customer satisfaction on most events.*

Again, each stakeholder can change the set of objects of the introduced templates to generate ISQs that express its strategic motives or goals. Please note that in the summaries presented above, the focus is on the stakeholder, e.g., the summaries describe the retailers, visitors and event organizers. A different set of summaries can be obtained, if we put the operation, in this case an event, in the focus of linguistic summaries. Currently we are working on normative guidance towards what level of the operation should be used as focus of the linguistic summaries, given the preferences of stakeholders and the context of the BMR.

Given all the above ingredients for the formal representation of example from Sect. 3, we can specify the soft-quantified business model:

$$sqbm_{ijferc} = \langle TJFERC, \{qs_0, qs_{1a}, qs_{1a'}, qs_{1a''}, qs_{1b}, qs_{k1}, qs_{k2}, qs_{k3}, qs_{k4}\} \rangle$$

### 5.3 Soft-Quantified Intentional Validity of Business Models

Once an initial business model design is generated, the ISQs can be compared amongst stakeholders or domain experts who can judge whether these statements are acceptable and achievable. This can be used using the linguistic value scale *<not feasible, rather not feasible, not sure, rather feasible, feasible>*.

To allow for automated reasoning about the validity of soft-quantified business models, we can formalize this as well. Formally, a business model is intentionally valid

from a soft-quantified perspective if all ISQSs for that BMR are above the fuzzy ‘truth value’  $T \in \mathbb{M}$ , where  $T$  can be chosen depending on the ‘strictness’ of business model evaluation:

$$FValid(b) \Leftrightarrow ((Truth(qs_o) > T) \wedge (Truth(qs_{1a}) > T) \wedge (Truth(qs_{1b}) > T) \\ \wedge (Truth(qs_3) > T) \wedge \dots \wedge (Truth(qs_n) > T))$$

If we define  $FValid$  in terms of a complete SQBMR instance  $sqb$ , we get:

$$FValid(sqb) \Leftrightarrow (\forall s \in sqb.sq)(Truth(s))$$

If for example, all the statements we have generated are evaluated as at least “rather feasible”, the model is judged to be valid for all stakeholders. For instance, if by means of collaborative discussions, all stakeholders determine that the linguistic summary “*all retailers makes an acceptable profit on most events*” is rather feasible, the business model design for the retailer is considered feasible. If all generated linguistic summaries are feasible, the business model design can progress to the next phase (integration), in which the design is further concretized and quantified in a more traditional way.

## 6 Conclusions and Outlook

As markets evolve at an accelerated pace, we see that contemporary organizations increasingly are required to adapt their business logic in order to adhere to shifting customer needs and to support new business activities through the inclusion of digital innovations. The consequently increased prevalence of the business model concept as a unit of analysis to support IT implementation and to understand its impact or implications for business strategy [3, 8] calls for structured approaches for business model evaluation. To assess the market potential of business models in early design stages, existing strictly qualitative approaches for evaluation need to be complemented with approaches that bridge the gap towards traditional, strictly quantitative approaches (e.g., from business economics).

To bridge this gap, we have focused in this paper on the formalization of the application of linguistic summarization as a method to support business model evaluation. Linguistic summarization facilitates users to derive ILSs, which capture the strategic preferences or KPIs of stakeholders without a need to specify or quantify these KPIs to a large extent. The formalization builds upon the groundwork that we have established in Wilbik et al. [21] which elaborates on how the method is used. The formalization consisted of two parts, namely formalizing a business model representation (to which we used the SDBM/R [12]) and formalizing the generation of ILSs [21] in ISQS format. We have integrated and combined these formalizations to illustrate how, in a systematic way, ILSs can be generated on the basis of a service-dominant business model design. We demonstrate the formalization by means of a set of examples and show how these may contribute towards support for business model evaluation.

As an outlook to the approach presented in this paper, we aim to further develop the set of ISQSs that can be developed per application. This includes finalizing the set of ISQS templates that can be generated, such that all business model elements can be

expressed by means of ISQSs, as well as providing rules with respect to the generation of ISQSs. Currently, an almost infinite set of ISQSs can be generated per party in a business model, which may inhibit the usability and interpretability of the outcomes. Therefore, we will assess which ISQS templates should be generated under which circumstances, or how the strategic preferences of a stakeholder can be captured through a limited set of ISQSs. Moreover, we also aim to validate our method further to understand the initial usability, usefulness and ease-of-use of the proposed method.

Future research will build upon this formalization. One promising approach is to use the formalization as a basis for developing automated tooling for business model evaluation. The formalisms presented in this paper can rather straightforwardly be translated into a data model and a rule base for such a tool. A second approach is the development of a directive on how different evaluation methods can be formalized to accommodate business model evaluation.

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