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Citation: Maiden, N., Baden-Fuller, C. & Dowsett, M. (2023). Towards AI-enabled support for creative thinking about business models. In: Pagani, M. & Champion, R. (Eds.), Artificial Intelligence for Business Creativity. . Abingdon, UK: Routledge. ISBN 9781003287582

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6. Towards AI-enabled support for creative thinking about business models

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Abstract
This chapter explores how human-centred artificial intelligence (AI) technologies could be deployed to both automate and support creative thinking about business models. Although the concept of business models is well-established, no bespoke techniques exist to support businesses to think creatively about models, systematically or regularly. This chapter reports the first steps of an ongoing project that prototypes AI enabled technologies to improve creative thinking about business models. The prototype is an example of co-creative AI, a form of human-centred AI in which machine and human reasoning interleave to solve complex problems. This chapter presents both the digital prototype and early business user feedback that provides not only first qualitative evidence for the need and value of creative thinking about business models but also design refinements needed for the prototype to be effective in business settings.

Creativity, business models and business strategies

Creativity is defined as the ability to produce work that is novel and original, as well as appropriate and useful (Sternberg 1999). The need for more creative thinking to solve complex problems is well-documented (e.g., Isaksen et al. 2011). These problems can be diverse. Creative problem solving has been applied many times to solve complex problems, from enabling people to work from home effectively during the pandemic (e.g., Weigelt et. 2021) to enabling the crew of the Apollo 13 spacecraft to return to earth safely (e.g., King 2011).

Unsurprisingly, creativity is also increasingly sought after to solve business problems. The World Economic Forum identifies creativity and complex problem solving as two essential and related skills, and research by NESTA revealed that creativity is consistently identified as the most significant predictor for the likelihood of occupation growth between now and 2030 (Easton & Djumalieva, 2018). Upfront creative thinking is also an essential pre-requisite for downstream innovation, to generate the ideas with which to design and develop business innovations (Design Council 2011).

Business problems have become significantly more complex and challenging in the digital age, in part because of the changes to where creativity is needed. Through the 19th and 20th centuries, fortunes were made by businesses becoming more creative about their services and delivery though the distribution chain. New products, processes and forms of wholesaling and retailing have been strongly evidenced. But in most cases, engagement with customers did not change. Customers were offered a predesigned product or service, but little choice about how to engage with the firm.

By contrast, from the start of this millennium, new firms put out novel and valued offerings that engaged with customers differently in both the digital and physical spaces. These offerings were often *Big-C* creative outcomes, defined as eminent and relatively rare contributions to society based on Kaufman & Beghetto's (2009) distinction between different degrees of creative outcome. Thus, we have advertising-supported search engines (such as Google), app-enabled mobile phones (such as Apple), novel forms of entertainment (such as streaming from Spotify), ways of shopping (such as Amazon) and ways of communicating (such as WhatsApp). And in the B2B world we have novel forms of engagement such as offering capital goods on a "needs basis" with guaranteed performance (such as Rolls Royce's Power by the Hour). All of these firms shared something – they engaged with customers in a novel manner.

The challenge of being creative in business has become significantly more complex as a result of these changes. Firms need to think beyond creative products and processes to how to engage with customers, and linkages that might exist between novel forms of customer engagement and novel products, services and processes. Often these forms are outcomes of *Pro-C* creativity that exhibit professional-level expertise for earning a living (Kaufman & Beghetto 2009), such as a new customer onboarding service and more innovative forms of customer engagement to co-develop new products. Generating these forms of creative outcome is often enabled by *Mini-C* creativity, a different form of outcome, which is a novel and personally meaningful interpretations of a peoples' own experiences, such as learning about new forms of customer engagement in other cultures. It is also enabled by *Little-c* creativity that leads to the generation of novel everyday outcomes such as new insights about engaging your customers from competitor practices.

The term used to describe how value is created and captured in a holistic sense using events at the customer-firm boundary is the business model. Typical firms face significant challenges in thinking about their next steps and strategies to deploy resources to achieve favourable outcomes. They always have to keep a watch on whether the current seemingly tactical minor creative challenge is not a signal for a major shift in business model approach. However, in spite of these recognised trends and opportunities, creative thinking applied to business models to generate *Pro-C*, *Mini-C* and *Little-c* outcomes has received little attention from the majority of businesses and academics writing about business. We claim that this is a missed opportunity.

One reason for this missed opportunity is that many businesses lack sufficient creativity knowledge. In this chapter we define creativity knowledge as operational knowledge about the frameworks, processes, techniques and tools with which to think creatively systematically and regularly, as well the established practices for applying this knowledge in different contexts. Amabile & Pratt (2016) assumed 3 major components necessary for creativity in any domain: expertise, intrinsic task motivation, and creative thinking skill. We observed that most business leaders have work expertise and intrinsic motivation to develop new business models and strategies, but most lack the creativity knowledge needed for effective and regular problem solving. Traditional means of introducing this knowledge, e.g., with training or expert facilitation, have not been effective. There are multiple possible reasons for this, and include the inaccessibility of knowledge about how to be creative in academic papers,

textbooks and websites, insufficient time to organise facilitated activities such as workshops, and lack of committed management support.

New digital technologies provide one alternative means of making this creativity knowledge available to business leaders. Artificial intelligence technologies that reason automatically using codified creativity knowledge have been demonstrated to support human creative thinking in different professional domains (e.g., Maiden et al. 2020a, 2020b). This codification translates operational knowledge about creative thinking frameworks, processes, techniques and tools into machine-readable forms that are implemented in software as e.g., algorithms, rules and interactive user guidance. The technologies implemented with this knowledge are one form of human-centred artificial intelligence (HCAI), which aspires to empower human rather than automate human work (Xu 2019, Yang et al. 2020), albeit with machine reasoning designed to generate support for human reasoning. Ben Shneiderman argues that HCAI needs to reframe AI to be "in-the loop" around humans to support people's self-efficacy, creativity and social participation (Shneiderman 2021). To direct the development of new digital tools with humans at their centre, he offered what he called 3 fresh ideas: (1) to deliver high levels of human control as well as automation, (2) to design to empower people with powerful tool-like appliances, rather than emulate human expertise, and (3) to promote a governance structure that describes how to develop more reliable systems and maintain a safety culture. Modern smartphone cameras, thermostats, elevators and dishwashers are new tools with AI capabilities that implement these ideas (Shneiderman 2020).

Therefore, in this chapter, we report ongoing research that codified creativity knowledge in a new digital prototype that delivered a form of human-centred artificial intelligence to support human creative thinking about business models and strategies. We summarise recent developments in HCAI and digital technologies to augment human creativity, and different forms of creativity knowledge available to be codified to support creative thinking. We then introduce the concepts of business models and strategies, and explicate the Business Model Zoo as one source of information about models to manipulate automatically with artificial intelligence algorithms. After these reviews, we report on our development of a novel prototype, called the Business Opportunity Builder, which uses AI algorithms to encourage creative thinking about business models and strategies. We also report our engagements with senior business professionals who walked through and provided feedback on the potential of this prototype. The chapter ends with an outline of the steps needed to deliver effective AI-enabled support for creative thinking about business models to businesses.

Human-Centred Artificial Intelligence

There is a growing body of work that is seeking to understand HCAI. Multiple authors (e.g., Shneiderman 2020) and institutions (e.g., Stanford 2022) agree on the aims of HCAI to empower rather than replace humans, e.g., using conversational agents that support communities (Wang et al. 2021). However, so far, there has been little progress to operationalise Shneiderman's (2020) three key ideas to deliver more effective HCAI. Instead, most reports have focused on the need to develop user-centred processes to design AI systems that learn and evolve. E.g., Yang et al. (2020) investigated why systems that learn

and evolve are more difficult than conventional ones to design by mapping different human-AI interaction design challenges onto user-centred design processes. Similarly, Xu (2019) proposed a HCAI framework for developing more effective AI tools based on new challenges for usable and useful systems, which Olsson & Vaananen (2021) extended with their 4P (product, people, principles and process) model of AI design to describe the expected dynamics in UX design practices, as a baseline for new design processes.

Like most of this reported work, Xu's (2019) framework assumed that AI tools use black-box machine learning systems with neural networks for pattern recognition in deep learning systems that require capabilities to explain to users the reasons for their outputs. Indeed, Yang et al. (2020) highlighted an absence of a common definition of AI from the research discourse around human-AI interaction. Their review revealed a range of poorly-defined terms such as machine learning, intelligent and AI-infused systems, which led them to propose an AI design complexity map defining 4 levels of AI systems. According to this map, simple probabilistic systems at level-1 exploit self-contained datasets to produce a small, fixed set of outputs, whereas evolving adaptive systems at level-4 learn from new data even after deployment, to produce adaptive, open-ended outputs that resist abstraction. All 4 of these levels assumed the use of black-box machine learning algorithms that need to explain their outcomes to end-users – an approach that so far has met with only limited success (e.g., Dosilovic et al. 2019).

By contrast, other types of AI system that can deliver explanations to users, e.g., rule-based expert systems, continue to be effective and deliver valuable outcomes in domains such as medical billing (Abdullah et al. 2017) and e-government (Hossain et al. 2015). As we will report, knowledge about creative thinking processes and techniques can be codified as generative rules. Likewise, different variations of case-based reasoning systems (Kolonder 1993) have also been effective for problem solving in domains such as healthcare (e.g., Bichindaritza & Marling 2006) and law (e.g., Rissland 2005). Indeed, the importance of case studies in business thinking and education reveals the potential value of reasoning across exemplars. AI systems that implement rule- and case-based reasoning can be treated as within the remit of HCAI and co-creative AI tools, and enable the more human-centred approaches required for more explainable AI, as outlined in Ehsan et al. (2021).

Therefore, based on these previous research outcomes, we sought to develop an alternative HCAI prototype that automatically manipulated codified creativity knowledge and available digital information about types of business models.

Digital creativity support and co-creative AI tools

Digital creativity support tools help people to engage creatively with the world (e.g., Cherry & LaTulipe 2014), and have been the subject of considerable research and development. Most have supported the generation of *Pro-C* and *Little-c* creative outcomes (Kauffman & Beghetto 2009), and used different forms of interaction to help users be more creative. E.g., the *CombinFormation* system searched web information to support a user's creative thinking (Kerne et al. 2008) and the *Carer* app searched cases of good practices to encourage carers to ideate about the care for older people with dementia (Zachos et al. 2013). Both the *Dynamic*

HomeFinder (Williamson & Shneiderman 1992) and a digital tabletop for making biological discoveries (Wu et al. (2011) used interactive visualisations to support creative thinking. Tools that support collaborative creativity have been implemented in many sectors including education (Aragon et al. 2009), television production (Bartindale et al. 2013) and real-time design work with crowds (Andolina et al. 2017). And other tools have appropriated different digital technologies to encourage creative thinking, e.g., the *Trigger Shift* tool for performance art in theatre (Honauer & Hornecker 2015).

However, although some have been demonstrated to augment human creative thinking, fewer digital creativity support tools have been implemented to support work in non-creative professional domains such as business. One exception was the *Risk Hunting app*, which supported creative thinking to resolve health-and-safety risks in manufacturing some codified knowledge of selected TRIZ principles (Maiden et al. 2020a). Another was *JECT.AI*, which integrated knowledge of creative strategies used by experienced journalist strategies with information from 10s of millions of published news and scientific stories to support journalists to generate more creative angles for new stories (Maiden et al. 2020b). And *Sport Sparks* codified knowledge of creative thinking techniques such as constraint removal to guide coaches to generate novel and useful action plans to overcome athlete challenges (Maiden et al. 2021). Moreover, use of this knowledge codification in the *JECT.AI* and *Sport Sparks* tools was demonstrated to contribute to the creative thinking by professional journalists (Maiden et al. 2020b) and sports coaches (Maiden et al. 2022).

Moreover, more recent digital tools to support human creative thinking deploy different forms of machine reasoning, and are often referred to as *co-creative AI tools* (e.g., Long et al. 2021). These tools can be framed as examples of "humans-in-the-loop" around artificial intelligence systems (Shneiderman 2020). The research focus is to design machine intelligence, rather than to augment human behaviour. E.g., *Calliope* deployed generative design algorithms to search large possible design spaces (Davis 2021), *Shelley* implemented deep-learning algorithms to generate horror stories (Yanardag et al. 2021), and a computational model encouraged conceptual shifts based on clustering of deep features from a database of sketches (Karimi et al. 2019). Unsurprisingly, reports of these tools have highlighted the capabilities of the machine reasoning, and made little reference to support for creative thinking by end-users. However, these reports do reveal the potential of machine reasoning to manipulate knowledge and information to generate outcomes that can guide and inform human creative thinking.

Returning to Amabile & Pratt's (2016) three required components for creative thinking in any domain, we assert that machine reasoning about codified creativity knowledge has the potential to substitute for at least some of the creativity knowledge lacking in many business users. To explore this possibility, selected knowledge about creative problem solving was codified to be manipulated automatically in a new digital prototype that was populated with information about business models and strategies. The two next sections explore the forms of creativity knowledge that were available to be codified and the digital information about business models and strategies about which to reason automatically.

Knowledge about creative processes and techniques

Creative problem-solving processes can be described as iterations of divergent and convergent thinking. The divergent thinking is intended to manipulate information to generate many possibilities and the convergent thinking to generate fewer, more complete ones (e.g., Plsek 1997). Within this framing, Boden (1990) distinguished between two core types of creativity – exploratory and transformational. Exploratory creativity assumes a defined space of partial and complete possibilities to explore – a space that also implies the existence of rules that define the space. Changes to these rules produce what might be thought of as a paradigm shift, called transformational creativity (Boden 1990). Ideas that are novel and useful are reached in the space by a set of generative rules for divergent thinking and convergent thinking. Boden also identified a third form – a specific form of exploratory creativity that she called combinational creativity, which is the process of making unfamiliar connections between familiar items in the pre-defined search space using a different set of generative rules (Boden 1990). These three types can provide a valuable framing of not only how techniques manipulate knowledge during creative problem-solving but also how this knowledge is codified for manipulation by algorithms.

Many creative thinking techniques developed to manipulate problem and solution information have been published. Collections of these techniques are reported widely in academic papers (e.g., Tauber 1972), books (e.g., Michalko 2006) and web-sites (e.g., Mycoted 2022). We have observed that most of the techniques support one of Boden's three types of creativity, and provide generative rules that users can reason with to generate new ideas. E.g., the *constraint removal* (Onarheim 2012) and *assumption busting* (Michalko 2006) techniques direct their users to challenge the constraints and assumptions related to a problem, and hence change the rules that frame a space of possibilities, to support transformational creativity. The *TRIZ inventive principles* (Altshuller 1999) and *creativity triggers* technique (Giunta et al. 2022) direct users to discover possibilities in a space that have qualities associated historically with more creative outcomes – qualities such as *asymmetry* (Altshuller 1999) and *playfulness* (Burnay et al. 2016). Each quality can be translated into one or more generative rules with which to discover possibilities, and support exploratory creativity. And techniques such as *storyboards* (e.g., Stickdorn & Schneider 2010) and *heuristic ideation* (e.g., Tauber 1972) use the timelines of stories and combination matrices to implement rules with which to make unfamiliar connections between familiar items, and support combinational creativity. These observations led us to make an important claim – that the manipulation of rules that frame spaces and/or discover possibilities in them is open to automation with algorithms, to the benefit of businesses. As well as making this creativity knowledge more accessible to business users, algorithms that can manipulate that knowledge when codified can generate large numbers of possible ideas quickly, thereby increasing idea quantity. Furthermore, the algorithms can reason with information and data not available to individuals, to increase idea quality. And tools accessible via workplace desktops or smart mobile devices can integrate creative thinking more effectively into existing work processes.

Information about business strategies and models

Strategy has been defined in many ways, but almost all definitions share a common core – how a firm deploys its resources to achieve a favourable outcome (Grant 2021). The focus in this chapter is on strategies of single business firms and units of larger firms, rather than larger corporations that encompass multiple divisions. Key factors that determine the success of a firm's strategy is how that firm designs and makes its core offer, puts that offer into the market to attract customers, and makes customers pay. It is about how value is created in the eyes of its customers then captured in the form of revenues (Teece 2010, Baden-Fuller and Morgan 2010). There are, of course other matters of concern to managers in the firm that are also strategic, such as labour contracts, supply chain contracts, firm organisation, but these typically are subsidiary to the wider question "*what are we offering, to whom, and how are we asking them to pay for the offer?*".

The arrival of the digital age has meant that concerns that were traditionally separated have come together. In the past, most firms were concerned with how their offer was designed and produced. The challenge of selling was typically seen as important, but tactical and soluble if the other challenges were solved. Today, this separation can no longer be justified. How firms engage with customers at the customer-firm boundary is no longer a matter of tactical concern, it is strategic. Moreover, the choice of what happens on the customer-firm boundary influences the whole firm. What was a previously *modular* or *separable* concern has now become *integrated* or *systemic*.

Much of the existing literature on business models focuses on this important connection between the core processes of the firm and activities along the boundary between the customer and the firm (Teece 2010, Baden-Fuller & Haelfiger 2013). The Business Model Zoo (BMZ) initiative was developed to present different forms of this connection to businesses. It set out four key choices, each of which represented a different way by which these connections are made: product, solutions, match-making, and mediated multisided. In the product business model type, the boundary decision can be separated from the core processes of the firm, because the relationship between the firm and its customer is *transactional* (Baden-Fuller and Haelfiger 2013, Baden-Fuller et al. 2017). This means that creative concerns about what happens inside the firm regarding the design of the offer and its production can be completely separated from distribution, marketing and selling. In the solutions business model type, they cannot be so arranged – how the firm sells critically influences the design of the offer, and vice-versa. The digital streaming platform Spotify exemplifies these connections – the method of streaming of the content deeply influences the viewers experience, and its ability to suggest the right movie to watch and remember when you stopped watching is as important to the enjoyment as the library choices. Likewise, the physical experience of the ambiance for the delivery of the high-quality hair cut or shave is as important as the cut itself. In these latter two cases, it is clear that all firm decisions have to look holistically at what is going on in all parts of the value chain, including the value capture.

The other two business model types replicate the first two situations, but for firms that have multiple customer groups. Are these firms running the different groups separately? This is the case for the sheep farmer who sells wool and meat without being concerned about the interactions between the buyers, and the case of the match-maker who has a transactional

relationship with the buyers and sellers. This is also the case for firms confronted by interactions between the two sides, e.g., not only for the platform gaming firm that is selling advertisements embedded within the games, but also for the traditional charity helping the poor by endeavouring to engage its two sides – donors and beneficiaries – to interact to stimulate more giving and ensure the beneficiaries recognise the quality of the core charity offerings. A further layer of complexity is to consider if the relationship between the firm and each of its *sides* or *customer groups* should be transactional (as with Amazon and its relationships with sellers located in China) or relational (as with Google and its advertisers, who are deeply tied into the Google machine through complex incentives).

The BMZ initiative launched its website as a vehicle to bring this view of different business model types to life. It contains descriptions of the four types and exemplars to further understanding with real examples. Each type that was discoverable in the website are summarised in Figure 6.1. Information about them and their related strategies provided the baseline input for the planned automated reasoning.

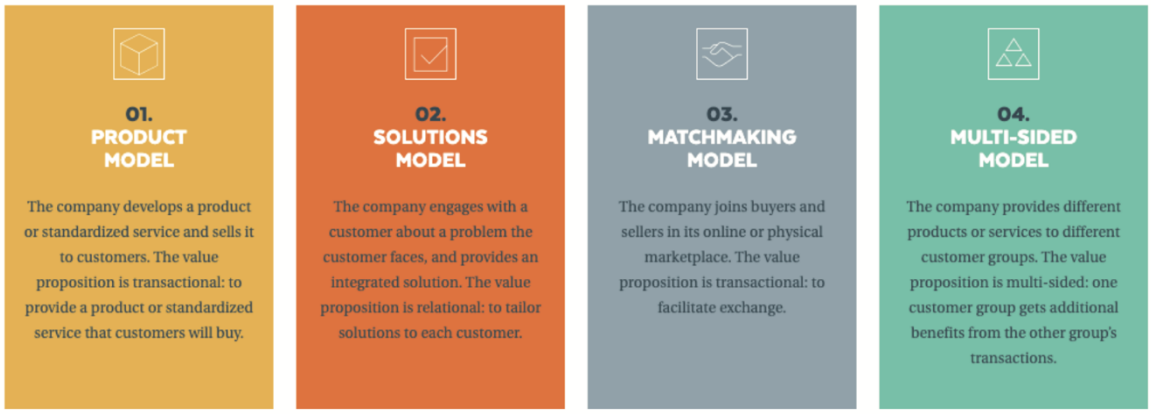

Figure 6.1: The four model types available via the Business Model Zoo (BMZ)

BOB – an interactive prototype for creative thinking about business models

Next, to explore how to reason automatically about codified creativity knowledge and information about business models, we designed, implemented and evaluated a simple digital prototype. The prototype was called the Business Opportunity Builder, or BOB for short. The development of BOB followed an established design science approach – one that sought to design and investigate artefacts that interact in and with a problem context, to improve something in that context (Wieringa 2014). We designed a new version of an artefact to interact with – BOB – that were then analysed in the context of use with business users, to investigate whether it had the potential to support their creative thinking and generate *Pro-C*, *Mini-C* and *Little-c* creative outcomes.

The authors used co-design techniques to develop the prototype. The lead author collaboratively developed with business users a series of simple wireframes of key interactions. These wireframes were then used to develop a small number of partial prototypes that were shared with other business users to collect their feedback on the

designed content, guidance and user journey. Details of this co-design process are reported in Dowsett (2020).

Full version of the BOB prototype

The first full version of the interactive BOB prototype was designed to support business professionals to think creatively about their business models and strategies using different co-designed features. It was developed as an interactive web application accessible via a URL, to enable users to provide feedback on it without the need to download or login to software. Each of the prototype's key features and, where needed their underpinning algorithms, are reported in turn.

The challenge description

The prototype offered the user a simple one-line text entry feature with which to enter a current business challenge to investigate, see Figure 6.2. To guide users the prototype also listed examples of challenges that could be explored, as a guide for what to enter.

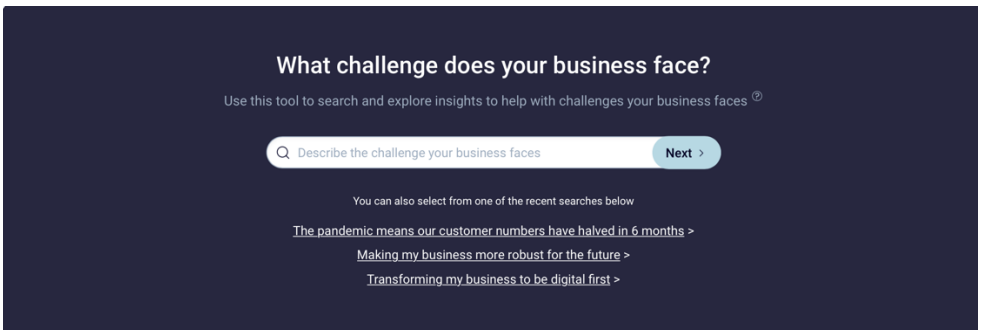

Figure 6.2. The prototype's feature for entering a description of a business challenge

The business model finder and descriptions

Based on the design of the earlier Business Model Zoo web-site, a simple online wizard guided a user through a series of four questions, the answers to two of which enabled the prototype to present one of the four selected business model types to the user. The wizard was designed to be simple and quick to use. It elicited each response on a 1 to 4 scale. Users simply clicked one option on each scale – no text entry was needed. Examples of two of the four questions asked by the wizard are shown in Figure 6.3. The first question asked the user to select the extent to which customers of the business pay for physical or digital products and services. The second asked the user to select the extent to which the business customises its product or service to each customer's needs. Users were able to navigate forwards and backwards through the wizard to change their answers to one or more questions, before requesting the business model type selected by the prototype.

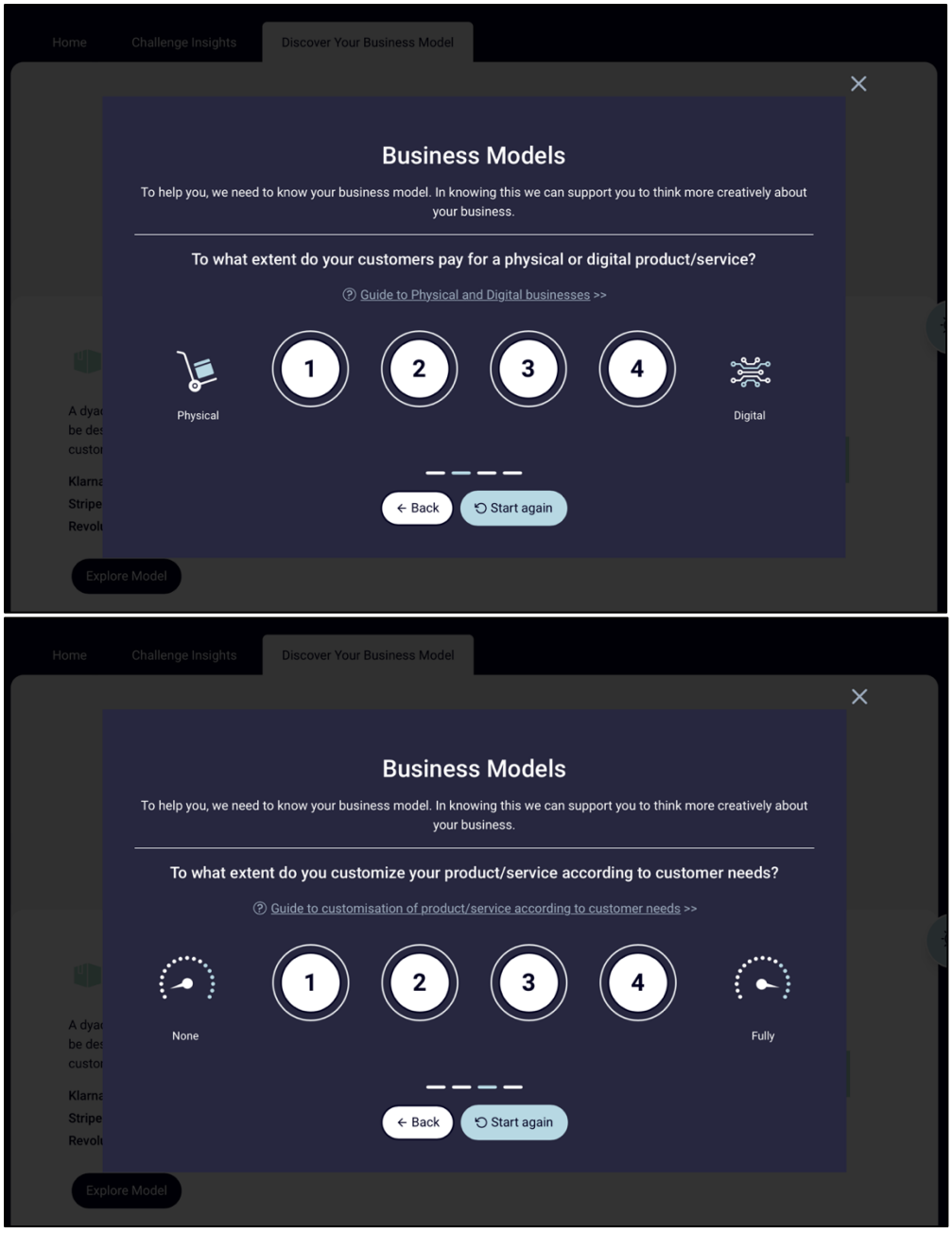

Figure 6.3. Two questions asked by the business model finder, to select the relevant business model type

The prototype implemented a simple algorithm to select one business model type automatically in response to each four responses. The inputs to the algorithm were only the four response values entered by the user, and the output was one of the four pre-defined business model types. The algorithm was designed to select one and only one model type in response to all possible combinations of the input values. The selected business model type was described using a short text description and single graphic taken from the original BMZ website. It was presented to enable users to review and confirm each selected model, before progressing. One example of this text and graphic is shown in Figure 6.4. If needed, the user was able to return to the wizard questions to change answers and restart the process. If the user agreed the selected business model type, the prototype provided different features with which to explore that model type.

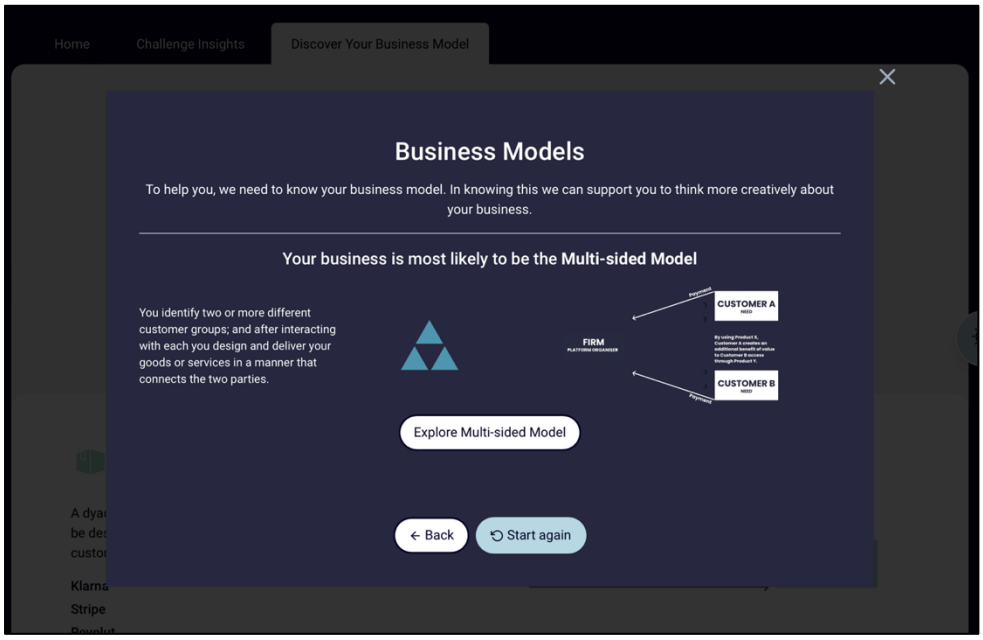

Figure 6.4. A summary description of one business model type presented to users

First, the prototype presented a more detailed description of the selected business model type, in text form. One section of the prototype's description of the Multi-sided Model type is shown in Figure 6.5. This description was supported by a short animation video that also described the model type. The video included a talking lion taken from the original Business Model Zoo website. The description was supplemented with links to case studies – curated examples of businesses that had implemented the presented type of business model. The names of these case studies are shown to the right of the model text, see Figure 6.5.

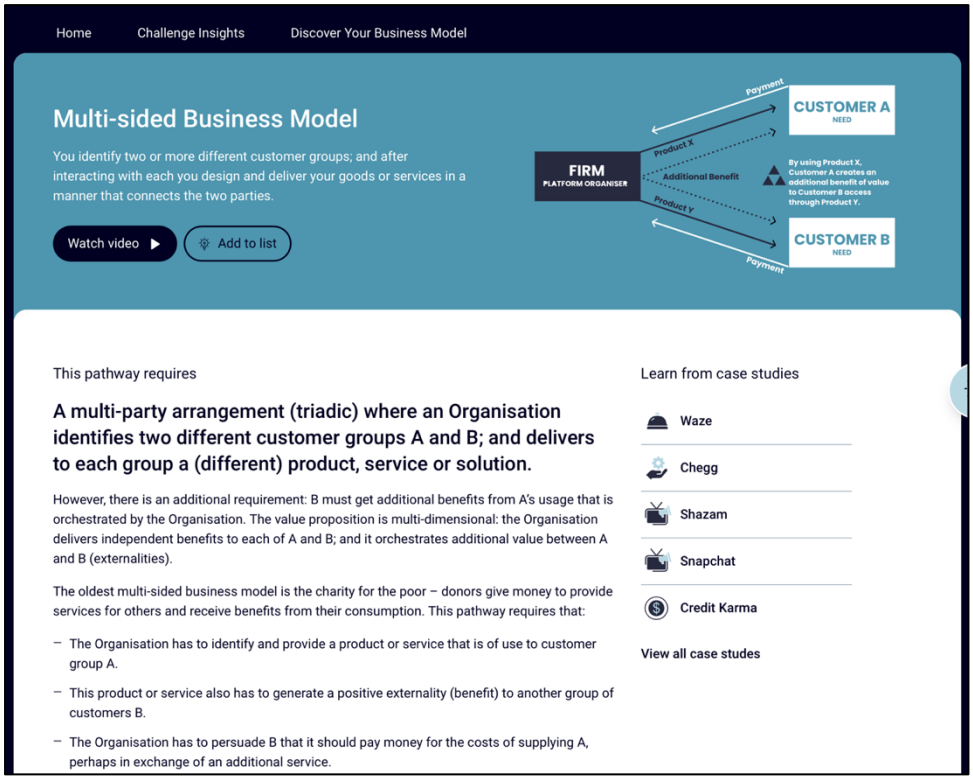

Figure 6.5. A more complete description of one business model type, and on the right the titles of curated case studies associated to that type

The business model examples

Each retrieved business model type had been curated and associated with multiple case studies of businesses identified to have implemented that type. Each example represented one case. A total of 106 case studies had been developed in the original Business Model Zoo project, and all were implemented in the new prototype. A user was able to review all of the cases linked to the selected business model type. Each case study was described in text form with a header introducing the business and fit to the model type, an overview of the business and its activities, history and customers. An example description in the prototype for the *Waze* case study is depicted in Figure 6.6. As such, the prototype encouraged users to engage in simple case-based reasoning – reasoning with previous experiences to understand and solve new problems in similar ways (Kolodner 1993). However, the users were not able to interact directly with each description, so the prototype only provided the baseline resources with which to undertake case-based reasoning. No interactive support was offered. Nonetheless, user access to these descriptions was expected to support them to generate at least *Pro-C* and *Little-c* creative outcomes. Each case could offer one draft *Pro-C* solution to a business modelling-related problem, and smaller elements of that case could direct thinking to generate *Little-c* outcomes that others might not consider novel, but can contribute to future *Pro-C* solutions.

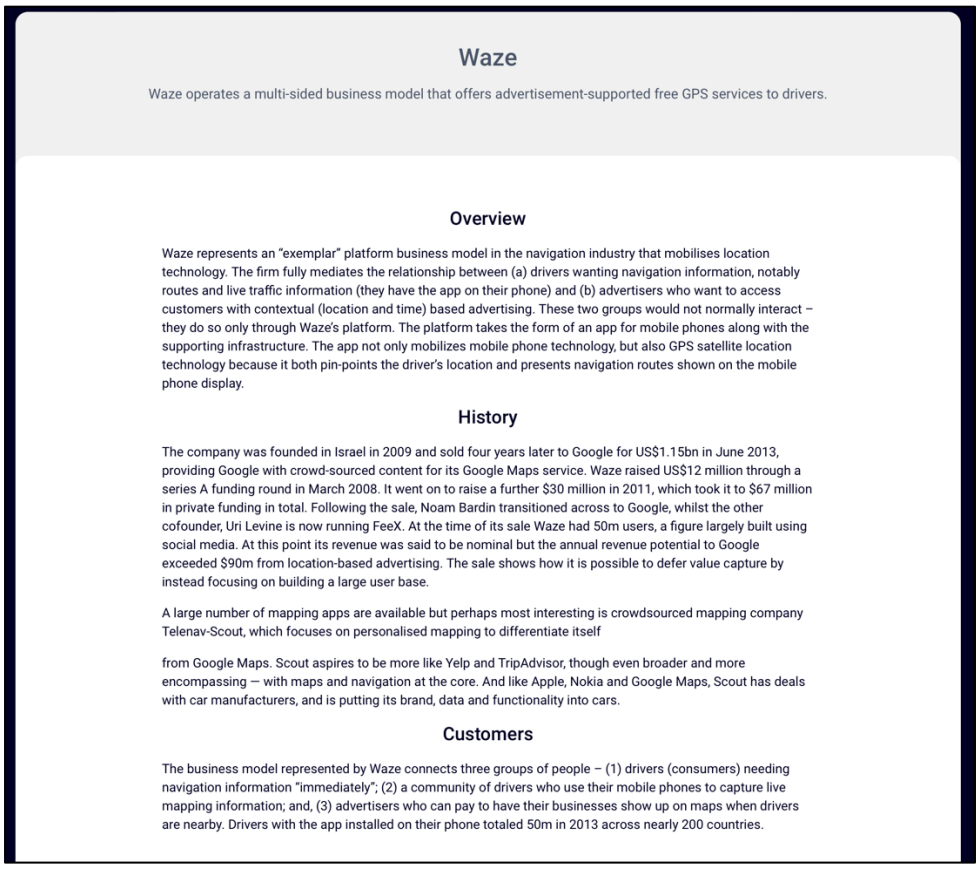

Figure 6.6. One case study description retrieved and presented by the prototype to users

By contrast, to support more directed creative thinking with these case studies, the prototype also supported users to interact with them and explore possibilities that might be judged to be more novel and useful. First, a carousel presented three case studies at a time on interactive cards, so that the user could explore the cases quickly by scrolling backwards and forwards and filtering the case studies that were presented, see Figure 6.7.

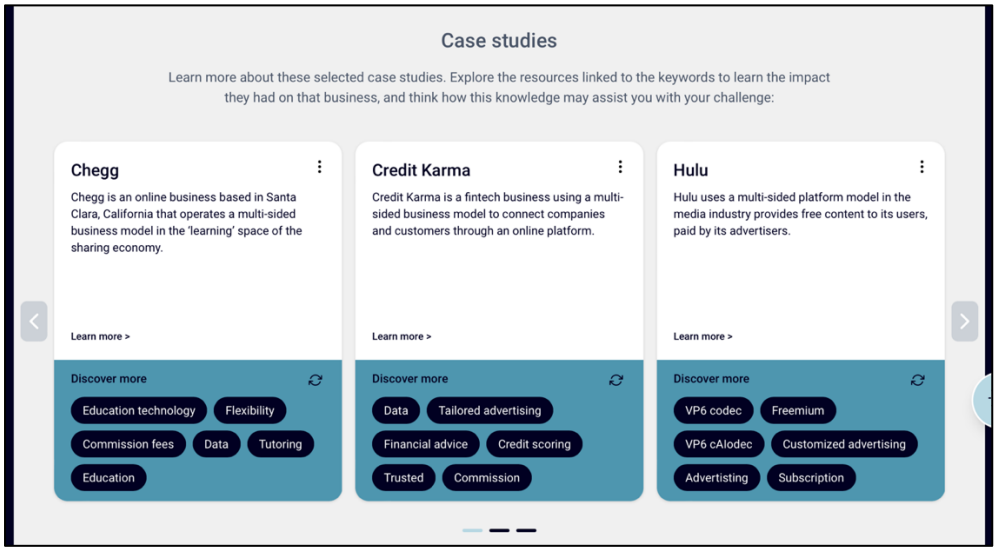

Figure 6.7. Multiple interactive case studies presented in the prototype's carousel

In turn, each interactive card was divided into three parts – the name and summary of the case study, an option to view the full case study description shown in Figure 6.7, and interactive themes automatically generated by the prototype for each case. The prototype had the potential to generate the interactive themes automatically for each case using entity extraction algorithms, although the first version presented manually-generated themes. The user could then click on each theme to interrogate it and to discover more information related directly and indirectly to the case. An example of this interrogation is shown in Figure 6.8. The user has selected the *Credit Karma* case and clicked on the theme *Credit scoring*. In response, the prototype has presented an interactive pop-up populated automatically with links to online documents discovered using Google and other web searches generated automatically from simple creative searches of online content. These pop-ups and links were designed to encourage users to explore multiple possibilities for new ideas, consistent with Boden's definition of exploratory creativity, and generate *Pro-C*, *Mini-C* and *Little-c* creative outcomes. The queries automatically generated by the prototype acted as rules to guide users to discover more ideas possibilities in the spaces.

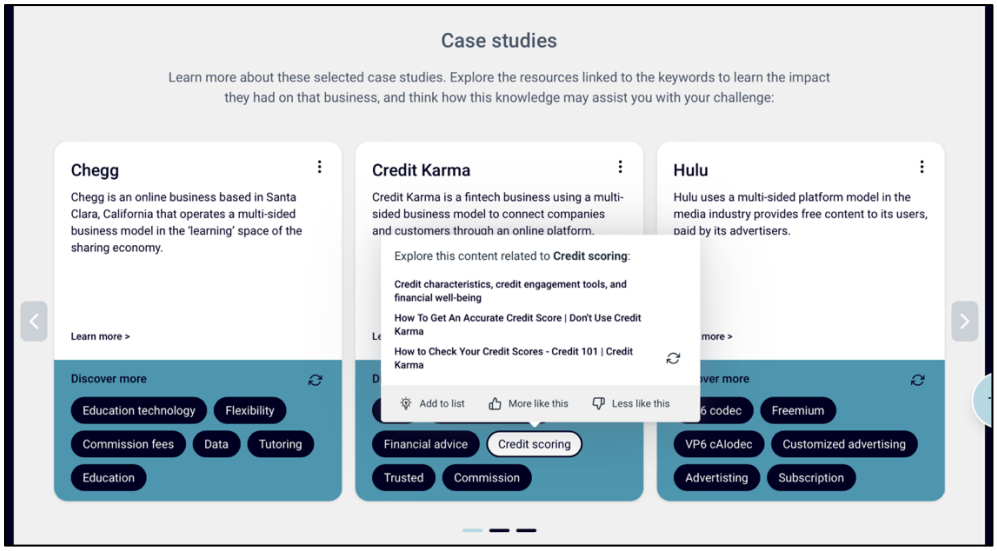

Figure 6.8. An interaction with case study theme presented in the carousel, to encourage exploratory creative thinking

Insights and constraints

Furthermore, the prototype also implemented two new features to encourage users to discover ideas in different spaces of possibilities. The first, called *Insights*, discovered information from different external sources in response to the simple keywords entered to filter the examples case studies associated with the selected business model type. The algorithms that retrieved this information codified creativity knowledge as expansions of queries with which to discover content related more tangentially to the keywords. The information was presented on different interactive cards populated automatically with content extracted from different curated channels – e.g., academic papers from Google Scholar and videos from YouTube. The algorithms called public APIs to these providers to retrieve meta-content about the papers, podcasts and videos – meta-data such as titles, formats and, where appropriate, duration. The prototype presented this content to users using information cards. The cards were designed to have a similar presentation layout to the cards describing the case studies. Examples of them are depicted in Figure 6.9. Clicking on the card title opened the selected paper, podcast or video in a separate tab to the browser. Users were able to use simple interactive features to, e.g., filter the content sources accessible via the cards. The *Insights* feature was implemented to guide users primarily to generate *Mini-C* and *Little-c* creative outcomes in the form of ideas that others might not consider novel, but can contribute to future *Pro-C* solutions, or new meaningful reflections that can also contribute to future *Pro-C* solutions.

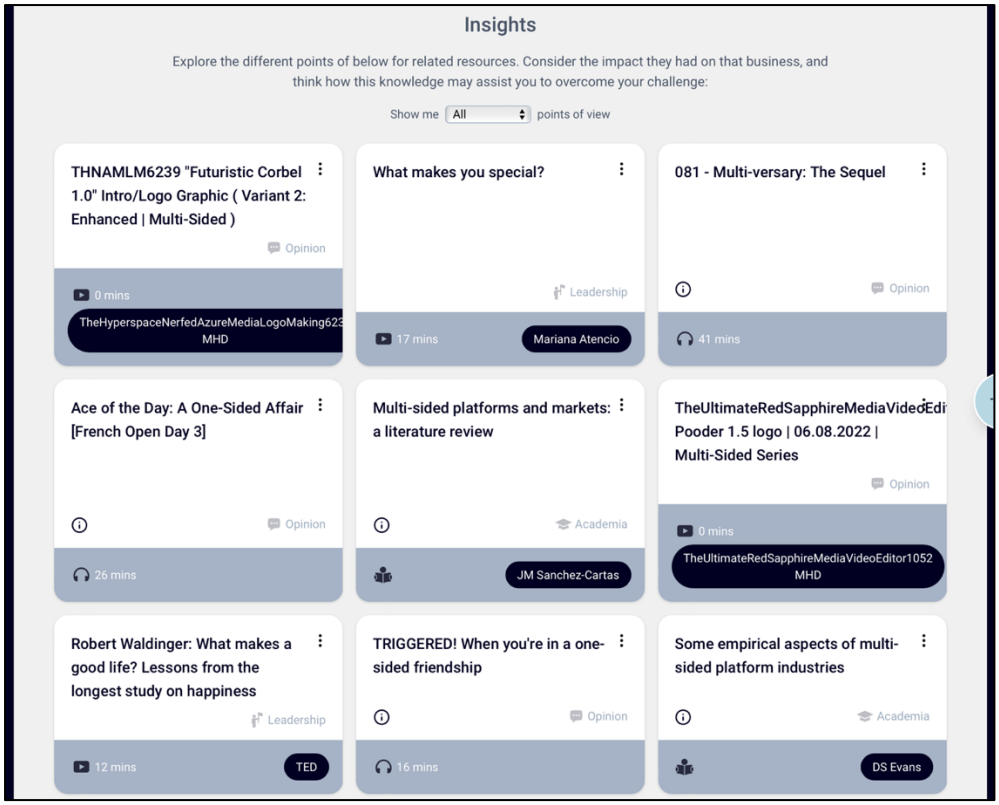

Figure 6.9. The prototype's presentation of information cards that provide different insights into the entered business challenge

The second feature, called *Transformations*, was introduced to guide users to undertake transformational creativity thinking about their business model and strategies. According to Boden, exploratory creativity assumes a defined space of partial and complete possibilities to explore – a space that also implies the existence of rules that define the space. Changes to these rules produce what might be thought of as a paradigm shift, called transformational creativity (Boden 1990). Therefore, to encourage this transformational creative thinking, the prototype also presented four different questions that directed users to change one or more rules that were defining their space of ideas being explored, in order to open up new spaces of possibilities. These rules related to people, places, organizations and other concepts associated with their businesses, and were designed using creativity knowledge about transformational creative thinking techniques. E.g., one published constraint removal technique (Onarheim 2012) directs users to discover then deliberately remove constraints that limit the space of possible ideas, then to generate ideas in this enlarged space of possibilities. The operational knowledge of how to implement this technique was codified in simple rules and interactive guidance for the user. Figure 6.10 shows four questions that had the potential to be generated by the prototype. Examples of these questions were "*Imagine if you were not limited to the current leadership model, how might you address the challenge?*" and "*How would you approach this challenge if you were not restricted to the physical venue of your business?*". Again, the *Transformations* feature was implemented to guide users primarily to generate *Pro-C* and *Mini-C* creative outcomes.

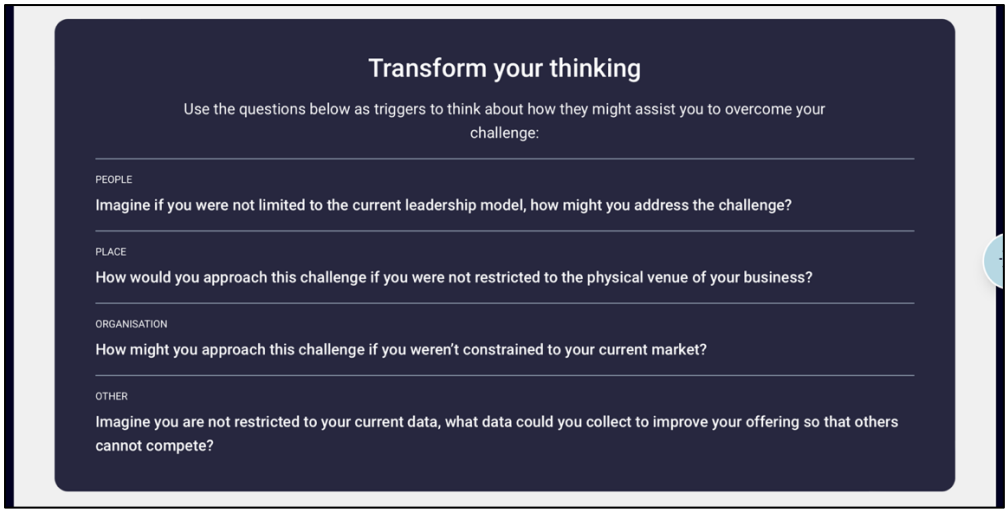

Figure 6.10. Guidance provided by the prototype's *Transformations* feature

Finally, during all interactions with the prototype, the user was able to access, add to and download inspirations from the *Inspiration list*. This list was accessed by clicking on a lightbulb icon on the right side of the page. When clicked, the main content page narrowed and the list became visible to the right of it, see Figure 6.11. During interactions with the prototype, a user was able to add business model types, case studies and themes to the list, at the click of a button, then add notes to these additions, as inspirations for further creative thinking.

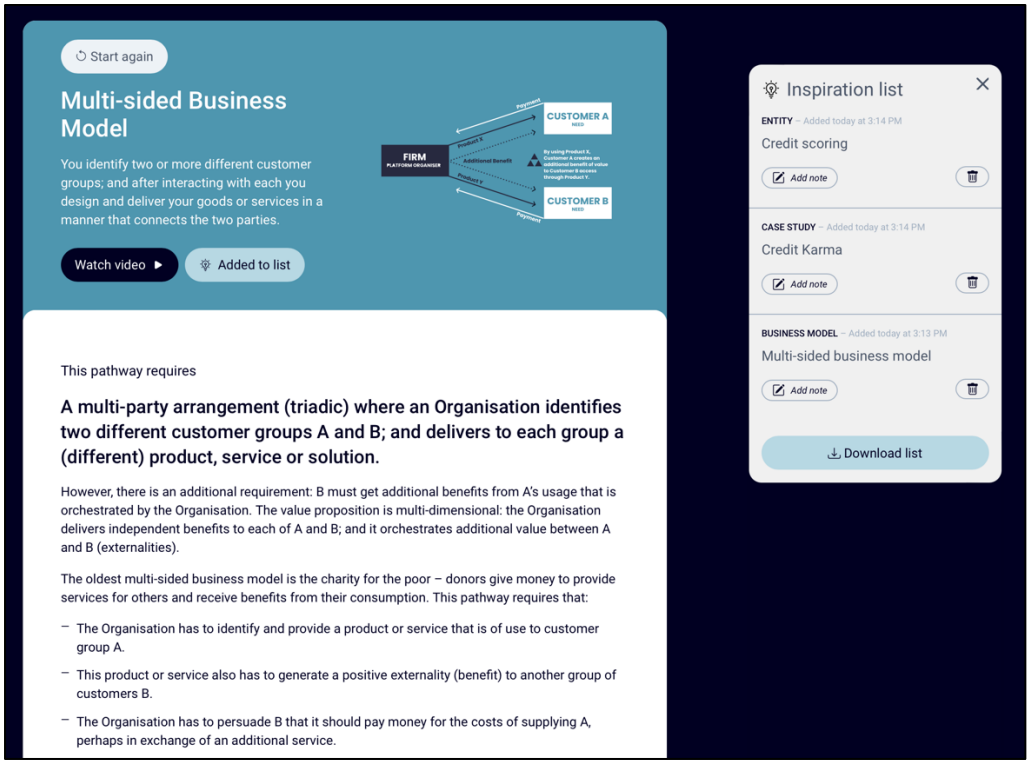

Figure 6.11. The *Inspiration list*, which can be accessed on the right side to record discovered businesses, case studies and themes, and generated ideas

Summarising, the prototype combined codified creativity knowledge in form of creative searches and interactive guidance with information about business model types and related case studies. It was co-designed with business users. However, feedback on the prototype was still missing. Therefore, the authors conducted first formative evaluations of the prototype with business users who had not previously accessed the prototype, to provide qualitative feedback on its concepts, aim and features. These first evaluations are summarised in the next section.

First evaluations of the BOB prototype

The reported version of the BOB prototype was evaluated by four business professionals from different organizations. The current roles, sectors and location, and the total years of work experience of each of these professionals are listed in Table 6.1. Three had 20+ years of work experience in different business sectors and were located in the United Kingdom.

Role	Sector	Years work exp.	Location
Operations manager	Brand supplies	4+	Dubai
Company executive	Digital technology	25+	UK
Founder / business strategist	Social / creative	20+	UK
Managing director	Market research	25+	UK

Table 6.1. The current roles, sectors and location, and the total years of work experience of each of the business professionals at the time of the first prototype evaluation

Each professional engaged with the prototype individually, and each evaluation session took place online, remotely, using screen sharing through Zoom. Each session took between 40 and 60 minutes. During each session, the business professional was asked to perform tasks from a prepared test script and to 'think out loud' as they performed these tasks. Each test script was adapted slightly to the individual, flexible and allowed the professionals to explore different features and undertake different actions. When this occurred, unscripted and/or adapted questions were asked in response to what was observed and/or said, and prompts were given to guide the professionals back to the scripted tasks. All of the sessions were recorded, and the combined screen and think aloud audio recording were reviewed to collect both positive and negative feedback about the prototype.

All four of the business professionals were able to use the tool and undertake the scripted tasks. The tasks required each to bring a business challenge, then to walk through the prototype's features to explore that challenge. The audio recordings revealed that the professionals were positive about the prototype as a whole. Both the concept and the premise behind it – creative guidance to think differently about business models and strategies – were deemed valuable and of interest. Many professionals responded that they would return to use such a tool in their professional work.

Furthermore, different features of the prototype were singled out as having specific potential value. The digital support to explore different business case studies was reported to be potentially very helpful. Both the detailed case study content and the associated interactive themes were also reported to have value. In addition, the professionals were positive about

the different content types and formats, such as videos and podcasts, which were available to explore using the *Insights* feature. These different content types were reported to be both unexpected and surprising. Furthermore, the questions presented to encourage more transformational creativity using the *Transformations* feature were reported to be engaging, of interest and useful. And the right-side *Inspiration list* was described as a great device to store, reflect on and share ideas and sources with colleagues.

That said, the professionals also reported that, had each of them been able to enter more information about a business challenge, then the prototype might have provided them with more complete and more relevant guidance. When asked to elaborate, many reported that the simple business challenge was perceived to limit the information entered into the prototype to reason with. Similarly, many of the professionals reported that the discovered insights content was often interesting but not sufficiently related to the entered challenge, and this introduced a lot unwanted noise into their tasks.

Moreover, in spite of positive feedback about the prototype's overall concept, premise and features, the professionals reported other problems which formed barriers to adoption. Much of the information presented by the prototype (e.g., about the business model types and case studies) was perceived to be inaccessible and/or difficult to understand. The business model descriptions were reported to lack important information about e.g., growth in terms of the stages that businesses often need to go through. Unsurprisingly, the business professionals considered themselves to be intelligent and knowledgeable about their businesses and challenges. However, their interactions with the prototype were reported to create a sense of not understanding these challenges sufficiently. Likewise, although the wizard-led process for selecting a business model type in response to simple choices was perceived to be intuitive, some of the questions asked by the wizard were unclear, and the associated examples available to explain these questions did not help. Furthermore, the rationale for the prototype asking some of the questions, such as whether the product or service was physical or digital, were not understood, and some of the business professionals wanted to be able to answer these questions differently (e.g., to be able not to answer, or to provide a middle-of-the-range value). Some also questioned the absence of other questions that they reported to be important in business model selection, such as about the size of the business requiring the model.

Furthermore, much of the prototype's generated guidance was perceived to be irrelevant to the entered challenge. Although the case studies were valued, comments were also made about their range (which was too limited, or from the wrong sectors), their validity (which was not sufficiently up-to-date), their poor fit to the presented business model type, and the inappropriateness of the extracted entities (which were not related closely enough to the user-entered challenge). Similarly, the *Transforms* questions to encourage transformational creative thinking were insufficiently refined and/or adapted to, e.g., the entered challenge and/or the discovered case studies.

However, the prototype feature that received the most comments was the *Insights* feature. In spite of the potential and excitement that the feature generated, some of the returned results were not relevant. In response, constructive feedback from the professionals included the

inclusion of keyword searches (e.g., to discover related information about the entity presented in the bottom-right of each card), knowledge level filters (e.g., expert versus entry-level) to provide more user control over the discovered insights, and tagged content from paywalls (to avoid friction during tasks). The visual presentation of the information cards was also reported to be too uniform and dry. And finally, to encourage more collaborative thinking about business models and strategies, the prototype should enable other users in the same organisation to explore other user results, to generate what was called '*tribal knowledge'* and the saying '*If only we knew what we know'*.

To conclude, this first evaluation with the four experienced business professionals revealed the potential value of even limited interactive features to encourage creative thinking about businesses and their models. The overall design was usable, and revealed that the core design ideas were valid. However, perhaps unsurprisingly given the first version prototype, the execution of the design was relatively poor, and substantial reworking of parts of the interaction, algorithms and curated content were needed. Indeed, these evaluation results demonstrate how sensitive business users might be to co-creative AI products in tasks such as business model selection.

Therefore, to understand better how digital tools such as BOB might be used in businesses, semi-structured interviews were conducted with a different 10 business professionals from different organizations. Each professional was asked the same questions, then offered a chance to engage with the same described and evaluated version of the BOB prototype individually. The current roles, sectors and location of each of the professionals are listed in Table 6.2.

Current role	**Company profile and sector**	**Location**
Partner	Large company, working across sectors	Global
Consultant	Start-up consultancy supporting other start-ups	UK
Innovation manager	SME developing not-for-profit digital technologies	UK
Business development	Start-up developing a digital health app	UK
Business founder	Start-up supporting creative production and consultancy	UK
Business development	SME developing not-for-profit digital technologies	UK
Business founder	SME working in the education technologies sector	UK
Business founder	SME agency working in experiential marketing	UK
Business development	SME working in the education sector	UK

Table 6.2. The current roles, company profiles and sectors, and location of each of the business professionals at the time of the second prototype evaluation

All the interviews were conducted individually online, and allowed for in-depth exploration of topics. During each interview, each business professional was asked about their business and role in that business, about the business's approach to developing its business model, and whether creative thinking and/or digital tools played a role in developing the business model. At the end of each interview, each business professional was walked through the BOB prototype and asked questions about its features and guidance. More details are reported in Chandras (2022). In this chapter we report only the results from an analysis of the audio-recorded transcripts that identified three usage scenarios in which future versions of the BOB prototype can add value to businesses. Each scenario is described in turn.

The first scenario was to support strategy and lead generation by start-up founders to discover more creative business opportunities. These founders reported often encountering challenges during early business development to craft or evolve their business model and strategies. A need for guidance to select a business model, combined with personalised diagnostic features to develop the business's needs were identified. These features should include multi-media support for explaining key business concepts and different business templates customised to each the start-up. Support for cash-flows, such as guidance for finding monetisation mechanisms like freemium or joint business partnerships, was also needed in this scenario.

The second scenario was quite different, and supported client-facing consultants and business development team members to upskill to deliver pitches to clients. People in these roles are often required to come up with winning pitches that solve client business challenges, so they need to update the knowledge and skills with sector- or subject-specific information, data and insights.

The third scenario described how consultants and other stakeholders might work together to share perspectives and crowdsource ideas with which to solve business problems. Two reported challenges with large client teams were poor access to stakeholders and lack of stakeholder's creative engagement to contribute fresh perspectives and ideas. Therefore, future versions of the prototype will need to motivate then guide stakeholders to participate effectively in collaborative processes, to share perspectives and generate new ideas as part of a collaborative creative process.

Conclusions and next steps

This chapter has reported early design research that integrated codified knowledge about established creative thinking processes, techniques and tools with digital information about business models from the existing Business Model Zoo. The result was a new digital prototype called BOB that was designed to support business users to generate new ideas about their business models. BOB was an example of co-creative AI, a form of human-centred AI in which machine and human reasoning interleave to solve complex problems. It was designed to support business professionals to generate different forms of *Pro-C*, *Mini-C* and *Little-C* creative outcomes (Kaufman & Beghetto 2009) related to their business models, systematically and regularly. However, in first evaluations, although the professionals were positive about the concept behind BOB and its features for creative thinking support, the early prototype needed to be refined to demonstrate its potential to generate the different forms of creative outcomes. Similar barriers to use were encountered when deploying co-creative AI tools in other professional domains (e.g., Maiden et al. 2020b).

The next stages of this design research will be to develop new versions of the BOB prototypes to support business professionals working in the three scenarios reported in the second study. Indeed, this development work has already started. Each is being designed to integrate into the reported workflows of business leaders and consultants, and to provide more creative guidance about business strategies and tactics as well as models to these users

more quickly than in the current prototype. We look forward to reporting these prototypes and their evaluations in the future.

Reference list

Abdullah, U., Ligęza, A., & Zafar, K. 'Performance evaluation of rule-based expert systems: An example from medical billing domain'. Expert Systems, 34:e12218, 2017. doi: 10.1111/exsy.12218.

Altshuller, G. *The Innovation Algorithm: TRIZ, Systematic Innovation, and Technical Creativity*. Worcester, MA: Technical Innovation Center, 1999.

Amabile, T.M. and Pratt, M.G. 'The Dynamic Componential Model of Creativity and Innovation in Organizations: Making Progress, Making Meaning'. Research in Organizational Behavior (36), 157–183, 2016. doi: 10.1016/j.riob.2016.10.001

Andolina, S., Schneider, S., Chan, J., Klouch, K., Giulio, J., & Dow, S. 'Crowdboard: Augmenting In-Person Idea Generation with Real-Time Crowds'. Proceedings of 11th ACM Creativity & Cognition Conference, ACM Press, Singapore, 106-118, 2017. doi: 10.1145/3059454.3059477

Aragon, C.R., Poon, S.S., & Aragon, A. M-H. D., (2009). A tale of two online communities: fostering collaboration and creativity in scientists and children. Proceedings of the 7th ACM Conference Creativity & Cognition Conference, Berkeley California, ACM Press, 9-18. https://doi.org/10.1145/1640233.1640239

Baden-Fuller, C. and Haefliger, S. Business Models and Technological Innovation. Long Range Planning Volume 46, Pages 419-426. http://dx.doi.org/10.1016/j.lrp.2013.08.023

Baden-Fuller, C. & Morgan, M.S. 'Business Models as Models'. Long Range Planning Volume 43, Issues 2–3, Pages 156-171, ISSN 0024-6301, 2010. https://doi.org/10.1016/j.lrp.2010.02.005.

Baden-Fuller, C., Giudici, A., Haefliger, S. & Morgan, M. Business Models and Value. Academy of Management Proceedings, 2017(1), doi: 10.5465/AMBPP.2017.90

Bartindale, T., Valentine, E., Glancy, M., Kirk, D., Wright, P., & Olivier, P. 'Facilitating TV Production Using StoryCrate'. Proceedings of 9th ACM Conference Creativity & Cognition Conference, ACM Press, Sydney Australia, 193-202, 2013. doi: 10.1145/2466627.2466628

Bichindaritza, I. & Marling, C. 'Case-based Reasoning in Health Sciences: What's Next?', Artificial Intelligence in Medicine 36(2), 2006. doi: 10.1016/j.artmed.2005.10.008

Boden, M.A. *The Creative Mind*, Abacus, London, 1990.

Chandras, D. 'Design Thinking in Practice: UK Launch Approach for CebAI's BOB tool'. Masters Dissertation, Bayes Business School, City, University of London, September 2022.

Cherry, E. & Latulipe, C. 'Quantifying the Creativity Support of Digital Tools through the Creativity Support Index'. ACM Transactions on Computer-Human Interaction, 2014. 21. 10.1145/2617588. doi: 10.1145/2617588

Burnay, C., Horkoff, J. & Maiden, N. 'Stimulating Stakeholders' Imagination: New Creativity Triggers for Eliciting Novel Requirements'. 2016 IEEE 24th International Requirements Engineering Conference (RE), Beijing, China, 36-45, 2016. doi: 10.1109/RE.2016.36.

Davis, J.U., Anderson, F., Stroetzel, M., Grossman, T., & Fitzmaurice, G. 'Designing Co-Creative AI for Virtual Environments'. Proceedings of 12th ACM Creativity and Cognition Conference '21). ACM Press, Virtual Conference, Article 26, 1–11, 2021. doi: 10.1145/3450741.3465260

Design Council. *Design for Innovation: Facts, Figures and Practical Plans for Growth*, 2011. available at http://www.designcouncil.org.uk/

Došilović, F.K., Brčić, M., & Hlupić, N. 'Explainable artificial intelligence: A survey'. 41st International Convention on Information and Communication Technology, Electronics and Microelectronics, Opatija, Croatia, 0210-0215, 2018. doi: 10.23919/MIPRO.2018.8400040.

Dowsett, M. 'Intersecting design and business: An Exploration of Digital Creative Techniques to Stimulate Insights, Communication and Understanding of Business Models'. Masters Dissertation, Bayes Business School, City, University of London, September 2020.

Easton, E., & Djumalieva, J. (2018). Creativity and the future of skills. Report from Creative Industries Policy and Evidence Centre, NESTA, London, United Kingdom.

Ehsan, U., Wintersberger, P., Liao, Q.V, Mara, M., Streit, M., Wachter, S., Riener, A. & Riedl, M.O. 'Operationalizing Human-Centered Perspectives in Explainable AI'. In CHI Conference on Human Factors in Computing Systems Extended Abstracts (CHI '21 Extended Abstracts), May 8–13, 2021, Yokohama, Japan. ACM, New York, NY, USA, 6 pages, 2021. doi: /10.1145/3411763.3441343

Giunta, B., Burnay, C., Maiden, N. & Faulkner S. 'Creativity Triggers: Extension and Empirical Evaluation of their Effectiveness during Requirements Elicitation'. Journal of Systems and Software 191, C, September 2022. doi: 10.1016/j.jss.2022.111365

Grant, R.M. *Contemporary Strategy Analysis*, 11th edition, Wiley-Blackwell, 2021.

Honauer, M., & Hornecker, E. 'Challenges for Creating and Staging Interactive Costumes for the Theatre Stage'. Proceedings of 10th ACM Creativity & Cognition Conference, Glasgow Scotland, ACM Press, 13-22, 2015. doi: 10.1145/2757226.2757242

Hossain, M. S., Zander, P.-O., Kamal, M. S., & Chowdhury, L. 'Belief-Rule-based Expert Systems for Evaluation of e-government: a Case Study'. Expert Systems, 32, 563– 577, 2015. doi: 10.1111/exsy.12110.

Isaksen, S.G., Dorval, B.K., & Treffinger, D.J., 2011. *Creative Approaches to Problem Solving: A Framework for Innovation and Change*. Sage Publications, Thousand Oaks, California, United States, Inc; Third Edition, 2011.

Karimi, P., Maher, M.L., Davis, N., & Grace, K. 'Deep Learning in a Computational Model for Conceptual Shifts in a Co-Creative Design System', Proceedings ICCC'19, Charlotte, North Carolina, United States, 2019. Conference arXiv:1906.10188

Kaufman, J.C., & Beghetto, R.A. 'Beyond Big and Little: The Four c-model of Creativity'. Review of General Psychology 13,1, 2009.

Kerne, A., Koh E., Smith, S. M., Webb, A., & Dworaczyk, B. 'combinFormation: Mixed-Initiative Composition of Image and Text Surrogates Promotes Information Discovery'. ACM Transactions on Information Systems, 27(1), 1-45, 2008. doi: 10.1145/1416950.1416955.

King, M.J. Apollo 13 Creativity: In-the-Box Innovation. Journal of Creative Behavior 31(4), 299-308, 2011. doi: 10.1002/j.2162-6057.1997.tb00801.x

Kolodner, J. *Case-Based Reasoning*. Elsevier 1993.

Long, D., Padiyath, A., Teachey, A., & Magerko, B. 'The Role of Collaboration, Creativity, and Embodiment in AI Learning Experiences'. Proceedings of 12th ACM Creativity & Cognition Conference, Virtual Conference, ACM Press, Article 28, 1–10, 2021. doi: 10.1145/3450741.3465264.

Maiden, N., Zachos, K., & Lockerbie, J. 'Evaluating an Information System to provide Creative Guidance about Health-and-Safety in Manufacturing', Behaviour & Information Technology 40(11), 2020a. doi: 10.1080/0144929X.2020.1743756

Maiden, N., Zachos, K., Brown, A., Apostolou, D., Holm, B., Nyre, L., Tonheim, A., & van den Beld, A. 'Digital Creativity Support for Original Journalism'. Communications of the ACM, 63(8), 46-53, 2020b. doi: 10.1145/3386526

Maiden, N., Lockerbie, J., Zachos, K. and Wolf, A. 'SPORT SPARKS: Supporting Creative Thinking by Professional Coaches'. 9th International Conference on Sport Sciences Research and Technology Support 28-29 October, Retrieved 15th December 2021. https://openaccess.city.ac.uk/id/eprint/26676/.

Maiden N., Lockerbie J., Zachos K., Wolf A. & Brown A. 'Designing new digital tools to augment human creative thinking at work: An application in elite sports coaching'. Expert Systems 40(3), e13194, 2022. doi: 10.1111/exsy.13194

Michalko, M. *Thinkertoys: A Handbook of Creative-Thinking Techniques*, Ten Speed Press, Berkeley, California, United States, 2nd Edition, 2006.

Mycoted, (2023). Retrieved 14th April 2023, from https://www.mycoted.com/Main_Page.

Olsson, T., & Väänänen, K. 'How does AI challenge design practice?'. Interactions 28(4), 62–64, 2021. doi: 10.1145/3467479

Onarheim, B. 'Creativity under Constraints: Creativity as Balancing: Constrainedness'. PhD Thesis, Copenhagen Business School, December 2012.

Plsek, P. *Creativity, Innovation and Quality*. ASQ Quality Press, Wisconsin, 1997.

Rissland, E.L. 'Case-based reasoning and law'. Knowledge Engineering Review 20 (3):293-298, 2005. doi: 10.1017/S0269888906000701

Shneiderman, B. 'Human-Centered Artificial Intelligence: Three Fresh Ideas'. AIS Transactions on Human-Computer Interaction, 12(3), 109-124, 2020. doi: 10.17705/1thci.00131

Shneiderman, B. 'Responsible AI: bridging from ethics to practice'. Communications of the ACM, 64(8), 32–35, 2021. doi 10.1145/3445973

Stanford. Stanford University 'Human-Centered Artificial Intelligence'. 2022. Retrieved from https://hai.stanford.edu, 3rd January 2022.

Sternberg, R.J., (Ed.). *Handbook of creativity*. New York. Cambridge University Press, 1999.

Stickdorn, M. & Schneider, J. *This is Service Design Thinking*. BIS Publishers, Amsterdam. the Netherlands, 2010.

Tauber, E. M. 'Marketing Notes and Communications: Hit: Heuristic Ideation Technique - A Systematic Procedure for New Product Search'. Journal of Marketing, 36(1), 58–61, 1972. doi: 10.1177/002224297203600110

Teece, D.J. 'Business Models, Business Strategy and Innovation'. Long Range Planning, Volume 43, Issues 2–3, Pages 172-194, 2010, ISSN 0024-6301. doi: /10.1016/j.lrp.2009.07.003.

Wang, Q., Saha, K., Gregori E., Joyner, D.A., & Goel, A.K. 'Towards Mutual Theory of Mind in Human-AI Interaction: How Language Reflects What Students Perceive About a Virtual Teaching Assistant'. In CHI Conference on Human Factors in Computing Systems

(CHI ’21), May 8–13, 2021, Yokohama, Japan. ACM, New York, NY, USA, 15 pages, 2021. doi: 10.1145/3411764.3445645

Weigelt, O., Marcus, B., Felfe, J., Kluge, A., & Ontrup, G. ‘Working Under Pandemic Conditions: Crisis as an Opportunity for Change and Some Thoughts on the Future of Work’. Zeitschrift für Arbeits- und Organisationspsychologie 65 (4), 181–187, 2021. doi: 10.1026/0932-4089/a000376

Wieringa, R. *Design Science Methodology for Information Systems and Software Engineering*, Springer-Verlag, Berlin-Heidelberg, 2014.

Williamson, C. & Shneiderman, B. ‘The Dynamic HomeFinder: Evaluating Dynamic Queries in a Real-Estate Information Exploration System’. Proceedings of 15th annual international ACM SIGIR conference on Research and development in information retrieval (SIGIR '92), Copenhagen, Denmark, ACM Press, 338–346, 1992. doi: 10.1145/133160.133216

Wu, A., Yim, J.B., Caspary, E., Mazalek, A., Chandrasekharan, S., & Nersessian, N.J., (2011). Kinesthetic pathways: a tabletop visualization to support discovery in systems biology. Proceedings of the 8th ACM Creativity & Cognition Conference, Atlanta Georgia USA, ACM Press, 21-30. https://doi.org/10.1145/2069618.2069624.

Xu, W. ‘Toward human-centered AI: A Perspective from Human-Computer Interaction’. Interactions 26. 42-46, 2019. doi: 10.1145/3328485

Yanardag, P., Cebrian, M., & Rahwan, I. ‘Shelley: A Crowd-sourced Collaborative Horror Writer’. Proceedings of 12th Creativity & Cognition Conference, Virtual Conference, ACM Press, Article 11, 1–8, 2021. doi: 10.1145/3450741.3465251

Yang, Q., Steinfeld, A., Rosé, C., & Zimmerman, J. ‘Re-examining Whether, Why and How Human-AI Interaction Is Uniquely Difficult to Design’. Proceedings of 2020 CHI Conference on Human Factors in Computing Systems, Virtual Conference, ACM Press, 1–13, 2020. doi: 10.1145/3313831.3376301.

Zachos, K., Maiden, N., Pitts, K., Jones, S., Turner, I., Rose, M., Pudney, K., & MacManus, J. ‘A Software App to Support Creativity in Dementia Care’. Proceedings of 9th ACM Creativity & Cognition Conference, Sydney Australia, ACM Press, 124-131, 2013. doi: 10.1145/2466627.2466637