A Decision Support Tool for Business Models Analysis

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ABSTRACT

The business model (BM) concept – which has emerged in scientific literature and business world over the past fifteen years – is a new management concept that, although characterised by fuzzy boundaries, can be synthesized as "the rationale of how an organisation creates, delivers and captures value". Many authors see the BM as an excellent tool for the strategic evaluation of business ideas, but the literature review shows the lack of efficient quali-quantitative tools for evaluating potential BM alternatives and selecting the best BM solution from among them. In this paper we propose a Business Model Decision Support Tool (BM-DST) based on a quali-quantitative methodology of Multiple Criteria Decision Analysis (MCDA) called Analytic Hierarchy Process (AHP) and specifically based on a modified AHP procedure called Value-Analytic Hierarchy Process (V-AHP). A case study with a numerical example was carried out in the field of industrial plants, specifically in the context of the Industrial Product-Service Systems, in order to select the best BM solution from among three potential BM alternatives usually taken into account by Original Equipment Manufacturer (OEM) and Engineering-Procurement- Construction (EPC) company: Transactional Project Deliveries, Project Led Solutions and Life-Cycle Solutions.

Keywords: Business Model Canvas, Multi Criteria Decision Making, Product Service System, Analytic Hierarchy Process, Value-Analytic Hierarchy Process.

1. Introduction

A business model (BM) is "the rationale of how an organisation creates, delivers, and captures value" (Osterwalder and Pigneur 2010) and a business model framework is a comprehensive template used to detect the relevant business variables and their relationships with the company's value proposition. However, the business model concept is relatively new and an accurate literature review shows fuzzy boundaries: there are multiple business model definitions and business model frameworks, which often refer to a specific industrial sector (Muegge 2012, Zott et al. 2011, Al-Debei and Avison 2010).

Many authors consider the BM an excellent tool for the strategic evaluation of business ideas but the literature review shows the lack of efficient quali-quantitative tools for selecting the best BM solution within a set of potential BM alternatives; starting from here we propose an appropriate Business Model Decision Support Tool (BM-DST) based on a quali-quantitative methodology of Multiple Criteria Decision Analysis (MCDA) called Analytic Hierarchy Process (AHP). In this case, a modified AHP procedure called Value-Analytic Hierarchy Process (V-AHP) will be used; this latter combines the traditional AHP procedures for the rating under qualitative criteria and a "lean" procedure for the rating under quantitative criteria (D'Urso et al. 2011).

A case study with a numerical example was carried out in the context of the Industrial Product-Service Systems (Meier et al. 2010). In particular, this case aims to select the adequate BM solution to satisfy both customer needs and business competitiveness, from the point of view of an Original Equipment Manufacturer (OEM) and Engineering-Procurement-Construction (EPC) company. OEM/EPC contractors in fact, are transforming themselves from equipment or turnkey plant sellers to service providers, supporting their clients with many additional services (from maintenance to operational performance management). According to different authors, this servitisation path is a non-reversible integration of product and service activities (Peillon et al. 2015) rather than a continuous transition from a pure product to a pure service offer. Then, this transformation requires a rethinking of business models in order to adapt the servitisation process and a tool to support a conscious decision about different BM alternatives.

2. Literature Review

The evolution of business model studies shows different authors trying to explore theoretical foundations of value creation in emerging business: e-commerce (Timmers 1998) and e-business (Amit and Zott 2001). Timmers provided a business model framework for the classification of internet electronic commerce based on four components: architecture, value proposition, business actors and roles, revenue sources. Amit and Zott examined the business model of 59 American and European companies, concluding that the potential value creation of e-businesses hinges on four interdependent dimensions: efficiency, complementarities, lock-in, and novelty. Chesbrough and Rosenbloom (2002) explored the role of the business model in capturing value from technology: the authors state that the ultimate role of the business model for an innovative solution is to ensure that the technological core of the innovation is embedded in an economically viable enterprise. Their framework is based on market, value proposition, value chain, cost and profit, value network, and competitive strategy. Starting from the numerous business failures related to the internet boom, Magretta (2002) clarified that a good business model is essential for each successful organisation. According to him, business models are stories that explain how enterprises work and describe, as a system, how the pieces of a business fit together. He detects only three components of the business model framework: value proposition, customers, and revenue sources.

Other authors extended the components of the business model framework to six: e.g. value proposition, customers, resources, network, and architecture, structure (Hedman and Kalling 2003); value proposition, customer, internal processes and skills, external positioning, economic model, personal and investor factors (Morris et al., 2005).

In order to determine whether a firm should modify its business model, Johnson et al. (2008) identified these steps: articulate what makes an existing model successful, watch for signals that the model needs changing, and decide whether reinventing the model is worth the effort. According to this approach, they propose a framework with three components: customer value proposition, profit formula, key resources and key processes. Zott and Amit (2008) examine the fit between a firm's product market strategy and its business model. They develop a formal model in order to analyse the effects of product market strategy and business model choices on the firm performances and arrive to the conclusion that business model and product market strategy are complementary to each other, not substitutes. According to this model two latent variables characterise the design themes of a business model (novelty and efficiency), and other three latent variables characterise the product market positioning of the firm (differentiation, cost leadership and timing of entry). In 2009, Bailetti proposed a tool that enables a product team to design a strong business model at the initial stage of life cycle. The tool is offer-centric i.e. a business model is linked to an offer, not to a business unit or a product portfolio. According to Bailetti, six variables affect the strength of a business model: significance, customer value, partner value, profit, leverage, intellectual property. Doganova and Eyquem-Renault (2009) investigate the role played by business models in the innovation process. They adopt a pragmatic approach to business models examining them as market devices, focusing on their materiality, use and dynamics. They show that the business model is a narrative and calculative device that allows entrepreneurs to explore a market and plays a performative role by contributing to the techno-economic network construction of an innovation. Key components of business models are product, customer, partners, value, profits and costs. A hierarchical taxonomy of the business model concepts, from which develop a more comprehensive framework appropriate to the business complex nature, was proposed by Al-Debei and Avison (2010). The framework presented by Casadesus-Masanell and Ricart (2010) allows a simple integration of the notions of strategy, business model and tactics. In their formulation, strategy and business model, though related, are different concepts: a business model is the direct result of strategy but is not, itself, strategy. They consider a three components business model framework: resources and competences, internal and external organisation, value propositions. According to Teece (2010), business model is significant for its connections with business strategy, innovation management and economic theory, so he developed a business model framework, which includes technologies and features of product/service, customer benefit, market segment, revenues stream, mechanism to capture value. Johnson (2010) identifies four

fundamental building blocks by means a business model works: the customer value proposition that meets a real customer needs; the profit formula that lays out how a company makes money delivering the value proposition; the key resources required by value proposition; the key processes needed to deliver it. These are a subset of the nine components proposed by Osterwalder and Pigneur (2010) who provide a tool for describing, analysing, and designing business models (customer segments, value propositions, channels, customer relationships, revenue streams, key resources, key activities, key partnerships, cost structure). Osterwalder and Pigneur proposed the Business Model Canvas tool to support business models design according with their framework.

Zott et al. (2011) found emerging common themes among scholars of business models. The business models emphasise a system-level and holistic approach to explaining how firms "do business". Firm activities play an important role in the various conceptualisations of business models proposed: business models seek to explain how value is created, not just how it is captured. In this context, they developed a framework based on value creation, performance, and competitive advantage. George and Bock (2011) discuss the nature and implications of dimensional dominance for firm characteristics and behaviour. These findings provide new directions for theory development and empirical studies in entrepreneurship by linking the business model to entrepreneurial cognition, opportunity co-creation and organisational outcomes. More recently, Baden-Fuller and Haefliger (2013) state that business models are fundamentally linked with technological innovation but the business model construct is essentially separable from technology. They define the business model as a system that solves the problem of identifying who is the customer, engaging with their needs, delivering satisfaction, and monetizing the value. The proposed framework depicts the business model system as a model containing cause and effect relationship.

Table 1 describes, in a non-exhaustive way, the evolution of the business model definition and framework, analysing most relevant scientific contributions given during the years 1998-2016.

Year	Author(s)	Title	BM Definition	BM Framework Components
1998	Timmers	Business models for electronic markets	"an architecture of the product, service and information flows, including a description of the various business actors and their roles; a description of the potential benefits for the various business actors; a description of the sources of revenues."	• architecture • value proposition • business actors and roles • revenue sources
2001	Amit and Zott	Value creation in e-business	"the content, structure, and governance of transactions designed so as to create value through the exploitation of business opportunities."	• complementarities • lock-in • efficiency • novelty
2002	Chesbrough and Rosenbloom	The role of the business model in capturing value from innovation: evidence from Xerox corporation's technology spinoff companies	"a coherent framework that takes technological characteristics and potentials as inputs, and converts them through customers and markets into economic inputs. The business model is thus conceived as a focusing device that mediates between technology development and economic value creation."	• market • value proposition • value chain • cost and profit • value network • competitive • strategy
2002	Magretta	Why business models matter	"stories that explain how enterprises work. A good business model answers Peter Drucker's age old questions: Who is the customer? And what does the customer value? It also answers the fundamental questions every manager must ask: how do we make money in this business? What is the	• value proposition • customers • revenue sources

Year	Author(s)	Title	BM Definition	BM Framework Components
			underlying economic logic that explains how we can deliver value to customers at an appropriate cost?"	
2003	Hedman and Kalling	The business model concept: theoretical underpinnings and empirical illustrations	"a term often used to describe the key components of a given business. That is customers, competitors, offering, activities and organisation, resources, supply of factors and production inputs as well as longitudinal process components to cover the dynamics of the business model over time"	• resources • customers • value proposition • network • architecture • structure
2005	Morris et al.	The entrepreneur's business model: toward a unified perspective	"concise representation of how an interrelated set of decision in the areas of venture strategy, architecture, and economics are addressed to create sustainable competitive advantage in defined markets"	• value proposition • customer • internal processes/skills • external positioning • economic model • personal/investor factors
2008	Johnson et al.	Reinventing your business model	"consist of four interlocking elements (customer value proposition, profit formula, key resources, and key processes), that, taken together, create and deliver value"	• customer value proposition • profit formula • key resources • key processes
2008	Zott and Amit	The fit between product market strategy and business model: implications for firm performance	"a structural template of how a focal firm transacts with customers, partners, and vendors; that is, how it chooses to connect with factor and product markets. It refers to the overall gestalt of these possibly interlinked boundary-spanning transactions"	• novelty • efficiency • differentiation • cost leadership • timing of entry
2009	Bailetti	How open source strengthens business models	"the narrative and expected profit and loss statement that define the: importance of getting the job done, solving the problem, or satisfying the need; value delivered to customers, company and other key stakeholders; control over or access to the key resources, processes, and norms required to deliver value"	• significance • customer value • partner value • profit • leverage • intellectual property
2009	Doganova and Eyquem-Renault	What do business models do? Innovation devices in technology entrepreneurship	"a narrative and calculative device that allows entrepreneurs to explore a market and plays a performative role by contributing to the construction of the techno-economic network of an innovation"	• product • customer • partners • value • profits • costs
2010	Al-Debei and Avison	Developing a unified framework of the business model concept	"an essential conceptual tool of alignment in digital business. It can be depicted as an intermediate layer between business strategy and ICT-enabled business processes in order to fulfil the missing link created by the complexity of the digitalised environment"	• value proposition • value network • value architecture • value finance
2010	Casadesus-Masanell and Ricart	From strategy to business models and onto tactics	"a reflection of the firm's realised strategy	• resources and competences • internal/external organisation • value propositions • customer value proposition
2010	Johnson	Seizing the white space	"the way in which a company delivers value to a set of	

Year	Author(s)	Title	BM Definition	BM Framework Components
			customers at a profit"	• profit formula • key resources • key processes • customer segments • value propositions • channels • customer relationships • revenue streams
2010	Osterwalder and Pigneur	Business model generation: a handbook for visionaries, game changers, and challengers	"the rationale of how an organisation creates, delivers and captures value"	• key resources • key activities • key partnerships • cost structure
2010	Teece	Business models, business strategy and innovation	"the manner by which the enterprise delivers value to customers, entices customers to pay for value, and converts those payments to profit"	• technologies and features of product/service • customer benefit • market segment • revenues stream • mechanism to capture value
2010	Zott and Amit	The business model: recent developments and future research	"a system of interdependent activities that transcends the focal firm and spans its boundaries"	• value creation • performance • competitive advantage
2011	George and Bock	The business model in practice and its implications for entrepreneurship research	"is commonly described and reflects on organisational design, the resource-based view of the firm, narrative and sensemaking, the nature of innovation, the nature of opportunity, and transactive structures"	• resource structure • organisational design • transactive structure • value structure
2012	Muegge	Business model discovery by technology entrepreneurs	"an explanation of how the business delivers value to a set of customers at attractive profits"	• importance • stakeholders value propositions • profit formula • capabilities
2013	Baden-Fuller and Haefliger	Business Models and Technological Innovation	"a system that solves the problem of identifying who is (or are) the customer(s), engaging with their needs, delivering satisfaction, and monetizing the value"	• Customer • Customer engagement • Value delivery and linkages • Monetization

Table 1. Synthesis of studies, definitions and framework components of BM

The literature review on BM framework allows stating that:

- many definitions of BM have been proposed in literature;
- several BM frameworks have been proposed by the authors;
- the number of different BM framework components is into the range [3-9];
- no qualitative-quantitative Business Model Decision Support Tool (BM-DST), aimed to select the best BM solution within a set of potential BM alternatives, have been detected.

The most complete framework, having the higher number of component is the Business Model Canvas proposed by Osterwalder and Pigneur (2010). The nine Business Model Canvas components are: key resources (KR), key activities (KA), key partnerships (KP), cost structure (C$), value propositions (VP), channels (CH), customer relationships (CR), customer segments (CS), revenue streams (R$).

Using Business Model Canvas as a basis, number and percentage of frameworks containing each Business Model Canvas component, in a set of twenty BM frameworks analysed, was detected. Results are summarized in Table 2.

	Component of Business Model Canvas Framework								
	KR	KA	KP	C$	VP	CH	CR	CS	R$
Number of BM frameworks containing the component	7	6	7	7	18	2	1	6	10
Percentage of BM frameworks containing the component	35%	30%	35%	35%	90%	10%	5%	30%	50%

Table 2. BM frameworks containing each Business Model Canvas component

Table 2 shows that value propositions (VP) is the most common component detected. Revenue streams (R$) component is present in half of the cases and about one-third of the analysed framework contains key resources (KR), key activities (KA), key partnerships (KP), cost structure (C$) and customer segments (CS) as components while uncommon are the components channels (CH) and customer relationships (CR).

The framework of Osterwalder and Pigneur was used in recent studies as a starting point for specific applications (Bocken et al. 2014) and to support the implementation of Product-Service Systems. Business Model Canvas was used to identify and classify the characteristics of the PSS business model (Barquet et al. 2011), to analyse the company business context and allow the choice of the appropriate type of PSS (Barquet et al. 2013; Adrodegari et al. 2016), also, to support PSS business model definition in the capital goods companies (Azevedo and Ribeiro 2013; Peillon et al. 2015).

Referring to the lack of a Business Model Decision Support Tool (BM-DST), literature review concerning the evaluation of potential BM alternatives shows that some authors have addressed, although marginally, the issue of evaluation of potential BM solutions, often just to validate the BM framework proposed by the same authors (Osterwalder et al. 2002; Osterwalder and Pigneur 2010; Casadesus-Masanell and Ricart 2010). Muegge (2012) provides a tool for business model analysis, which includes an operative process, and a worksheet for describing a business model in concise and explicit manner. Hacklin and Wallnöfer (2012) explored the implications and limitations of applying the business model as a strategising device.

The BM frameworks oriented to the evaluation of potential BM alternatives are largely qualitative; just two cases out of ten (Bailetti 2009; Shin and Park 2009) are defined by the authors as quantitative evaluation models, but they really cannot be classified as Business Model Decision Support Tool.

Boritz and White (2016) provided a synthesis of the research performed on business models, focusing on how business models are defined, what elements are considered in different frameworks, and how they can be presented to stakeholders to enable and enhance their understanding of an entity's value creation process. They argue that business models can be used by managers to identify the strengths and weaknesses of their value creation process, by auditors to assist in engagement planning and execution, and by analysts and investors to evaluate the value that an entity creates and will continue to create in the future. In addition, various stakeholders could use business model descriptions for a better understanding of the relationship between an entity's strategy, resources and outcomes as well as related risks.

3. Methodological approach

Advantages and disadvantages, costs and benefits that characterize decisions depend on multiple, often conflicting, points of view or criteria used in decision-making activity. Since Seventies, Multiple Criteria Decision Analysis (MCDA) is a mathematical discipline which offers a realistic and naturally multidimensional approach to decision theory (Bouyssou et al. 2000; Figueira et al. 2005; De Felice and Petrillo 2013) generating a considerable interest among scientists. In late Seventies, Saaty (1976) developed the Analytic Hierarchy Process, a

MCDA methodology based on pairwise comparisons among criteria and alternatives, in order to obtain an overall ranking able to represent a "rational decision". The pairwise comparison, i.e. the definition of a relative importance between entities, according to a criterion, allows the priorities definition for intangible entities, which are free of scales of measurement by definition, but also for tangible entities evaluable on scales with "zero" point and measurement units (Aczel and Saaty 1983; De Felice and Petrillo 2014).

A recent research work (Compagno et al. 2013) simplifies the traditional AHP methodology introducing the V-AHP version, as shown in Figure 1. The graph shows the flowchart of the V-AHP decision making process, which includes:

1. the definition of the evaluation general objective;
2. the selection of evaluation criteria and sub-criteria;
3. the AHP-R rating of evaluation criteria and sub-criteria;
4. the analysis of the qualitative and quantitative performances of the alternatives;
5. the distinction between quantitative and qualitative criteria;
6. the use of the traditional "lean" rating in a relationship scale for the quantitative criteria;
7. the use of the relative AHP rating or of the absolute one (i.e. Saaty Scale) for the qualitative criteria;
8. merging/composition between "lean" rating and AHP one for the definition of the ranking of alternatives.

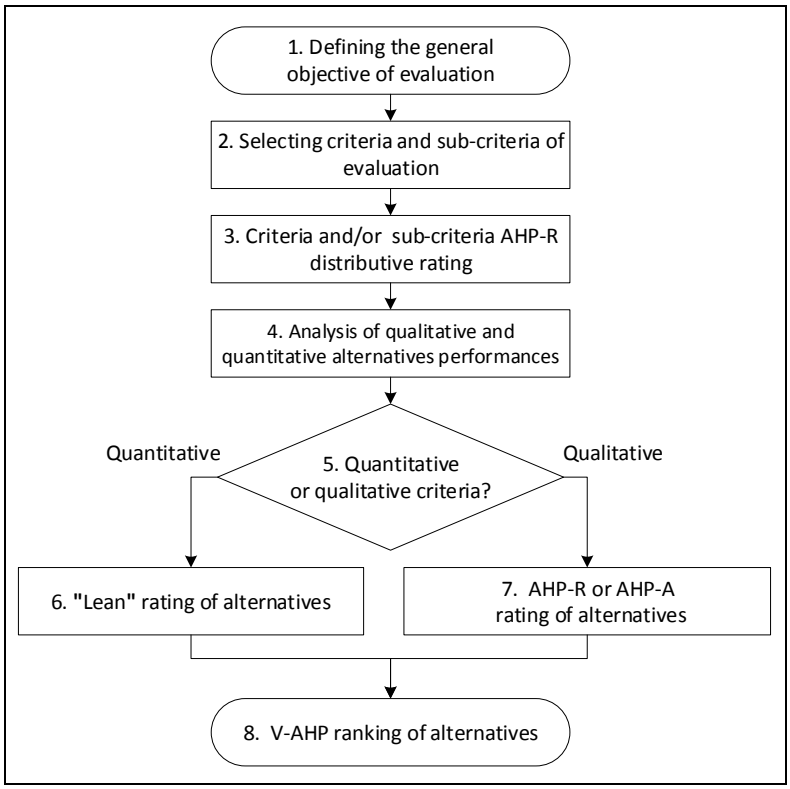

Figure 1. V-AHP procedure

Studies on V-AHP arise from the need, highlighted by Saaty (1986), to set priorities by pairwise comparisons for both entities: intangible ones, by definition without scales, and tangible ones, evaluable on scales with "zero" point and measurement units.

The Value-Analytic Hierarchy Process allows the ranking of alternatives; it is the combination of traditional AHP rating on qualitative criteria and "lean" rating on quantitative criteria. The latter is obtained by the ratio between the value of performance related to the *i*-

th alternative and the sum of performance values related to all the alternatives under consideration.

For the analytical discussion of the V-AHP we consider the array *L* having, as components, *n* quantitative performance values on ratio scale:

$$L = \begin{bmatrix} l_1 \\ \vdots \\ l_n \end{bmatrix} \quad (1)$$

The pairwise comparison, operated by the ratio of the *n* quantitative performance values, gives a matrix *B* having size $n \times n$, rank 1 and principal eigenvalue $\lambda_{max} = n$; columns of the matrix B are the linear combinations of *n* quantitative performance values.

$$B = \begin{bmatrix} \frac{l_1}{l_1} & \cdots & \frac{l_1}{l_n} \\ \vdots & \ddots & \vdots \\ \frac{l_n}{l_1} & \cdots & \frac{l_n}{l_{nj}} \end{bmatrix} \quad (2)$$

It is therefore valid the following equation:

$$\boldsymbol{BL = nL} \quad (3)$$

which can be expressed in a matrix form:

$$\begin{bmatrix} \frac{l_1}{l_1} & \cdots & \frac{l_1}{l_n} \\ \vdots & \ddots & \vdots \\ \frac{l_n}{l_1} & \cdots & \frac{l_n}{l_{nj}} \end{bmatrix} \begin{bmatrix} \boldsymbol{l_1} \\ \vdots \\ \boldsymbol{l_n} \end{bmatrix} = \boldsymbol{n} \begin{bmatrix} \boldsymbol{l_1} \\ \vdots \\ \boldsymbol{l_n} \end{bmatrix} \quad (4)$$

Array *L*, having as components the *n* quantitative performance values, is then, for the matrix B, the principal eigenvector associated with the principal eigenvalue $\lambda_{max} = n$.

Array *W*, containing the local weights of the *n* quantitative performance values, is normalised on unit; it can be obtained by ratio of quantitative performance values, without the implementation of the traditional Saaty AHP procedure. In particular, the distributive rating is realised by the ratio between the value of the performance related to the *i-th* alternative and the sum of the performance values related to all the alternatives under consideration (5); the ideal rating is then obtained by operating the ratio between the quantitative performance value related to the *i-th* alternative and the maximum quantitative performance value among the *n* alternatives under consideration (6).

$$w_i = \frac{l_i}{\sum_{i=1}^{n} l_i} \quad (5)$$

$$w_i^I = \frac{l_i}{max_{i=1}^{n}\{l_i\}} \quad (6)$$

In this section, a Business Model Decision Support Tool (BM-DST) able to evaluate potential BM alternatives is presented. This BM-DST is based on a modified MCDA AHP procedure called Value-Analytic Hierarchy Process.

The overall objective of the decision-making process, at the first level of AHP hierarchy, is the selection of the best BM solution in a finite and bounded set of potential BM alternatives identified and assessed by the decision makers.

Evaluation criteria of potential BM alternatives, at the second level of the AHP hierarchy, are the BM framework components belonging to the framework selected; thus, they are the BM framework criteria used in decision analysis.

The object to evaluate, at the third level of the AHP hierarchy, are potential BM alternatives that decision maker intends to compare each other, in order to choose the best BM solution in a rational way, taking into account overall objective and predefined criteria.

The process based on the proposed BM-DST is shown in Figure 2 and it consists of nine phases that can be overlapped with the V-AHP procedure described in Figure 1.

BM-LDSS process consists of:

1. BM framework selection;
2. BM framework criteria identification;
3. AHP rating of BM framework criteria;
4. BM alternatives identification;
5. Quantitative/qualitative criteria discerning;
6. Rating "lean" of BM alternatives under quantitative criteria,
7. AHP rating of BM alternatives under qualitative criteria;
8. V-AHP rating of BM alternatives;
9. Best BM solution selection.

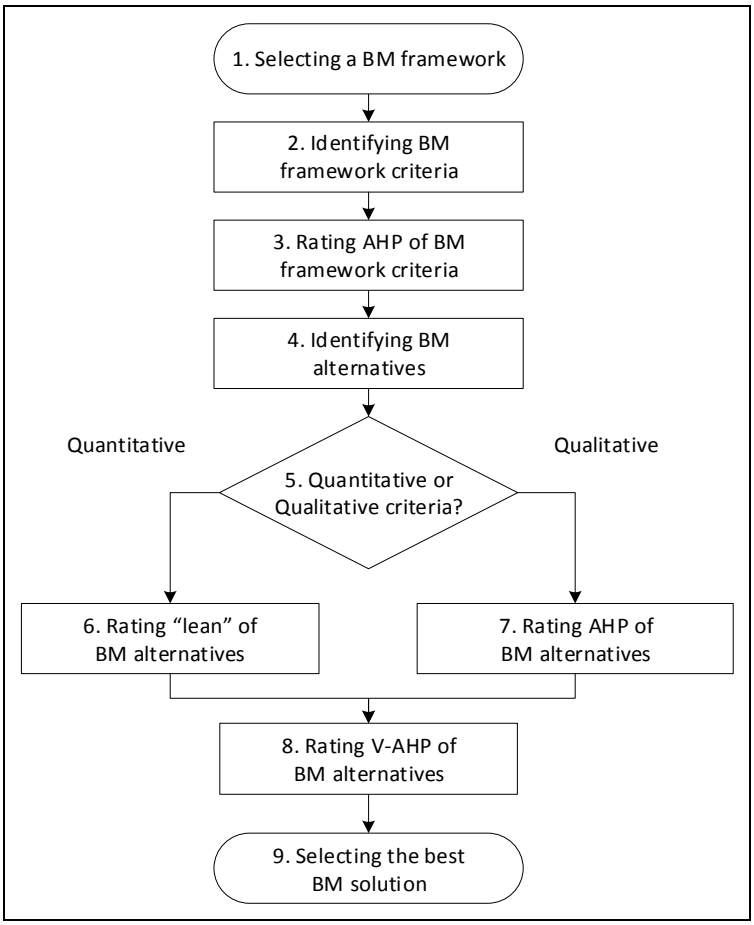

Figure 2. Business Model Decision Support Tool (BM-DST) process

Steps from 1 to 4 can be defined as stages of the BM-DST creation: we select a BM framework by which to build and evaluate BM alternatives, also identifying qualitative and quantitative BM framework components i.e. identifying evaluation criteria of BM alternatives. The AHP based rating of BM framework criteria is calculated in order to identify a finite and bounded number of BM alternatives for next evaluation step.

Phases from 5 to 7 can be defined as evaluation phases of BM alternatives: a distinction is made between quantitative criteria for which a "lean" rating of alternatives is executed and qualitative criteria for which the traditional AHP rating of alternative is considered; finally, we calculate V-AHP rating of alternatives.

Phase 8 is the selection phase of the best BM solution among the potential BM alternatives previously identified and evaluated. It is logical to select the business solution with a

maximum V-AHP rating value, but it is also opportune to remember that a decision support system does not replace the decision maker in decision-process but just supports his/her activity.

4. Case study

A case study and the related numerical example is presented, concerning the proposed Business Model Decision Support Tool (BM-DSTS) in order to compare "Pure Product" (PP) selling (where product is a turnkey industrial plant) with "Product-Service System" (Tukker 2004) according to the definition of "Product-Oriented System" (POS) and "Use-Oriented System" (UOS) shown in Figure 3.

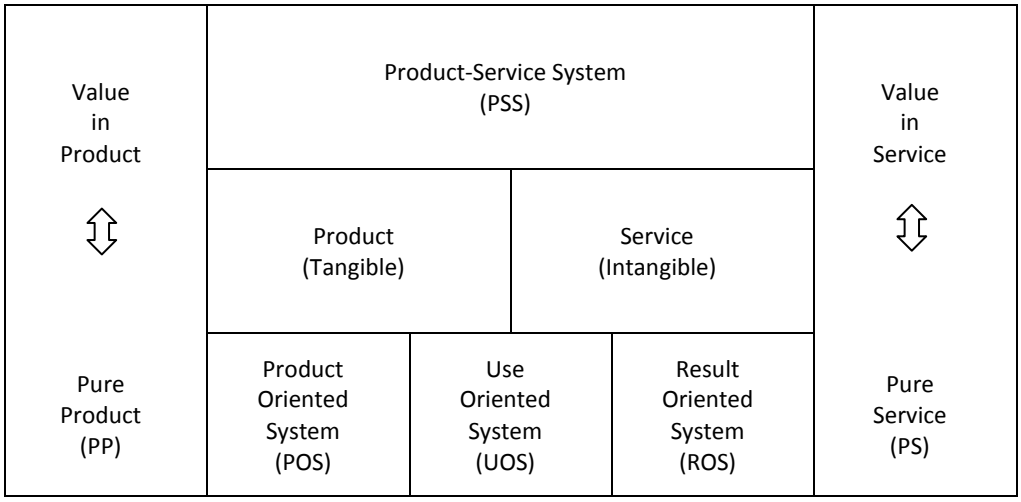

Figure 3. Classification of PSS proposed by Tukker (2004).

Analysing a similar issue, Kujala et al. (2010) described a specific six components BM framework and identified three potential business solutions:

(A) Transactional Project Deliveries which are simple system without additional service components (i.e. PP);

(B) Project Led Solutions in which operational services are important parts of the offering but the core is still the project delivery (i.e. POS);

(C) Life-Cycle Solutions where project and service components are offered as a single integrated solution (i.e. UOS) for the asset performance management during asset lifecycle (Kujala et al. 2011). This solution requires a durable partnership between the contractor and its customer.

Starting from the above-mentioned results obtained by Kujala et al., a new BM-DST is proposed in order to evaluate the three potential business solutions and to select the best one based on a defined strategy. The following steps refer to each phase shown in Figure 2:

1. The judgments were expressed through a dedicated brainstorming, by a panel of five industrial plant experts assuming the role of decision makers adopting the perspective of a company (OEM provider or EPC general contractor) which is able to extend its value proposition from solution (A) to (C). One of the experts had the role of customer, in order to take into account the customer point of view and its relevance in PSS business.
2. The BM framework, selected by the decision maker to carry out the numerical example, is the Business Model Canvas proposed by Osterwalder and Pigneur (2010) which defined a BM as "the rationale of how an organisation creates, delivers and captures value".
3. The identified BM framework's criteria are the nine Business Model Canvas components:
    - customer segments (CS);

- value propositions (VP);
- channels (CH);
- customer relationships (CR);
- revenue streams (R$);
- key resources (KR);
- key activities (KA);
- key partnerships (KP);
- cost structure (C$).

Osterwalder and Pigneur identified in the Business Model Canvas two areas:

- the efficiency area, containing the components key resources (KR), key activities (KA), key partnerships (KP), cost structure (C$), and
- the value area, containing the components customer segments (CS), value propositions (VP), channels (CH), customer relationships (CR), revenue streams (R$).

4. The Analytic Hierarchy Process (AHP) generates a rating of BM framework criteria. The pairwise comparison matrix of the nine Business Model Canvas components, shown in the first ten columns of Table 3, was performed using the Saaty fundamental scale. In this specific numerical example, judgments underline a BM based on the offered value with emphasis on value propositions (VP) and revenue streams (R$).

	KR	KA	KP	C$	VP	CH	CR	CS	R$	W_C
KR	1	1	1	1	1/9	1/5	1/5	1/5	1/7	4%
KA	1	1	1	1	1/9	1/5	1/5	1/5	1/7	4%
KP	1	1	1	1	1/9	1/5	1/5	1/5	1/7	4%
C$	1	1	1	1	1/9	1/5	1/5	1/5	1/7	4%
VP	9	9	9	9	1	1	5	5	3	33%
CH	5	5	5	5	1	1	1	1	1/3	12%
CR	5	5	5	5	1/5	1	1	1	1/3	9%
CS	5	5	5	5	1/5	1	1	1	1/3	9%
R$	7	7	7	7	1/3	3	3	3	1	21%

Table 3. Criteria pairwise comparison matrix and results

The value area dominates the efficiency area: i.e. company is strategically focused on actions to increase customer satisfaction and loyalty offering a high value, without sacrificing revenue. The maximum normalized eigenvector W, shown in the last column of Table 3, reflects judgments made by the decision maker. The consistency ratio assumes the value CR = 0.03 (sufficiently lower than the suggested threshold value 0.10). best business solution within a set of potential business alternatives.

5. BM alternatives are the three above-mentioned potential business solutions: (A) Transactional Project Delivery, (B) Project Led Solution, (C) Life-Cycle. Figure 4 shows a graphic framework of the BM-DST based on Business Model Canvas.

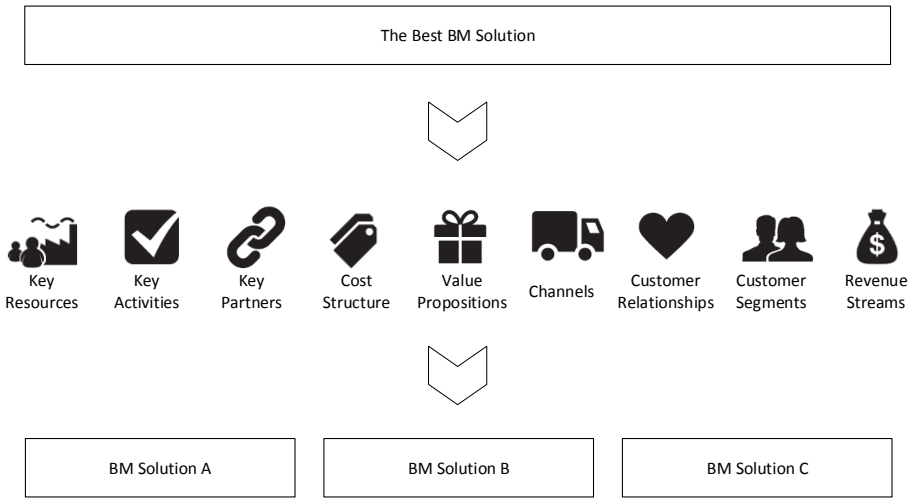

Figure 4. Business Model Canvas Decision Support System

6. In this numerical example only the cost structure (C$) is a quantitative criterion, while the other BM components are qualitative criteria.

7. The cost structure (C$) describes all costs (e.g. only EPC costs in case A plus service and operations management costs in case B and C) that the company would sustain for each business solution. Financial flows are considerably different from transactional project (PP case would provide a reduced time scale for return on investment for the company) to UOS solution for which the cash-flow is extended to the product operational period and payment could be based on the PSS operational performances, as defined in the provider-customer agreement. The actual costs for each solution was then calculated obtaining the values reported in Table 4. The "lean" rating of BM alternatives under quantitative criteria was carried out as described in § 2 equation 5. Table 4 shows: cost values on monetary scale, inverse of cost values, "lean" rating of alternatives calculated on inverse cost values, in order to prefer the alternative with minimum cost.

C$	**[M€]**	**[M€$^{-1}$]**	**$W_{C\$}$**
A	12.50	8.00E-02	40%
B	15.00	6.67E-02	33%
C	18.00	5.56E-02	27%

Table 4. The "lean" rating of a quantitative BM criterion

8. AHP rating of BM alternatives under each qualitative criterion was carried in the traditional manner. Table 5 shows pairwise comparison matrix, maximum normalized eigenvector and consistency ratio of the BM alternatives under each qualitative criterion. The elements which guided the alternative assessment for each criterion are discussed below.

KR	A	B	C	W_{KR}	
A	1	1/3	1/3	14%	
B	3	1	1	43%	
C	3	1	1	43%	CR=0.00
KA	A	B	C	W_{KA}	
A	1	1/3	1/7	8%	
B	3	1	1/5	19%	
C	7	5	1	73%	CR=0.06
KP	A	B	C	W_{KP}	
A	1	1/3	1/5	10%	

B	3	1	1/3	26%	
C	5	3	1	64%	CR=0.03
VP	A	B	C	W_{VP}	
A	1	1/3	1/5	10%	
B	3	1	1/3	26%	
C	5	3	1	64%	CR=0.03
CS	A	B	C	W_{CS}	
A	1	1/3	1/3	14%	
B	3	1	1	43%	
C	3	1	1	43%	CR=0.00
CH	A	B	C	W_{CH}	
A	1	1/3	1/3	14%	
B	3	1	1	43%	
C	3	1	1	43%	CR=0.00
CR	A	B	C	W_{CR}	
A	1	1/3	1/5	10%	
B	3	1	1/3	26%	
C	5	3	1	64%	CR=0.03
R$	A	B	C	$W_{R\$}$	
A	1	1/3	1	20%	
B	3	1	3	60%	
C	1	1/3	1	20%	CR=0.00

Table 5. Alternatives pairwise comparison matrix and results

Key resources (KR) can be physical, financial, intellectual, or human resources which allow a company to deliver the value proposition to different market segments. They can be owned or leased by the company or acquired from key partners. According to Kujala et al. (2010) the OEM tends to offer a POS solution to customers with limited skills in maintenance service, and a UOS solution to customers who perceives the technological complexity of the offered product. PSSs business model requires considerable investments specifically for human resources recruitment (Barquet et al. 2011), corporate culture and top management commitment (Adrodegari et al. 2016).

In order to operate successfully, a business model requires the execution of key activities (KA). The PP transactional solution emphasize core capability in physical product, separate service units, product RandD (Galbraith 2002; Helander and Möller 2007; Oliva and Kallenberg 2003). The PSS providers have to guarantee other key activities before, during and after the unit operations (Barquet et al. 2011), so that service delivery can generate value for the customer: POS solution require localisation and centralisation of tasks, service capacity utilisation (Helander and Möller 2007; Oliva and Kallenberg 2003); life-cycle, user-oriented solution (UOS) point out customer-facing units, strategic role of marketing, business/market competencies, solution repeatability (Davies et al. 2006; Vargo and Lusch 2004).

The key partnerships (KP) component highlights the network of suppliers and partners who cooperate to achieve business success. Companies create partnerships for many reasons: optimise their business models, reduce risk or acquire (key) resources or (key) activities. This element was evaluated through the nature of relationships (long/short term, price/strategic based) and the position in the value network (Adrodegari et al. 2016). About the case study: PP solution involves the management of supplier network, services and non-core business (Cohen et al. 2006; Davies 2004; Helander and Möller 2007), in POS solution PSS provider often use network service companies that limit customisation (Davies 2004; Oliva and Kallenberg 2003; Windahl et al. 2004); life-cycle solution emphasize large share of value stream, of data and information, the role of external partners and a network of customers (Cova and Salle 2008; Davies 2004; Windahl et al. 2004).

The value propositions component (VP) describes the set of products and services that create value for a specific customer segment, solving a problem or satisfying a

need. PP solution offers cutting-edge product, warranty and spare-parts availability (with additional costs for customer) to ensure the proper functionality of the system (Galbraith 2002; Gebauer 2008; Markeset and Kumar 2004), this solution is preferred by customers who perceive the ownership of the product as a value. In PSS solutions it is necessary to define what the customer consider as a source of value: in POS solution it could be the reduction of the capital costs and known operational costs (Gebauer 2008); in UOS solution the co-development, with the PSS provider, of a solution that offers best performance and outcome (Davies 2004; Davies et al. 2006; Vargo and Lusch 2004), according to PSS provider service portfolio.

The customer segments component (CS) defines the different groups of people or organisations an enterprise aims to reach and serve. Transactional project deliveries (PP) are usually intended for customers with independent strategies and in-house technological know-how (Helander and Möller 2007; Markeset and Kumar 2003). Project led solution (POS) are preferred by customers for which maintenance is a non-core process, so that flexibility can be reached through outsourcing (Gebauer 2008; Oliva and Kallenberg, 2003; Windahl et al. 2004). UOS solution is preferred by customers who rely on PSS provider expertise to optimize operations and who accept to engage itself in long-term relationships (Davies 2004; Penttinen and Palmer 2007; Windahl et al. 2004; Adrodegari et al. 2016).

The channels component (CH) describes how a company communicates with and reaches its customer segments to deliver a value proposition. Referring to the supplier's marketing approach, Kujala et al. (2011) argued that PSS providers have more success in deliver a PSS solution (POS or UOS business model) when the project supplier has a proactive marketing approach. Proactive marketing and co-creation of the life-cycle offering is suggested to be especially useful when the solution is perceived to be complex and risky (Crespin-Mazet and Ghauri 2007) and the PSS solution can be offered and priced as more attractive than the transactional solution.

The customer relationships component (CR) highlights the types of relationships a company establishes with specific customer segments. According to Oliva and Kallenberg (2003) and Kujala et al. (2010), customer relationships increases along a continuum from the transactional project deliveries (PP) to the user-oriented solution (UOS). In this scenario the emphasis of the business model changes from transactional to relationship-based.

The revenue streams component (R$) represents the cash-flow a company generates from each customer segment. A business model can involve two different types of revenue streams: transaction revenues resulting from one-off customer payment or recurring revenues resulting from ongoing performance-based payments or from post-purchase customer support deliveries. PP solution determine transactional revenue (Cohen et al. 2006; Markeset and Kumar 2005; Slywotsky et al. 1998); in the project led solutions (POS) the company accepts to assume a part of operational risks and it can be rewarded with a premium (Oliva and Kallenberg 2003; Sawhney 2006); UOS solution determine gain-sharing, performance guarantees, solution profits, pricing on second-best options (Davies et al. 2006; Sawhney 2006; Slywotzky et al. 1998).

9. V-AHP rating of BM alternatives was obtained combining results of Table 3, Table 4 and Table 5. In particular, Table 3 shows local weights of BM framework criteria; Table 6, arising as combination of Table 4 and Table 5, depicts local weight of BM alternatives. Figure 5 summarizes local weight graphically.

	KR	KA	KP	C$	VP	CH	CR	CS	R$
A	14%	8%	10%	40%	10%	14%	10%	14%	25%
B	43%	19%	26%	33%	26%	43%	26%	43%	60%
C	43%	73%	64%	27%	64%	43%	64%	43%	15%

Table 7. Local weight of BM alternatives

V-AHP rating of BM alternatives is then obtained applying the principle of hierarchical composition in order to calculate BM alternatives global weights by processing the matrix product between the 3×9 matrix of the BM alternatives local weight and the 9×1 array of the BM criteria global weights.

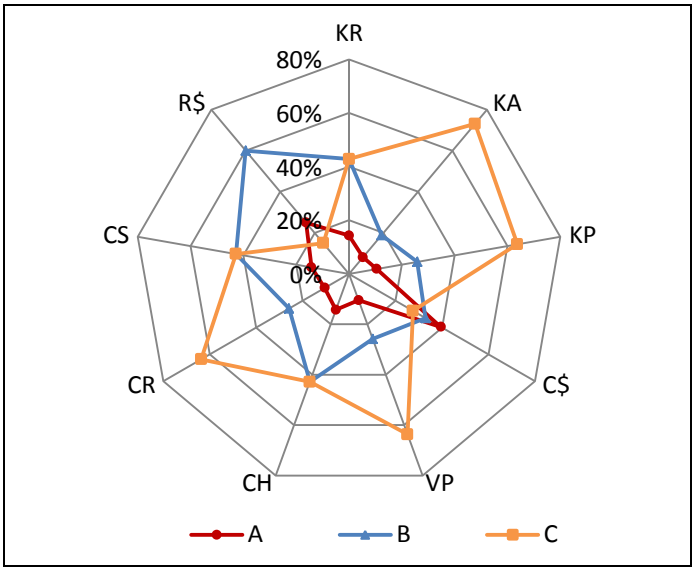

Figure 5 Local weights of BM alternatives

Table 7 and Figure 6 show the BM alternatives global weights i.e. V-AHP rating of evaluated BM alternatives.

BM alternative	V-AHP rating
A	16%
B	37%
C	47%

Table 7. Rating V-AHP of BM alternatives

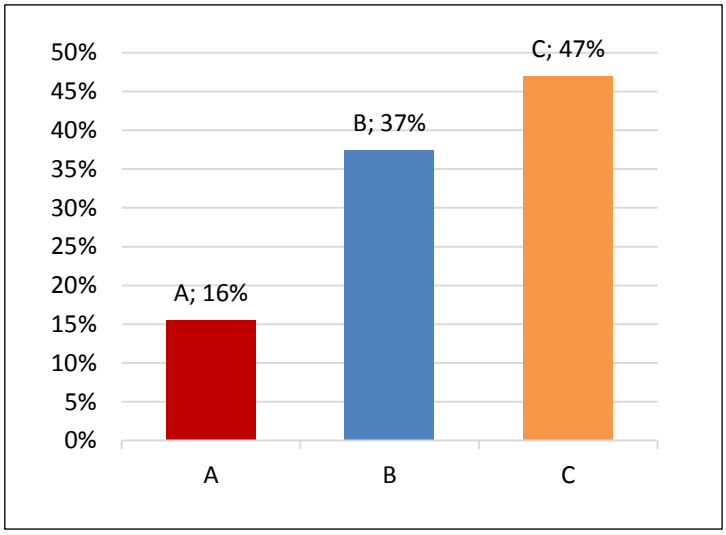

Figure 6 V-AHP rating of BM alternatives

The business alternative to select, based on results of the implemented Business Model Decision Support Tool (BM-DST), is the business alternative (C) UOS solution which, with a global weight of 47%, emphasize the PSS Used-Oriented Performance.

6. Conclusions

Over the past fifteen years the BM concept has emerged in scientific literature and business world: it can be seen as a tool for strategic business analysis still not very mature and affected by uncertainty in definition and use. In the broad set of definitions characterizing the BM concept, one which we intend to consider for the purposes of this paper defines it as "the rationale of how an organisation creates, delivers and captures value".

Many authors consider the BM an excellent tool for the strategic evaluation of business ideas but, probably because of the young age of the concept, only few of them have ventured into the design of a specific tool to evaluate potential business solutions: the literature review shows just two cases out of ten defined by the authors as quantitative evaluation models but in fact not classifiable as real Business Model Decision Support Tool (BM-DST).

In this paper we propose a Business Model Decision Support Tool (BM-DST) to evaluate potential business solutions, based on a quali-quantitative methodology of Multiple Criteria Decision Analysis (MCDA) called Analytic Hierarchy Process (AHP); more precisely based on a modified AHP procedure called Value-Analytic Hierarchy Process (V-AHP) here used combining traditional AHP procedures for the rating under qualitative criteria and "lean" procedures for the rating under quantitative criteria.

A numerical example of Business Model Decision Support Tool (BM-DST) based on the Business Model Canvas proposed by Osterwalder and Pigneur (2010) was carried out in the field of industrial plants, specifically in the project-based firms context, in order to select the best BM solutions among: (A) Transactional Project Deliveries (PP), (B) Project Led Solutions (ROS) and (C) Life-Cycle Solutions (UOS).

A software application was implemented by using a common spreadsheet in order to prove the "lean" characteristic of our Business Model Decision Support Tool (BM-DST) which is easy to implement in any business context.

Regarding managerial implications, it is worth emphasizing the possibility that the Business Model Decision Support Tool (BM-DST) offers to decision makers who perform strategic roles within companies: to evaluate the potential business solutions that the same company is able to field and to choose the best one on the basis of points of view or criteria that professionals consider relevant for the development of their company.

Finally, future implications may concern the application of group decision making techniques to take into account several points of view and related weights adopting both a perspective of supplier and customer in order to address the holistic evaluation of business solutions.