IDSS-BM: Intelligent Decision Support System for Business Models

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ABSTRACT

For decision makers, the Business Model is crucial for the success of organizations. It reflects manager's assumptions about what customers want, and how an enterprise can best meet those needs and get paid for. Decision support systems can assist in making Business Model design decisions. However, previous work on decision support systems for business models provides no solution for explaining their reasoning for managers. The purpose of this paper is to discuss the development of a new generation of intelligent decision support system that have ability of providing explanations to increase confidence in proposed solutions. The intelligent system by giving some support for the suggested conclusions could be used as learning tool in business schools. The proposed system uses Case-Based Reasoning (CBR) as the resolution methodology, which is an important aspect of artificial intelligence. It is a computational methodology designed to generate new solutions to given problems by analyzing known solutions to previously solved problems. The Business Model decision-making tool would provide both the solution and explanation on how it is obtained.

CCS CONCEPTS

• **Information systems** → **Information systems applications**; **Decision support systems**; **Expert systems**;

KEYWORDS

Decision Support System, Business Model, Case-Based Reasoning

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1 INTRODUCTION

Rapid change in the business environment puts companies in an obligation to review their business model to remain competitive [9, 11, 14, 37]. This is because Business Model (BM) is crucial to any organization [25]. It provides a strong approach to understand, analyze, communicate, and manage strategically-oriented choices [2, 32, 33]. Research on business models is a speedily growing discipline that is still in exploration that is still in search of a conceptual foundation. Literature on Business Model finds its origin in a great number of research fields, such as information systems [19], strategic management [5] and technology and innovation management [10]. Thereby, managers make several decisions regarding the design of a BM such as how revenue model, value proposition, and customer channels should be constructed [28] and should constantly reevaluate and continually adapt their business models to succeed [29]. However, managers are acting under high levels of uncertainty so assumptions about what might be viable and feasible are for the most part myopic in terms of the outcome [4]. Consequently, managers have to start collect information for validating and refining their initial hypothesis and strategic decisions. This information are used to evaluate the validity of their assumptions and make decisions that are necessary to succeed [13, 29, 34].

Nowadays, the fusion of Artificial Intelligence (AI) with Decision Support Systems (DSSs) has helped in widening the window of current research and application in information processing and analysis. As a result, the systems are smarter, quite efficient, adaptable, and better able to aid human decision making. Therefore, few authors presented decision support tools that assist in designing business model. Although, previous work provides no solution for explaining their reasoning for managers. Case-based reasoning (CBR) in decision support systems is an important aspect of artificial intelligence. CBR systems have the ability to learn from past situations, and to generate solutions to new problems based on past solutions given to past problems. Numbers of research proposed a case-based approach to explanation, based on storing, indexing, and retrieval of similar cases and other techniques [35]. Although CBR has been applied in various fields, it has not yet been applied for designing Business Model and explaining the solution to the manager. Case-Based Reasoning not only provides the solution to the design of BMs, but also takes care of providing explanation about "Why the Answer is a Good Answer" [35] to increase confidence in solutions proposed by the intelligent system. In addition, researchers also developed ontologies and design methods, such as Business Model Canvas [31], VISOR [15], the STOF model [6], Business Model Cube [24] and the BM Navigator [18]. Our CBR-DSS for BM design and explanation uses the most favored Business Model ontology in practice .

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Furthermore, the knowledge of experts coded in these tools is not retained. The tool proposed in this paper makes it possible to manage and retain expert knowledge with CBR that is seen by researchers as better-suited knowledge-based system design than rule or model-based techniques [3].

Therefore, the aim of this paper is to explore the possibility of integrating explanation in decision support systems for Business Models with case based methodology. The rest of this paper is organized as follows: a literature review on Business Model tools with a discussion of their shortcomings is presented in Section 2. A description on how explanations and case-based reasoning are related is given in section 3. The section 4 introduces the Business Model decision-making tool underpinning our approach to the use of explanations and case-based reasoning. Finally, a conclusion with perspectives and future enhancements are given.

2 RELATED WORK

Research on business models is a rapidly growing field that is still in exploration of a conceptual foundation. Literature on Business Model finds its origin in a great number of research fields such as strategic management [5], technology and innovation management [10], or information systems [19].

Recent contributions to the area of business model design [6, 12, 20, 31] have argued that additional software and tools are needed to support the design of BMs.

Some authors presented decision support tools that assist in designing business models. In [20], the e3value editor is presented. It allows BM designers to capture and evaluate them from a financial angle. Authors in [17] suggest a BM design toolbox that offers a set of soft and methods for designing BMs. A description of the business model modeling language (BM2L) that allows users to capture a BM using a formal markup language is given in [31]. Ebel et al present a framework for developing tool support for the design and management of business models by the collaboration between participants in a business model development project [14]. A decision support system (DSS) is developed to help SaaS by integrating market analysis and producing alternative designs for business models [12].

These tools are based on formal analysis of financial data and forecasts scenario planning [16, 21]. In [13], authors developed design principles for a Hybrid Intelligence Decision Support System (HI-DSS) that combines collective intelligence and machine intelligence with machine learning.

While these tools are useful, as far as their intended purpose is concerned, we would argue that no tool could provide explanations to increasing confidence in solution, that describe what the system "knows", how it works, and why specific actions are appropriate [36]. Given such explanations, the user is more likely to accept the decisions, suggestions, or results provided by the system [27, 38]. In general, researchers argue that an intelligent system must have the ability to build a trust relationship with the users, by explaining its own behavior. They proclaim that explanations should be an approach to the design and implementation of intelligent systems not just an addition. [8].

Furthermore, the knowledge of experts in these tools is not retained. The tool proposed in this paper is a knowledge based system that. It makes possible to manage and retain expert knowledge with Case-Based Reasoning (CBR) that is seen by researchers as better-suited for knowledge-based system design than rule or model-based techniques [3].

3 EXPLANATIONS AND CASE-BASED REASONING

Many case-based reasoning explanation techniques were proposed [35], as "displaying the most similar case technique", used in (CARES) System [30]. It uses CBR to compare and contrast between the new and past colorectal cancer patient cases. Then, the system produces inferences based on those comparisons to specify the high-level risk patient groups. In addition, the CREEK system provides multiple explanations layers [1]. In this system, the case may serve as a type of top-level explanation with more detailed levels of explanations for each case feature. In the "Visualization technique" [26], the similarity measure of a set of cases is projected onto a two-dimensional surface such that the distance between them corresponds approximately to the similarity. This technique at the same time serves as a simplification of the similarity measure. Furthermore, it allows the user to get an overview of the case space and shows whether a solution is correct. The "Explanation models technique" were used in the research presented in [7]. The system combines model-based and case-based reasoning for predicting the result of legal cases.

Expanding on these works, we have started investigating combined techniques of explanation. Starting by analyzing decisions about the design of the BM, the goal of this step is to be able to identify possible user expectations towards the explanatory capabilities of our intelligent system. The requirements can be used to identify which kind of knowledge has to be represented in the system.

4 PROPOSED IDSS-BM

Our main reason for choosing case-based reasoning is that the IDSS-BM is a decision support system used by domain experts and novice managers and students, and we require providing not only an answer but also its relative explanatory support. The Case- based reasoning (CBR) is an accepted problem solving method that uses old cases to explain new situations, or reasons from precedents to interpret a new case [22]. The CBR systems accomplish that by using additional background knowledge. The system displays all the most similar cases and brings relevant cases to the attention of the user whenever designing their BM. The main functions of the system include:

(1) The description of the BM: generation of initial ideas of the business and description of the BM components and assumptions.
(2) Explanation of the result.
(3) Validation of the BM with corresponding explanation.
(4) Evaluation of the robustness of the BM components with corresponding explanation.

Some case-based approaches retrieve a previous case based on the superficial syntactical similarities. Other applications in strategy decision-making require deeper semantical similarities. In CBR-DSS, for BM design, we make a fundamental assumption that implemented case retrieval technique based on the semantical similarity is for retrieving interesting cases.

4.1 Knowledge modeling

The proposed system uses ontologies to build models of general domain knowledge. Although in a CBR system, the main source of knowledge is the set of previous experiences.

This ontology can take advantage of this domain knowledge and obtain results that are more accurate. Furthermore, the system can provide the user with additional knowledge on the business model. Because users did not always understand the terms used by a system, especially when they are novice managers or students, ontology can play an important role in explanation in different ways. It can clarify the meaning of concepts (Conceptualization) by visualizing concepts and relations between them [35].

Therefore, IDSS-BM can teach students about the domain, about the Business Model itself and about the reasoning process as the vocabulary used by the system. The knowledge modeling in IDSS-BM is based on the initial knowledge acquisition process combined to a continuous learning process through retaining problem-solving cases. The case base will cover all the following aspects and should reflect the Business Model of the company itself [31].

- Enterprise description: market share, localization, sales volume, number of employees, industry.
- Value proposition : the products and services that a firm offers.
- Key resources : the infrastructure and the network of partners.
- Customer relationship: The relationship capital.
- Revenue Streams: The financial aspects.
- Key Partners.
- Cost structure.
- Key activities.
- Channels.
- Customer segments.

The case base also contains the uncertainties that represent the most impact in the enterprise environment .

- Factors of success.
- Multi criteria Evaluation.
- Stress Factors.
- Impact stress factor Evaluation .

4.2 Explaining and suggesting BM to managers

The whole IDSS-BM functionality is described based on the CBR cycle (Retrieve, Reuse, Revise and Retain). We suppose that the manager feeds the system with a specific input problem (new case). The objective is to explain the design of a proper BM for their company. The IDSS-BM problem solving cycle consists of 4 phases:

Retrieve The system uses the *retrieve* function of CBR to suggest the adequate BM for this enterprise to the user. User determines the problem by introducing information regarding his enterprise description. In the first step, the enterprise description can constitute the problem space and the solution space is a set of Business Models of similar companies based on the introduced description. The "enterprise description" of the case description is choosen according to the similarity measure, and informally might be defined in the following way:

$$Similarity(NC, RC) = f(enterprise\ description(NC, RC))$$
$$Where:$$
$$NC: New\ Case.$$
$$RC: Retrieved\ Case.$$

The explanation is provided with displaying the most similar case. In addition, the user can visualize the solution. The system uses a technique where the similarity of a set of cases is projected onto a two-dimensional surface such that the distance between them corresponds approximately to the similarity. This technique, at the same time, serves the simplification of the similarity measure. It allows the user to get an overview of the case space and shows whether a solution is correct. Then, the system retrieves the most similar case to the context of the manager's company.

Reuse After a successful retrieving process, it is possible to establish a solution for the new case called a solved case.

Revise After the most similar cases are retrieved, the user has to select the most appropriate business model based on the current case. Formally, in the CBR cycle, after revision phase, a solved case is considered as a tested/repaired case.

Retain In this step, the tested/repaired case is placed into the case base as a learned lesson for coming times reuse as a learned case.

4.3 Business Model Explanation and Validation

For explanation and validation purposes, the process life cycle is described as follows:

Retrieve The system uses the retrieve function of CBR to support managers in making design decisions during business model validation. User determines the problem by introducing the defined BM. This constitutes the problem space and the solution space is a valid BM.

Firstly, the system should include information about the probability of success of the current version of the business model. It provides a forecast on the probability of having success in the future such as receiving funding, survival and growth [13]. This is done with the classification tasks offered by the CBR applications that use the solution from the best matching case, matched against those in the case base to determine what type, or class, of case. In that way, classification tasks can serve the prediction process.

A Case-based reasoning is an incremental learning process because a new solution is retained each time a problem is solved, making it available for future problems [23]. The system learns from past cases stored initially in the system, and from evaluation and selection of the adequate BM with strong predictors for the future success. The system uses this experience to select the adequate Business Model. This process will be executed step by step. Finally, the user needs to properly visualize the solution that match the features of the validation function.

Once retrieved, the same steps of case based reasoning (Reuse, Revise and Retain) should be executed.

4.4 Explanation and robustness evaluation of BM components

For explaining and evaluating the BM, the problem solving cycle consists of 4 phases:

Retrieve The system uses the retrieve function of CBR to supports the manager in making design decisions during evaluation robustness of business model components. User determines the problem by introducing the defined BM. This is the problem space and the solution space is a robust BM. Firstly, the system should select trends, uncertainties and outcomes that will be used as stress factors.

In previous research [21], factor stress were derived from existing scenarios or from brainstorm sessions with involved stakeholders. In our system, it will be derived automatically from cases stored initially in the case base. This is done with the classification tasks offered by the CBR applications that use the solution from the best matching case, matched against those in the case base to determine for a given case, its type or class. In that way, classification tasks can serve the field of prediction.

Case retrieval is learning and having memory of cases. It has learned about, how the stress factors affect the BM components, and from how to select the best alternative. In this step, a visualization should be produced with a coloring scheme that indicate the impact of a specific stress factor on a BM component.

- Red: the stress factor makes a BM component no longer feasible.
- Orange: the stress factor makes a BM component no longer viable.
- Green: the stress factor affects the feasibility or viability of the BM component with positive impact [21].

The result is a set of colored BM, than the most robust BM will be selected. For effective explanation and learning, the system runs step by step. Then, the other steps of CBR process are accomplished.

5 CONCLUSION

In this paper, an approach for combining explanations and case-based reasoning to help managers regarding their business models has been proposed and discussed. Given such explanation capability, the user is more likely to accept the decisions, suggestions, or results provided by the system. Therefore, it has been described how explanations plays an important role in design decision of a Business Model.

This paper contributes to the design of intelligent systems with the use of knowledge management to enhance the mission of managers, enabling decision-makers to define and generate hypothesis in the context of uncertain environments, in addition to validate and evaluate their hypothesis.

As a future research direction, we want to invest in interactivity through a sub-module for Human-Machine Dialog. It attracts the user with writen or oral conversation to provide feedback, correct errors, and producie more detailed and appropriate explanations. Furthermore, we want to augment existing design to take into account the user's preferences and personal needs. The user's level change over time and the system must be able to trace them and adjust to them. The historic of the user's learning behavior should be taken with attentiveness to guide the progress of novice users to experts.

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