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Adaptive selection of the business model for a network enterprise

Elección adaptativa de los modelos de negocio de empresas de red

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Contents

ABSTRACT:

The article refers to the problem of developing software to facilitate strategic decision-making in the field of engineering for network enterprises. The authors analyze popular approaches to presenting the structure of business models. They further suggest a method for classifying business models based on patterns of structures formed from elementary features with a binary value type. Based on expert estimates on qualitative indicators and fuzzy logic, the authors developed a systematic decision-making methodology for selecting a network business model. The study introduces the concepts of business model signature and business model naming. The proposed decision support tools are designed to implement effective strategic planning, maintain flexible organizational and economic mechanisms, and optimal management of business processes.

Keywords: network business model, enterprise engineering, intelligent technologies, business process

RESUMEN:

El artículo está referido a abordar los problemas relacionados con el desarrollo de software o sistemas lógicos que faciliten la toma de decisiones estratégicas en el ámbito de las redes de empresas de ingeniería. Los autores analizan los enfoques populares para la presentación de las estructuras de modelos de negocios. Los autores, más allá, sugieren un método para clasificar modelos de negocios basados sobre patrones de estructuras, formados de características elementales con un tipo de valor binario. Basados en cálculos, los autores estiman - sobre indicadores cuantitativos y lógico vagos- el desarrollaron una metodología de toma de decisiones sistemática para seleccionar un adecuado modelo de negocio en red. Este estudio introduce los conceptos de firma para modelo de negocios y nombramiento de modelo de negocio. Adicionalmente, se proponen herramientas diseñadas para soportar las decisiones con la finalidad de i) implementar planificaciones estratégicas efectivas, ii) mantenimiento de mecanismos económicos y organizacionales flexibles y procesos óptimos de manejo de negocios.

Palabras clave: modelo de negocio de red, ingeniería de empresas, tecnologías inteligentes, proceso de negocio

1. Introduction

The analysis of experience to implement innovative projects shows that the creation of a competitive innovative product requires coordinated work of several enterprises, expressed in cooperation (Buckley, 1985; Kirchhoff *et al*., 2002). Thus, regulatory economics stimulates production structures to act within the framework of the network business format (Kantemirova *et al*., 2018; Prause, & Attari, 2017). The study of intelligent strategic decision support systems (DSS) is particularly important because of their high potential to substantiate effective structural transformations of the network enterprise business. Intellectual technologies can help to find answers to the questions encountered in the practice of companies (Osterwalder, & Pigneur, 2010, 2013).

The adaptation to market changes requires strategic decision-making related to changes in the business model and setting up relevant business processes with regard to network interactions (Batkovskiy *et al*., 2016a, 2016b). Designing the structure of the knowledge base, which is the core of DSS, requires the use of ontological engineering. Practical testing of its language tools has already proved its ability to model the structure of complex objects, including economic concepts (Batkovskiy *et al*., 2016a, 2016b; Vlasov, & Demin, 2017).

A business model is a conceptual tool that contains a set of elements and their relationships and allows expressing a company's logic of earning money. It is a description of the value a company offers to one or several segments of customers and the architecture of the firm and its network of partners for creating, marketing and delivering this value and relationship capital, in order to generate profitable and sustainable revenue streams (Osterwalder, 2004). Therefore, in terms of knowledge management, strategic decision-making for selecting a business model should be considered as an engineering process. Given the complexity of strategic decision-making, this article focuses on creating methodological support for the DSS development in the field of business model engineering.

2. Literature review

There are two approaches to decision-making: intuitive – with the freedom of choice (Czerniak, & Berkner, 2016), and rational (Grunig, & Kuhn, 2017). H. Chesbrough and R.S. Rosenbloom (2002) cite the example of the *Xerox* Corporation, for which the rational choice of a business model has proved an effective strategic decision. Such prominent specialists as T.A. Gavrilova, D.A. Kudryavtsev, and V.F. Khoroshevsky pay particular attention to this issue (Gavrilova, & Lescheva, 2016; Gavrilova, & Kudryavtsev, 2014). However, despite the fact that business models are a well-researched topic of research, selection of tools for a business model is still limited to simple recommendations.

In (Al-Debei, & Avison, 2010), the major elements of a business model are value supply, value structure, value network, and financial value. In fact, such an interpretation of a business model structure can be considered as generally accepted. In (Hacklin *et al*., 2018), the key components of a business model are distribution channels, market segments, and models of profitability. In (Weking *et al*. (2018), the principal elements of a business model are enterprise architecture defined in terms of organizational change, innovation, and the strategy; the market segment, market niche; the proposed value; the value chain; the profit-making model. According to an alternative approach to the structure of a business model, called the cube model (Lindgren, & Rasmussen, 2013), the key elements of a business model are: value supply, customers and users, the value chain, competencies, networks and network structures, connections, and the value formula.

When comparing different approaches to decomposition of an enterprise business model into components, one can see that the concept of value is an integral component of a business model.At the same time, the so-called "digital" value models based on assessments of specific indicators should be used for enterprise engineering (Zinder, 2018a, 2018b). In contrast to the "analog" models (Litau, 2018a, 2018b), "digital" value models can be evaluated with intelligent technologies.

A. Osterwalder managed to describe the blueprint component of a business model. However, he had to reach the meta-level using the ontological engineering approach (Osterwalder, 2004). Business ontologies should be easy to understand by specialists and interpreted by intelligent systems when used. The SUMO and SENSUS projects, as well as the OWL and OntoSelect ontology libraries (Mitrofanova, & Konstantinova, 2015), and the Ontolingua system (Beniaminov, 2017).

Several other scientists developed their blueprints of the general business model, having parameterized them for specific cases. In particular, the outline of a business model for a cubic startup by Steve Blank and Bob Dorf (Blank, & Dorf, 2018), the outline of a business model for a "steady" startup by Bohdan Durnota and Peter Aughton (Maughan, & Durnota, 1995), and the outline of a business model for a retail company by A. Shubin (Shubin, 2016). However, the authors believe that all of them were built based on the outline of a business model according to A. Osterwalder and Y. Pigneur (Osterwalder, & Pigneur, 2010, 2013) through changing the verbal formulations, clarifying or decomposing of the business model components.

The following section examines approaches to the development of intelligent engineering for network enterprises.

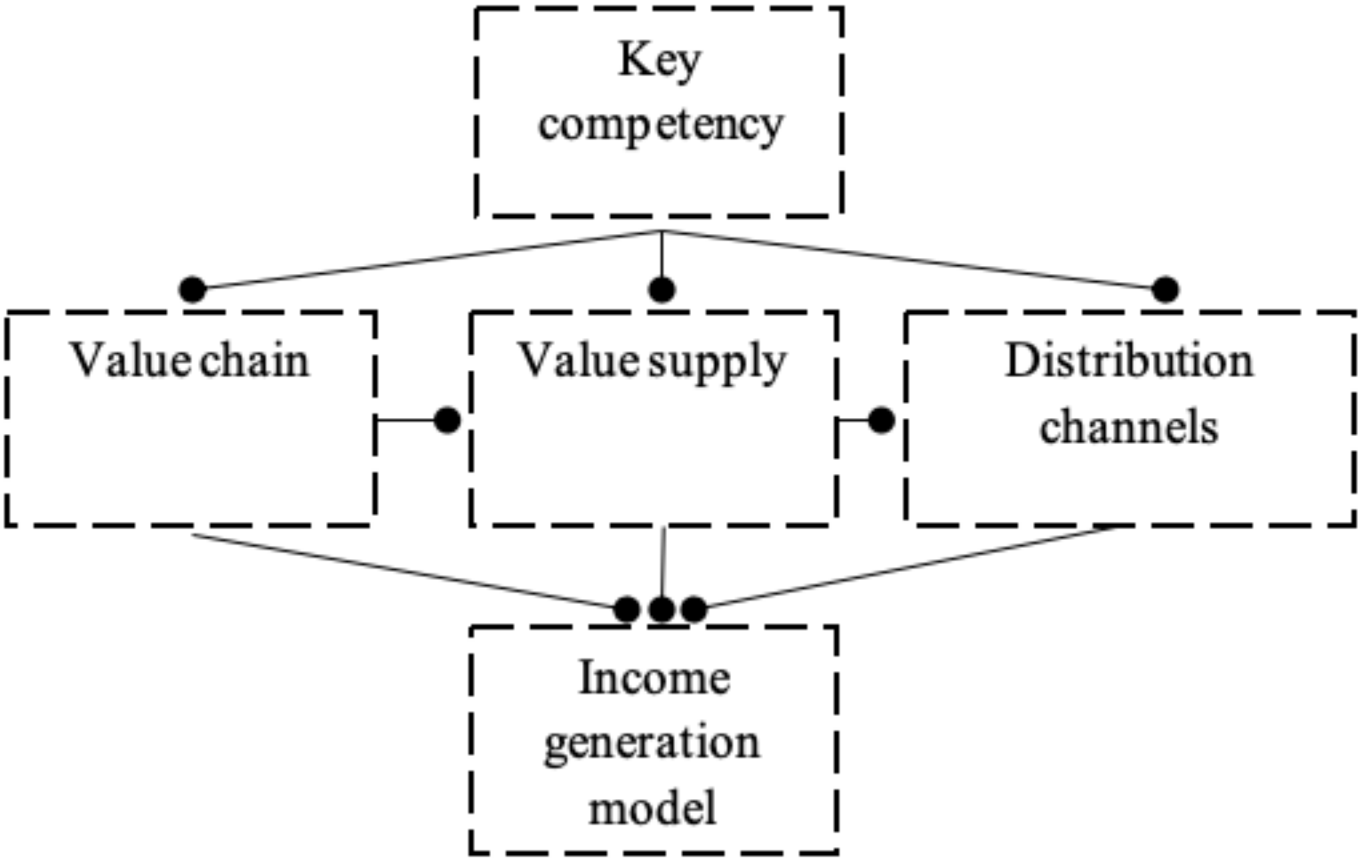
3. Methods

A network enterprise is the association of participants created for conducting business based on the principles of competition and cooperation, developed around the possibility of resource-sharing (Usov, 2013). A network business is the activity of such structures as a cluster, special economic zone, and technical innovation zone (Osipov, 2014). The network business model provides enterprises with access to critical resources and technologies (Popova, & Yadrikhinskaya, 2016). In contrast to the merger business model with increasing dynamic capabilities (Čirjevskis, 2017), the network business model is built on the benefits of integration into the value chain.

In terms of engineering, the network business model should be considered as a component of enterprise architecture (Gassman *et al*., 2016). In turn, the decomposition of a business model into components is easily implemented using ontological engineering, as this type of engineering combines the advantages of a systematic approach with the flexibility of language means. Therefore, in terms of developing a decision-making methodology for choosing a business model, ontological engineering should be used together with the natural language processing (NLP) methods (Manning *et al*., 2014).

Figure 1 shows the meta-ontology that summarizes various structures of an enterprise business model.

Figure 1
Ontology of an enterprise business model



It is advisable to formalize network business model using a unified template. Such unification should be implemented through the classification of network business models.

4. Results

4.1. Classification of network business models

The hierarchical taxonomy of business models is described in detail in (Al-Debei, & Avison, 2010). The archetypes and classification of business models (reusable models) are also presented in (Weking *et al*., 2018).

When an enterprise uses several business models at once, it is worth mentioning a combined or a hybrid (mixed) business model. Furthermore, there are other terms used in this particular case: *business case*, *multi-business model* (Lindgren, & Rasmussen, 2013).

We suggest using the following features (Gassman *et al*., 2016) to classify network business models (Table 1).

Table 1
Classification of business models, specified by patterns of their structure

No.	Business model	Patterns						
		a	*b*	*c*	*d*	*e*	*f*	*g*
1.	Outsourcing	+						
2.	Crowdfunding			+				
3.	Crowdinvesting			+				+
4.	Fundraising			+			+	

Note: reassigning activities to other performers (a); using one's own production capacities (b); attracting external financing (c); using internal funds (d); investing in external business (e); non-commercial business interests (f); market business interests (g).

The frame from Table 1 can be updated with new business models, "stretch" horizontally, supplemented with new patterns. Thus, the number of business model types can increase to include new patterns (developed, constructed).

In addition to network business models, there are other classes of business models generated by one or another distinctive feature, as a rule, characterizing the competitive advantage of a given business model. Those include innovative (Hacklin *et al*., 2018), sustainable (Evans *et al*., 2017), open (Visnjic *et al*., 2018), etc.

The practical use of the proposed classification of network business models (based on patterns) is discussed in the next section.

4.2. Decision-making model for choosing a business model for a network enterprise

The choice of a business model is considered as a strategic decision requiring an adequate methodological basis and automation as a functional module of the DSS. Therefore, the adoption of this decision should be regarded as an engineering process, which will be described further.

The variety of existing network business models ( ) is a proper subset of a set ( ) of all types of business models:

$$NBM \subset BM\,, \tag{1}$$

where NBM is a set of network business models; BM is a set of all known types of business models.
Any choice implies narrowing a set of alternatives A to a non-empty set A_γ, which can contain only one element, i.e. $|A_\gamma| = 1$:

$$\gamma : A \to A_\gamma, \tag{2}$$

where A is a set of all alternative decisions; A_γ is a selected set of alternatives caused by the decision; γ is a mapping, narrowing the set of alternatives to the set of selected alternatives.
The choice of a network business model is the choice of a general business model from a "narrowed" set BM to set NBM:

$$\gamma_N : BM \to NBM\,, \tag{3}$$

where BM is a set of all business model types; NBM is a set of all network business models; γ_N is the transformation of exclusion from the set BM of all business models, not belonging to the class NBM of network business models.
The procedure γ_G of selecting a business model implies using a set of K_{BM} criteria:

$$\gamma_G : BM \to bm_{opt}, \tag{4}$$

where BM is a set of all alternative business models; bm_{opt} is a recommended business model, optimal in terms of decision-making; γ_G is a mapping implying an exclusion from the set of alternatives of all non-optimal business models.
The maximization of the rating type indicator obtained by the method adequate to the purpose of selection should be used as an optimality criterion to transform γ_G.

In this case, the procedure γ_N of selecting a network business model involves a procedure γ_G of choosing a business model, supplemented by a set of criteria K_{NBM^+}.

$$\gamma_N : NBM \to nbm_{opt}, \tag{5}$$

where NBM is a set of all alternative choices of a network business model; nbm_{opt} is the selected network business model; γ_N is a mapping implying the choice in the decision-making process of an optimal network business model.
Decomposition of a business model (not necessarily a network business model) into constituent elements results in a certain multicomponent structure. Generally speaking, the structure BM_{core} of a general business model $bm \in BM$ is as follows:

$$BM_{core} = \langle B_{tpr}, B_{techr} \rangle, \tag{6}$$

where B_{tpr} is a production type component; B_{techr} is a technological implementation component.

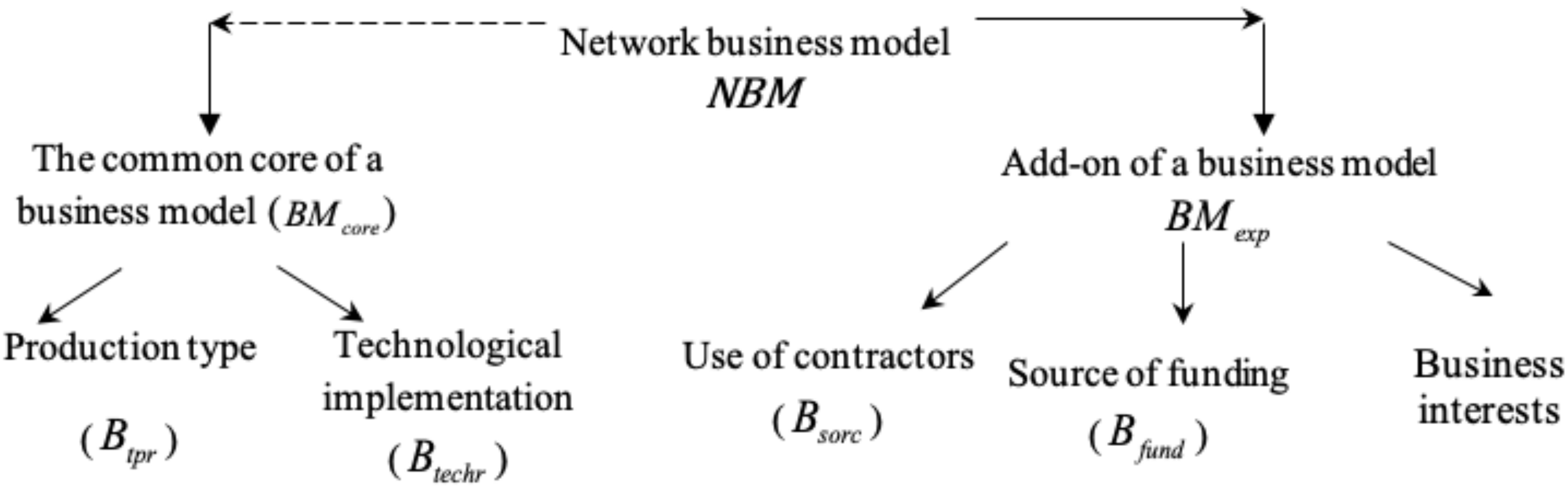
Let us agree that (6) will be referred to as the "*core*" business model, as these components are specified for any business model type. However, a network business model requires an add-on of several additional components, which will be referred to as *"add-on"* since network components extend the common core of a business model.

Key competencies and innovative potential of an enterprise are the main drivers for choosing a network business model. Key competencies must be specified considering the type of an enterprise and the type of its final product. In this case, key competencies are specified as an activity (Prahalad, & Hamel, 2006). Factors hindering the implementation of the selected business model, defined at an early stage before the final decision, act in the form of risks.

It is convenient to assess potential risks on scales comparing qualitative and quantitative characteristics (Zinder, 2018a, 2018b; Kuzmin, 2015). Thus, the add-on components of the network business model are formed under the influence of resource potential factors, key competencies, and risk levels.

The structure of the network business model components, comprising of the core and the add-on, is shown in Figure 2.

Figure 2. Structure of the network business model components



The algorithm shown in Figure 2 allows decomposing a network business model into the constituent elements. This results in a structure formed by the indicators setting the context for choosing a business model in specific conditions. Moreover, to some extent, they are equated to the business model itself, generating metrics for choosing a network business model.

The component *production type* B_{tpr} takes the values: "single"; "serial"; "mass". The component *technological implementation* B_{techr} takes the values: "electronic communications"; "organizational concepts".
The certainty factor coefficient (*CF*), where (*CF*) takes the values from 0 to 100, belongs to the set of valid values equivalent to the set $\tilde{X}$, formed by equipping the *x* elements of the *X* set with a membership function μ_X, takes values in the interval [0,1]:

$$\tilde{X} = \{\tilde{x}_i\} = \{x_i, \mu_X(x_i)\}, \tag{7}$$

where $\tilde{x}$ is a fuzzy value of index *x*; *X* is a set of acceptable values *x*; is a fuzzy set.
To summarize the factors of confidence, one should use a fuzzy operation $\dot{+}$, set as:

$$CF_x \dot{+} CF_y = CF_x + CF_y - \frac{CF_x \cdot CF_y}{100}, \tag{8}$$

where $\dot{+}$ is a fuzzy addition operation; CF_x is the *x*-th confidence factor; CF_y – is the *y*-th confidence factor.

To multiply the factors of confidence, one should use a fuzzy operation $\dot{*}$, set as:

$$CF_x \dot{*} CF_y = \frac{CF_x \cdot CF_y}{100}, \tag{9}$$

where $\dot{*}$ is a fuzzy multiplication operation; CF_x is the *x*-th confidence factor; CF_y is the *y*-th confidence factor.
Let us agree that estimates of key competencies and resource potential of an enterprise, as well as the degree of risks consequences, will be set on the scale of {*"Low", "Medium", "High"*}. It is assumed that the assignment of the KPI level of key competencies related to the creation of product innovation, resource endowment and the degree of significance of risk consequences of *"Low", "Medium" or "High"* values can be carried out using the expert method based on calculation of the quantitative estimates corresponding to KPI. In turn, fuzzification of indicators, that is, the assignment of confidence factors *(CF)*, can be carried out based on the competence of experts participating in the assessment of these indicators on a qualitative scale.
An example of the production rules for choosing a network business model is shown below:

$$\text{IF } (CC = "Low") \text{ AND } (RP = "High"), \text{ THEN } (a := "+" \text{ AND } CF_a := CF_a \dot{+} (CF_{KC} \dot{*} CF_{RP}))$$

Based on the threshold criteria, positive or indeterminate values are established for the characteristics: *a, b, c, d, e, f, g*:

$$\begin{cases} x = "+", CF_x \geq CF_{min} \\ x = "\text{undefined}", CF_x < CF_{min} \end{cases}, \tag{10}$$

where *x* is a sign of the network business model, *x* ={ *a, b, c, d, e, f, g* }; CF_x is a confidence factor of the positive value of the *x*-th attribute of the network business model; $CF_{\min}$ is a threshold value for setting a sign of a network business model (for example, $CF_{\min} = 50$).
The result is a structure ∑, which contains all the significant features of a network business model. The structure ∑ will be referred to as a *signature* of the network business model. After the signature of a network business model is generated, it is necessary to identify the resulting structure, that is, to come up with a name for the new business model. The authors suggest implementing identification or naming of a business model based on the similarity (Anshakov, 2012) of the business model signature with the lines from Table 1. The line of the table for which the depth of similarity with the signature ∑ is the maximum contains the appropriate name for the network business model. The identification implies recognition of one of the patterns obtained through the network business models classification.

The proposed economic-mathematical model can be used to create an intelligent system designed for engineering network enterprises. The signature approach to identifying business models is based on the theory of similarities, which is widely used in data analysis systems, but unlike these systems, decision-making does not rely on combinatorial methods but is implemented through a production model. The resulting solutions are recommendatory in character and should be conceptually formed at the exit from the DSS. The decisions on choosing a business model will be acceptable while ensuring proper quality of the input data and the knowledge base consisting of production rules. Furthermore, the classification of business models should be supplemented with a sufficient number of patterns. The technical issues of software implementation require further discussion – first, it requires basic recommendations that should be followed in the process of designing and developing intelligent DSS.

5. Conclusions

The complex character of strategic decision-making was the reason why this article is devoted to the creation of software for DSS development in the field of business model engineering. The proposed methodology, based on expert estimates and heuristic rules, allows choosing the best possible business model considering the capabilities of a network enterprise. The features of the proposed method are the use of meta-ontology classification patterns, the use of qualitative scales for assessment, and fuzzy logic rules. The proposed intelligent decision support tools were designed to implement effective strategic planning, maintain flexible organizational and economic mechanisms, and optimal management of the business processes. These tools can provide enterprises with additional competitive advantages.

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