Improving Computer-Support for Collaborative Business Model Design and Exploration

Marin Zec[1], Peter Dürr[2], Alexander W. Schneider[1] and Florian Matthes[1]
[1]Fakultät für Informatik, Technische Universität München, Boltzmannstr. 3, 85748 Garching, Germany
[2]Applied Social Sciences, Munich University of Applied Sciences, Am Stadtpark 20, 81243 München, Germany
{marin.zec, alexander.schneider, matthes}@tum.de, peter.duerr@hm.edu

Keywords: Business Model Innovation, Business Model Canvas, Business Model Development, Business Model Exploration, Morphological Analysis, Computer-Aided Business Model Design, Computer-Aided Business Model Generation, Group Dynamics

Abstract: Finding a viable and sustainable business model is a major challenge not only for startup companies. Established companies are re-thinking their existing business models and explore new business opportunities. The Business Model Canvas is currently one of the most popular frameworks for business model innovation. While computer-aided design (CAD) tools are well-established in mechanical engineering, business model design is still mostly done using pen-and-paper methods. In this paper, we (1) discuss benefits and shortcomings of the Business Model Canvas approach, (2) show how it can borrow techniques from General Morphological Analysis to overcome shortcomings, and (3) derive three key requirements for future collaborative CAD tools for business model design. Our analysis contributes to an understanding of how software support can improve collaborative design and evaluation of business models.

1 INTRODUCTION

Business model innovation plays an increasingly important role for both startup as well as mature companies due to increasing competition (Mitchell and Coles, 2003; Mitchell and Coles, 2004). On one hand, the primary organizational goal of startup companies is to generate a viable business model – sometimes resulting in disruption of whole markets. On the other hand, established companies primarily aim to execute their business model as efficiently as possible. As a result, they tend to struggle with rapid and/or profound market changes.

However, many established companies realize the strategic importance of business model innovation for the sustainability of their organization (e.g. Amazon Web Services, a collection of cloud computing services offered by Amazon.com in addition to their primary e-commerce business). Consequently, an increasing number of companies strive for continuous business model innovation. They pursue various strategies to do so, such as promoting and establishing intrapreneurship, corporate venturing or creation of corporate venture capital units. Examples include Google Ventures, Siemens Venture Capital and Unilever Ventures. Still business model innovation remains to be a complex problem for both startups and more mature companies (Chesbrough, 2010).

Business model innovation is typically conducted in teamwork since expertise in different domains such as marketing, engineering and accounting is needed for holistic business model design. However, each expert tends to maintain his/her domain-specific mental model and terminology. Boundary objects make collaboration across different groups possible since they provide a common point of reference for discussion and collaboration. Individuals/groups with different background can interpret them differently without surrendering the shared boundary object's identity (Carlile, 2002). The Business Model Canvas (BMC) (Osterwalder and Pigneur, 2010), an artifact designed to facilitate business model design by providing a problem structure and focus of thought (Eppler et al., 2011), can serve as boundary object for business model innovation.

The BMC was at first proposed as a pen-and-paper or whiteboard tool for business model design workshops. However, Osterwalder et al. (2013) call for CAD software for business modeling since they expect it to yield benefits for strategic planning similar to the benefits and features CAD software brought to engineering or architecture, e.g. "[...] speed, rapid

Zec M., DÃijrr P., Schneider A. and Matthes F.
Improving Computer-Support for Collaborative Business Model Design and Exploration.
DOI: 10.5220/0005424000290037
In *Proceedings of the Fourth International Symposium on Business Modeling and Software Design (BMSD 2014)*, pages 29-37
ISBN: 978-989-758-032-1

prototyping, quicker visualization, better collaboration, simulation, and better planning [...]".

In this paper, we discuss the strengths and shortcomings of state-of-the art BMC software (e.g. facilitation capabilities). We introduce General Morphological Analysis as a powerful technique for complex problem modeling and argue, that the design of CAD software for business model design should borrow useful concepts from computer-aided General Morphological Analysis. The contribution of this paper is the identification of three key requirements for collaborative CAD software for business model design.

2 BUSINESS MODEL CANVAS

The BMC gained popularity in practice since it provides a simple framework and, as a result, facilitates structured discussion about a hypothesized or actual business model. The BMC promotes visual thinking and a holistic perspective on a business model. Visual thinking is a way to develop and clarify ideas about designs and acts as a catalyst for new ideas (Buxton, 2007). Furthermore, part of the power of visuals is their ability to serve as a visible external memory (Baddeley, 1998). Particularly whiteboards are an effective medium for visual thinking due to their free-form nature (Walny et al., 2012).

The BMC is a visual one-page template for describing a business model (Osterwalder and Pigneur, 2010). The BMC comprises four perspectives on a business model: Customers, Offer, Infrastructure, and Financial Viability. Each perspective subsumes one or more business model building blocks; (1) *Customer*: Customer Segments, Customer Relationships, Channels, (2) *Offer*: Value Propositions, (3) *Infrastructure*: Key Activities, Key Resources, Key Partners, and (4) *Financial Viability*: Cost Structure, Revenue Streams. The BMC is comprised of nine building blocks in total (see Figure 1).

The BMC is based on the Business Model Ontology developed in (Osterwalder, 2004). The key idea of the BMC is to provide a simple and common visual framework for communicating and developing business models. The BMC reached wide adoption among practitioners such as business development units, startup companies or seed accelerators.

There is no mandatory sequence according to which the building blocks of the canvas have to be worked out (Fritscher and Pigneur, 2010). Since the building blocks are interrelated, various elements of the business model have to be modified during multiple iterations anyway. However, many practitioners start with identifying customer segments (*Who are we creating value for?*) or the value proposition (*Which value are we creating?*) and iterate over all remaining blocks.

Irrespective of which starting point was chosen, the business model designers scrape through the remaining building blocks in a sequence that seems reasonable to them. They jump back and forth to refine the business model until they are satisfied. During the process, alternative versions can be sketched out on separate canvases or on the same canvas using different colors. The finished BMC represents a business model hypothesis and serves as a basis for subsequent steps in the business model innovation process such as validation or implementation.

In a workshop setting, the BMC can be printed out on a poster or sketched on a whiteboard to provide a shared display. The simple structure and the visual arrangement of the building blocks provide a shared language and point of reference for group discussions.

A major advantage of the pen-and-paper or whiteboard approach is that elements (i.e. ideas) can be added, edited, moved around and, if necessary, removed spontaneously. Thus, the current state of the group discussion is captured at any time and group members do not forget ideas in the heat of the discussion. The use of color coding, drawings and rearrangement of elements helps maintain a clear organization of the canvas elements.

2.1 Software Support for BMC

A major drawback of the pen-and-paper as well as whiteboard approach is that the BMC cannot easily be shared with interested stakeholders. In addition, the more elements the canvas contains the harder it is to keep track of them since it gets more and more difficult to maintain clarity.

One way to share a physical BMC is to take a digital picture of it and send the picture to the relevant stakeholder. Another way is to (re)create the canvas using text-processing/graphics/slide-based presentation software or embedding the picture in an electronic document. In any case, creating a BMC using generic software tends to be rather time-consuming (Fritscher and Pigneur, 2010).

Despite a lack of thorough scientific investigation on the effectiveness of BMC mapping software (Eppler et al., 2011), various BMC modeling tools emerged for computer-aided business model design to facilitate easier sharing while providing specific modeling facilities well adapted for the BMC. CAD software for business model design based on the BMC ranges from rather lightweight browser-based canvas tools such as BM|DESIGN|ER

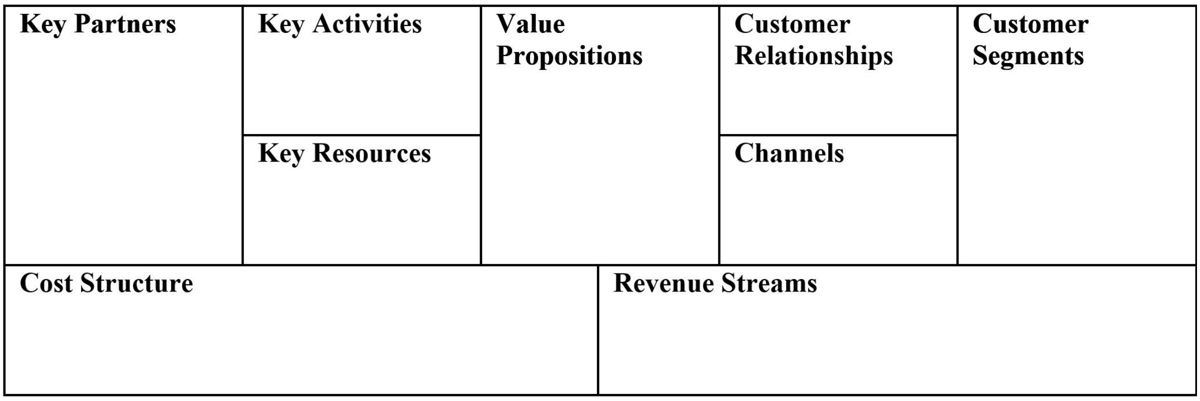

Figure 1: The Business Model Canvas (Osterwalder and Pigneur, 2010).

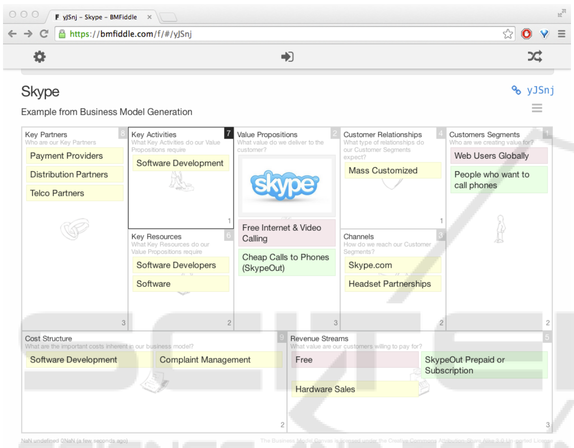

Figure 2: Screenshot of Business Model Fiddle (Steenkamp, 2012).

(Fritscher and Pigneur, 2010), Business Model Fiddle – Fig. 2(Steenkamp, 2012), Canvanizer (Proud Sourcing GmbH, 2011) and Strategyzer (Business Model Foundry GmbH, 2013) over meta-model-based wizards (Hauksson and Johannesson, 2014) to rich desktop software suites, e.g. BiZZdesign Architect (BiZZdesign, 2004).

Eppler et al. (2011) compared the use of generic slide-based presentation software to BMC mapping software. Their study found a positive effect of the BMC on perceived collaboration and a negative effect on perceived creativity. The authors conclude “that artefacts can have considerable power in shaping group interactions and idea generation in the context of business model innovation” and call for further research on visual artefacts used to facilitate business model innovation.

2.2 Benefits of BMC Software

Particularly collaborative, web-based BMC software offers two major advantages over pen-and-paper/whiteboard sessions and general-purpose software:

1. **Support for Distributed Teams.** Web applications facilitate collaboration across time, location and organizational boundaries. Since teams are often distributed in terms of at least one of these dimensions, software-based business modeling saves costs in comparison to pen-and-paper/whiteboard workshops.
2. **Easier and More Flexible Customization, Reuse and Sharing.** Canvas elements can be easily customized in terms of coloring, typography and position. Various media can be embedded (e.g. images, video or spreadsheets). Canvases can be saved in various formats, re-opened for further refinement and easily shared with stakeholders.

We analyzed three popular web-based BMC modeling tools: Business Model Fiddle, Canvanizer, and Strategyzer. All tool sticks to the one-page layout of the paper template for their main view. The tools differ slightly in the way how building blocks can be filled with content and how elements can be customized. Some tools offer features which extend the original idea of the BMC. For instance, Strategyzer provides a financial estimator. Strategyzer and Canvanizer offer real-time collaboration, i.e. concurrent editing and chat support. Business Model Fiddle allows many customization of the canvas (e.g. renaming of building blocks) and the creation of snapshots to record changes. In addition, designers can sketch on uploaded images and assign them to building blocks.

The main benefits of CAD for the BMC approach is the support for collaboration across time, location and organizational boundaries as well as reuse. The analyzed tools mimic a paper/whiteboard and exploit benefits of information technology. However, there is little facilitation support since in both, on-site meetings and asynchronous distributed modeling sessions, many methodological questions such as finding a reasonable starting point have to be answered by the modelers. None of the analyzed tools guides business modelers through the process. While sticking to the one-page layout, they slightly differ in the way how building blocks can be filled with content and elements be customized.

2.3 BMC and Facilitation

The role of the BMC in business model design is similar to the notion of grammatical design which constitutes boundaries within which designers can find creative solutions if they deviate from standard solutions (Brown and Cagan, 1996). The BMC frames the discussion and predetermines the general structure of the boundary object. BMC designers tend to "think 'within' the given domains of the template" (Eppler et al., 2011). They are supposed to be creative within said domains. However, there is little guidance on how to make use of one's full creative potential. In practice, groups often ideate through spontaneous associations between concepts. Thus, the business model design process that supplements the BMC is intentionally informal and generic. It consists of five phases which do not necessarily have to be gone through in a linear manner (Osterwalder and Pigneur, 2010): (1) *Mobilize* (i.e. preparation), (2) *Understand* (i.e. research and analyze the context), (3) *Design* (i.e. generation of business model hypotheses using the canvas), (4) *Implement* (i.e. implementing the best hypothesis in the field), and (5) *Manage* (i.e. monitor the market and update the business model accordingly). The process model does not prescribe what to do in a specific phase. Instead, the authors refer to various other tools and methods.

Business model generation demands a broad range of skills, knowledge and experience as well as creativity. Thus, business model generation is often conducted in teamwork. There is a widespread belief that the performance of interactive groups is higher than the performance of nominal groups (i.e. the aggregate performance of the same number of non-interacting individuals). However, this does not necessarily hold true. For instance, various studies on group performance in brainstorming have shown that nominal groups outperform interactive groups, e.g. (Diehl and Stroebe, 1987; Mullen et al., 1991). While teams tend to generate more ideas if they follow Osborn's brainstorming rules (Osborn, 1957) than when they do not stick to those rules, they are still not as effective as nominal groups. Explanations for this phenomenon include social loafing (Paulus et al., 1993), social anxiety (Camacho and Paulus, 1995) and production block (Diehl and Stroebe, 1987).

While the BMC deserves merit for providing a common language for group discussion, teams have to be careful. Pitfalls in group brainstorming are only one example illustrating the intricacy of group dynamics in collaborative settings.

Teamwork can yield group process gains as well. For instance, team members might become more motivated when facing social competition. They might also improve their skills due to knowledge transfer. And even coordination gains are possible (e.g. conductor of an orchestra).

Generally, process gains as well as losses can occur in terms of motivation, capabilities and coordination. A skilled and experienced facilitator promotes process gains and mitigates process losses. For instance, they play devil's advocate to encourage alternative or counter-intuitive thoughts and, consequently, avoid groupthink and shared information bias (Baker, 2010). However, teams often do not involve a skilled facilitator because it is considered too expensive, they think there is no need for a facilitator (since negative effects are implicit and thus hard to notice) or there is simply no facilitator available.

In many situations, collaborative web-based CAD software is expected to be used without a dedicated facilitator, mostly to save time and money. Therefore, we argue that collaborative BMC software has to compensate for the lack of a skilled facilitator as much as possible. We expect CAD software for business design to enforce meta-model constraints and validate the model (e.g. impose mappings between value propositions and customer segments). This way, the BMC modeling tool can provide, for instance, helpful directions in the case of meta-model violations. Hauksson et al. (2014) implemented a desktop-based wizard for business model design which enforces BMC meta-model constraints.

While it is unlikely that software can fully replace a human facilitator, there are some simple yet powerful techniques to improve collaboration and ideation in groups. For instance, gamification techniques can help mitigate motivation losses. Allowing anonymous contributions might reduce social anxiety or evaluation apprehension and, as a result, increase diversity of ideas since ideas can be expressed uninhibitedly. Separation between divergent thinking (deferring judgment, creating as many ideas as possible) and convergent thinking (think and evaluate ideas analytically), shown to improve creativity processes and results (Cropley, 2006), can be supported by implementing different views and means of interaction for each of those phases. In addition, differentiating between single and team phases might increase the quantity of ideas: during single phases contributions from other team members should be hidden to avoid production block and mutual influence, during team phases contributions from others should be visible such that they can serve as an inspiration for additional ideas and refinements. While we do not provide an exhaustive list of design recommendations, we argue for the integration of insights from social psychology and creativity research into the design of future CAD tools for business modeling.

2.4 Discussion

In general, the BMC captures one specific business model. While it is possible to sketch more business models on the same canvas at the same time, the canvas tends to get confusing. Therefore, in practice, each business model is usually sketched out on a separate canvas.

The BMC facilitates a structured discussion about a business model but it does not guide its users to explore the formal solution space systematically. Rather, users tend to start with specifying one building block and then scrape from building block to building block. However, this heuristic approach might miss innovative and viable solutions. One method to circumvent this disadvantage and to explore the full solution space is Morphological Analysis which is presented in the next section.

Another issue that arises in collaborative settings which is not addressed by the BMC is group dynamics. Social psychology literature has shown how various negative effects such as social loafing tend to occur in group settings. As a result, team performance and productivity might degrade considerably.

3 USEFUL CONCEPTS FROM MORPHOLOGICAL ANALYSIS FOR BMC SOFTWARE DESIGN

In this section, we introduce General Morphological Analysis (GMA), a generic problem modeling technique, and associated software tools. We argue that they feature useful concepts which should be considered to be adopted by CAD software for business modeling. In a broader sense, Morphological Analysis (MA) is concerned with the study of form, structure and interconnections between structural elements (Shurig, 1986). Various disciplines such as linguistics or biology conduct subject-specific variants of MA. Swiss Astronomer Fritz Zwicky developed a generic type of MA commonly referred to as General Morphological Analysis (GMA) (Ritchey, 1998). GMA is a method which aims to facilitate system or problem understanding and structuring. GMA is particularly suited for multi-dimensional, non-quantifiable problems for which mathematical or causal modeling is not applicable or appropriate (Ritchey, 1998). The general idea of GMA is to derive a non-quantified model of the system or problem under examination by identifying its key structural components. In the following, we will focus on GMA for problem structuring and solving.

Parameter A	**Parameter B**	**Parameter C**	**Parameter D**
a1	b1	c1	d1
a2	b2	c2	d2
a3	b3		d3

Figure 3: The general structure of a morphological field. One specific formal configuration is highlighted in gray.

3.1 Method

The initial step of GMA is to clarify the problem statement such that there is a shared understanding of the problem. The result of this step is a set of aspects, or parameters, that seem to be the most relevant characteristics of the problem at hand.

GMA distinguishes between parameters (also: components or dimensions) and parameter values. The first step of GMA is to break down the problem into subcomponents. Ideally, the subcomponents are mutually exclusive and collectively exhaustive. In practice, there might be some overlap between parameters. However, the overlap should be as small as possible. Team members have to discuss and collaboratively devise a set of parameters which captures all key aspects of the problem at hand. This step fosters a shared understanding of the problem because the group needs to reach a consensus about what the key aspects of the issue are. For business model design, the BMC provides an established problem structure (i.e. the nine building blocks).

Once an adequate set of parameters is found, the range of parameter values has to be specified for each parameter. Parameter values can be qualitative or quantitative. The level of abstraction is specific to the concrete problem and purpose of the analysis. What is important in this step of GMA is to investigate each parameter independently. This approach promotes di-

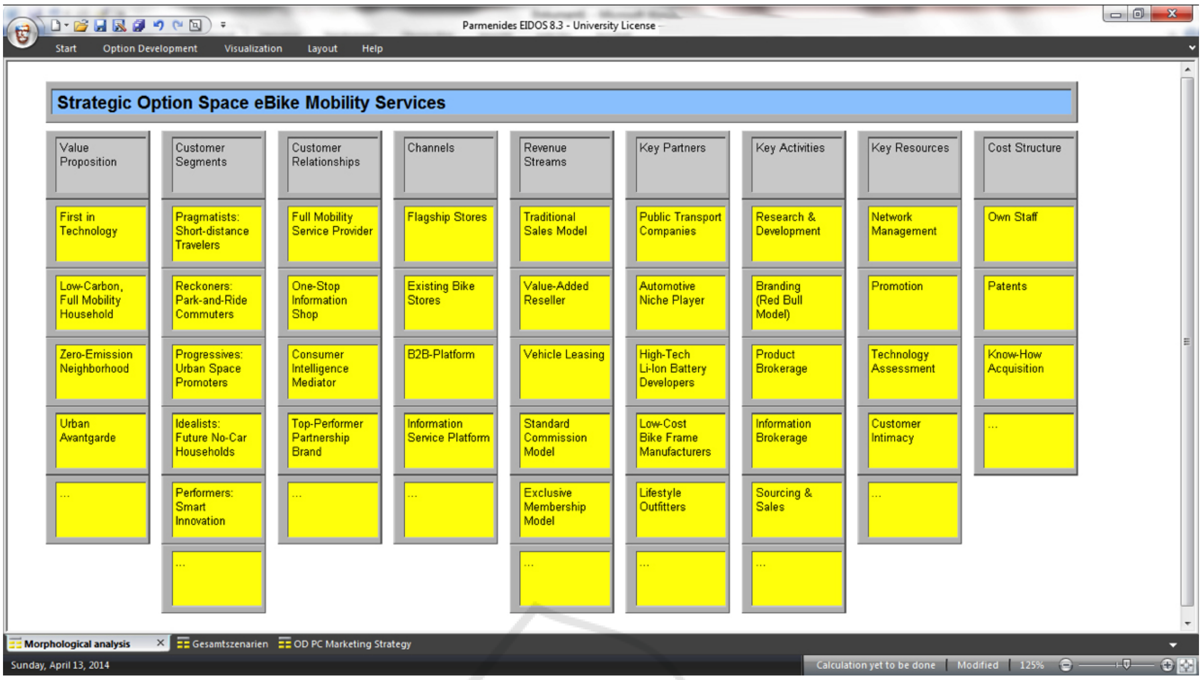

Figure 4: A screenshot from Parmenides EIDOS showing a morphological field which represents the strategic option space for an eBike Mobility Service.

vergent thinking and openness for counter-intuitive values. The focus at this point is on formal properties. Evaluation of feasibility should be deferred. We argue that this is a major advantage over the BMC method because individuals are tempted to think about different building blocks at the same time because they instinctively try to interrelate different building blocks (e.g. "‘if we want to sell our product to young people we have to build a mobile platform as a channel"’). While this approach can make sense, innovative ideas might not be taken into consideration because the discussion is centering around familiar business model patterns. Thus, business modelers constrain their creativity and, consequently, might miss particularly innovative business model designs.

Parameters and their value ranges constitute a morphological field (MF) which is usually represented by a matrix (see Figure 3). The MF matrix is a dense representation of the formal configuration space. The formal configuration space is the set of all morphological configurations (i.e. parameter value combinations containing one and only one value per parameter). Depending on the perspective and purpose of the analysis, the formal configuration space is sometimes referred to as formal problem space or formal solution space. To sum up, GMA is a structured problem modeling method which enables its users to establish the space of all formal solutions, systematically discuss the contained formal configurations and identify the best solution.

GMA prescribes clear separation between divergent thinking and convergent thinking. By contrast, in BMC workshops, participants tend to mix both styles of thinking too frequently and, as a result, do not systematically explore the space of bounded creativity.

3.2 Example

GMA can be used for various purposes such as scenario analysis, product innovation or strategy development. Figure 4 shows an example for a MF representing the strategic option space for an eBike Mobility Service in terms of BMC terminology. Each parameter (i.e. "building block", gray background) can take a value from its parameter range (depicted in yellow or white, respectively). A formal business model is given by a specific configuration from the morphological field (i.e. solution space). For instance, a specific formal business model is given by ("First in Technology", "Pragmatists: Short-distance Travelers", "One-Stop Information Shop", "Flagship Stores", "Vehicle Leasing", "Public Transport Companies", "Research & Development", "Promotion", "Patents"). Not all possible configurations represent viable business models since some business model elements might be incompatible. However, using GMA the complete set of formal solutions can be identified and systematically evaluated. GMA software can help

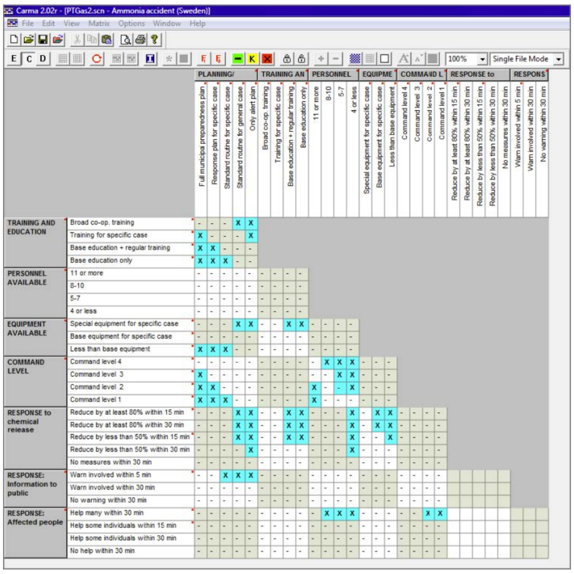

Figure 5: Consistency matrix in MA/Carma. Adopted from (Ritchey, 2005).

reduce the formal solution space to a viable solution space using various techniques such as cross consistency assessment or clustering.

3.3 Sofware Support for GMA

Conducting a GMA by hand has one major challenge: the size of the solution space grows exponentially with each additional parameter. As a result, it is often not possible to evaluate all formal solutions of the MF (e.g. a 5-parameter MF with 6 possible values for each parameter yields 6^5 = 7776 formal solutions. The example in Figure 4 contains 480.000 formal business models.). Therefore, in workshops without software support, the solution space cannot be analyzed exhaustively. Rather, only a small subset of configurations is selected for deeper analysis according to subjective preferences and within objective constraints (e.g. time limit). GMA software addresses the challenge of large solution spaces by providing means for reduction of the formal configuration space to a practical solution space. Examples for software which supports GMA and solution space reduction include Parmenides EIDOS (Parmenides Foundation, 2014) and MA/Carma (Ritchey, 2005).

MA/Carma allows the creation of an inference model. First, the user has to specify the consistency (or compatibility) of each pair of parameter values. Given such a consistency matrix (see Figure 5), MA/Carma generates an interactive inference model (see Figure 6). The user can declare arbitrary parameter values to be exogenous (colored red or medium

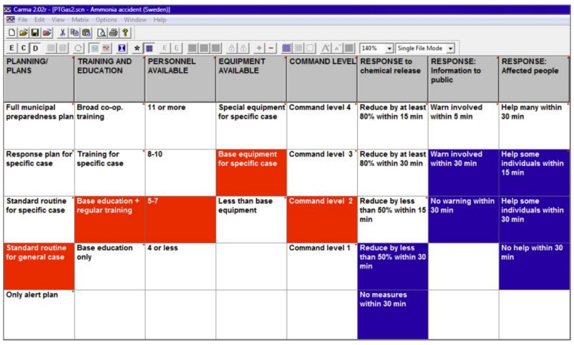

Figure 6: An interactive inference model constructed by MA/Carma. Adopted from (Ritchey, 2005).

gray, respectively) and the software calculates which values are still viable for the remaining parameters (colored blue or dark gray, respectively). A detailed description can be found in (Ritchey, 2005). Parmenides EIDOS supports a similar technique: users have to specify a numeric consistency value for each pair of parameters. Then, a consistency value for each configuration is calculated by the software. As a result, in their subsequent analysis, users can focus on configurations which yield the highest consistency values. In contrast to MA/Carma, Parmenides EIDOS supports clustering of similar configurations to identify more abstract patterns among viable solutions.

3.4 Discussion

GMA is a simple problem structuring method for individuals and groups. It can be used for various problems such as product innovation, strategy development or scenario analysis. MA is particularly useful if the problem at hand cannot be adequately expressed in a mathematical model, many different stakeholders are involved and various viewpoints have to be considered.

MA aims at constructing a formal solution space. Formal solutions in the solution space might be inconsistent and/or impractical. Solution space reduction techniques such as cross consistency assessment in combination with complementary software support help rule out inconsistent configurations and reduce the solution space significantly. This way, the solution space can be explored exhaustively yet efficiently.

To the best of our knowledge, there is no GMA software that is inherently collaborative and supports distributed teams. While GMA software such as Parmenides EIDOS or MA/Carma is used by facilitators to provide a shared display in workshops, their user interface and interaction design is tailored to individual users.

Moreover, we have not found any GMA software that accounts for psychological aspects and group dynamics. However, we argue that BMC software design can borrow from GMA and respective software. They key advantage of the software-based GMA approach to modeling of complex problems such as business model innovation is the systematic construction of the formal solution space and leveraging software to find viable solutions within the practical solution space.

A key feature of MA/Carma is the construction of an inference model of the solution space. Designers can interact with the model and analyze the dependencies of strategic decisions by treating specific parameter values as fixed input. Given a consistency matrix, the software automatically calculates which options remain to be viable for all other parameters. We argue that such an inference model provides more insights into the business modeling space than the depiction of the BMC. The BMC is a descriptive model that only represents one particular business model (or multiple descriptive models if colors are used.).

4 KEY REQUIREMENTS FOR FUTURE BMC SOFTWARE

In the previous sections, we identified three key requirements for future CAD software for business model design: (1) the ability to perform an interactive “what-if” analysis (*inference capability*), (2) methodical guidance throughout the design process (*facilitation capability*) to mitigate negative effects of group dynamics, and (3) the ability to collaborate across time, location and organizational boundaries (*support of distributed teams*).

The inference capability enables designers to experiment with business models by declaring particular business model elements as exogenous and analyzing the implications for the remaining building blocks. The facilitation capability offers guidance during the design process in order to increase creativity of the designers while limiting negative effects stemming from group dynamics. In addition, borrowing techniques from GMA software, future BMC software might provide a concrete process model for systematic generation of business models within the conceptual boundaries of the BMC while still allowing and promoting creativity (i.e. parameter (value) definition, cross consistency assessment and configuration space reduction). The support of distributed teams refers to the ability to carry out the business model design process cost-efficiently in a distributed setting.

Collaborative, web-based CAD software supporting the BMC is readily available. Thus, there is BMC support for distributed teams. However, those tools lack inference and facilitation capabilities.

Therefore, we propose to extend BMC software by borrowing concepts from GMA and respective software. Neither BMC methodology nor GMA address potential group process losses such as motivation loss (e.g. social loafing) or skill impairment (e.g. social anxiety). Thus, groups might not exploit their full cognitive and creative potential.

We argue that methods as well as tools for collaborative business model generation have to address negative effects of teamwork and try to mitigate them. Skilled human facilitators might accomplish this task. However, assessing the skill of a human facilitator is hard. In addition, in some contexts there is no possibility to hire an experienced facilitator or it might be considered too expensive.

The absence of a facilitator can be compensated in BMC software by implementing various facilitation and creativity techniques. For instance, creativity can be increased by clearly separating between divergent and convergent thinking phases. Alternating between individual and team ideation helps decreasing negative impact of anchoring and groupthink. Anonymity can help reduce social anxiety. On the other hand, anonymity might increase social loafing since contributions cannot be attributed to individuals and, thus, individuals might ”‘hide”’ behind the team. Facilitation capabilities have to be well-conceived and evaluated.

5 CONCLUSION AND FUTURE WORK

We identified benefits and shortcomings of state-of-the art CAD software for the BMC methodology. We agree with Osterwalder, Fritscher et al. that CAD software for business model design is likely to improve strategic planning, particularly for distributed business model design teams which face increasing competition (Osterwalder and Pigneur, 2013; Fritscher and Pigneur, 2014). The BMC deserves merit for providing a common (visual) language for business model design. However, we think that CAD support for business model design is still only in its infancy and that various questions need to be answered about how to design effective next-generation CAD software for collaborative business model design. We expect future BMC software to leverage the potential of software support and provide additional value that goes beyond mere digitization of the BMC approach.

Our next step is to refine the general requirements identified in this paper. Then, we will build a prototype which implements the ideas discussed above (e.g. inference and facilitation capabilities) and validate our hypotheses.

REFERENCES

Baddeley, A. (1998). Recent developments in working memory. *Current opinion in neurobiology*, 8(2):234–238.

Baker, D. F. (2010). Enhancing group decision making: An exercise to reduce shared information bias. *Journal of Management Education*, 34(2):249–279.

BiZZdesign (2004). BiZZdesign Architect. http://www.bizzdesign.com. [Online; accessed April 15, 2014].

Brown, K. N. and Cagan, J. (1996). Grammatical design and bounded creativity. Carnegie Mellon University, Department of Mechanical Engineering.

Business Model Foundry GmbH (2013). Strategyzer. http://www.strategyzer.com. [Online; accessed April 15, 2014].

Buxton, B. (2007). *The Anatomy of Sketching*. Morgan Kaufmann, San Francisco and CA and USA.

Camacho, L. M. and Paulus, P. B. (1995). The role of social anxiousness in group brainstorming. *Journal of Personality and Social Psychology*, (68):1071–1080.

Carlile, P. R. (2002). A pragmatic view of knowledge and boundaries: Boundary objects in new product development. *Organization Science*, 13(4):442–455.

Chesbrough, H. (2010). Business model innovation: Opportunities and barriers. *Long Range Planning*, 43(2-3):354–363.

Cropley, A. (2006). In praise of convergent thinking. *Creativity Research Journal*, 18(3):391–404.

Diehl, M. and Stroebe, W. (1987). Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology*, 53(3):497–509.

Eppler, M. J., Hoffmann, F., and Bresciani, S. (2011). New business models through collaborative idea generation. *International Journal of Innovation Management*, 15(6):1323–1341.

Fritscher, B. and Pigneur, Y. (2010). Supporting business model modelling: A compromise between creativity and constraints. In *Task Models and Diagrams for User Interface Design, 8th International Workshop, Revised Selected Papers*, pages 28–43, Brussels and Belgium.

Fritscher, B. and Pigneur, Y. (2014). Computer aided business model design: Analysis of key features adopted by users. In *47th Hawaii International Conference on System Science*, pages 3929–3938, Waikoloa and HI and USA.

Hauksson, H. and Johannesson, P. (2014). Metamodeling for business model design. facilitating development and communication of business model canvas (bmc) models with an omg standards-based metamodel. In *The 8th International Workshop on Value Modeling and Business Ontology (VMBO 2014)*, Berlin and Germany.

Mitchell, D. W. and Coles, C. B. (2003). The ultimate competitive advantage of continuing business model innovation. *Journal of Business Strategy*, 24(5):15–21.

Mitchell, D. W. and Coles, C. B. (2004). Establishing a continuing business model innovation process. *Journal of Business Strategy*, 25(3):39–49.

Mullen, B., Johnson, C., and Salas, E. (1991). Productivity loss in brainstorming groups: A meta-analytic integration. *Basic and Applied Social Psychology*, (12):3–23.

Osborn, A. F. (1957). *Applied imagination: Principles and Procedures of Creative Problem Solving*. Charles Scribner's Sons, New York and NY and USA.

Osterwalder, A. (2004). *The business model ontology: A proposition in a design science approach*, volume HEC 173. Institut d'Informatique et Organisation, Lausanne and Switzerland.

Osterwalder, A. and Pigneur, Y. (2010). *Business Model Generation: a handbook for visionaries, game changers, and challengers*. Jon Wiley & Sons.

Osterwalder, A. and Pigneur, Y. (2013). Designing business models and similar strategic objects: The contribution of is. *Journal of the Association for Information Systems*, 14(5):237–244.

Parmenides Foundation (2014). Parmenides EIDOS. https://www.parmenides-foundation.org/application/. [Online; accessed April 15, 2014].

Paulus, P. B., Dzindolet, M. T., Poletes, G., and Camacho, L. M. (1993). Perception of performance in group brainstorming: The illusion of group productivity. *Personality and Social Psychology Bulletin*, (19):78–89.

Proud Sourcing GmbH (2011). Canvanizer. http://www.canvanizer.com. [Online; accessed April 15, 2014].

Ritchey, T. (1998). Fritz Zwicky, Morphology and Policy Analysis. In *16th Euro Conference on Operational Analysis*, Brussels.

Ritchey, T. (2005). MA/Carma: Advanced Computer Support for General Morphological Analysis. http://www.swemorph.com/macarma.html. [Online; accessed April 15, 2014].

Shurig, R. (1986). Morphology: A knowledge tool. *Systems Research*, 3:9–19.

Steenkamp, J. (2012). Business Model Fiddle. http://www.bmfiddle.com. [Online; accessed April 15, 2014].

Walny, J., Carpendale, S., Henry Riche, N., Venolia, G., and Fawcett, P. (2012). Visual thinking in action: Visualizations as used on whiteboards. *IEEE Transactions on Visualizations and Computer Graphics*, 18(12):2779–2788.