Chapter 7
Discussion and Conclusion

The ultimate assessment for any research is 'What are the new and interesting contributions?'.

—Hevner et al. (2004)

The preceding chapters of the book have presented the detailed findings of the research. This chapter examines them from a more integrated perspective, highlighting the interrelated nature of the research and positioning the research contributions. The chapter starts with the interrelated findings and our consolidation of the findings for addressing the research objectives. We then discuss four major contributions of the research. Following this is a discussion of contributions towards organisational practice. Then, limitations are discussed. Finally, we conclude the book and outline future research.

7.1 Interrelated Results

The research results have been formed from the four research stages. While the previous chapter presented the results as sequential stages' outcomes, these results are related due to the interrelated nature of the research. This section examines the results from an integrated viewpoint in order to provide an overall picture of the research outcomes. In particular, four major integrated outcomes are discussed.

First, we note that *the research results are interrelated in structuring the BPC domain.* This is because the four research stages together examine the BPC domain, aligning to the exploratory-confirmatory continuum suggested by Miles et al. (2014). Figure 7.1 illustrates this interrelation. The first stage explored the knowledge sources in the domain, which had not been structured before. The second stage deducted the knowledge sources and conceptualised the BPC concept. It offered a conceptual model that synthesised unstructured knowledge into the focused building blocks of BPC. The third stage, extending this conceptualisation, organised knowledge in the domain using an ontological structure. The final stage instantiated a decision tool founding on the ontological structure, and then

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evaluated and confirmed the tool utility. In reflecting through the research stages, BPC knowledge has been sequentially structured, starting from diverse unstructured knowledge sources, to abstract conceptualisation, to an ontological structure, and finally to the instantiated decision tool supporting BPC establishment. Consequently, we suggest that the research results enable different *yet interrelated knowledge for structuring BPC*.

Second, the research results also suggest interrelated *yet different levels of abstraction for understanding BPC establishment*. This difference allows us to speak both abstractly about managerial aspects of BPC, and more concretely about its building blocks and detailed processes. The conceptual model, ontology, and decision support tool form three levels of BPC abstraction, which are depicted in Fig. 7.2. In the figure, the conceptual model presents abstract building blocks of BPC; the ontology specifies these building blocks into detailed elements, including processes, activities, data, and their relationships; and the decision tool operationalises these ontological elements with decision tables, what-if scenarios, and contextual recommendations. Given the three levels of abstraction, it is possible for different stakeholders to focus on different levels of concern but still reach consistency on BPC establishment. These consistent yet different levels of foci are an important requirement to establish complex business processes involving multiple stakeholders like BPC (Berente et al., 2009; Giachetti, 2004; Hasselbring, 2000).

The first two outcomes lead to the third interrelated result, which is *the ability to trace back the BPC knowledge through the research stages* (the upward arrow of Fig. 7.2). That is, operationalised knowledge in the decision tool can properly be traced back to the ontological elements, which can be mapped to the model components and in turn traced back to the knowledge sources. The traceability comes from the systematic approach brought by the design science research, where we systematically structure the research activities and explicitly justify and present key decisions made in these activities. This systematic approach is similar to the evidence-based strategy in design science (Denyer & Tranfield, 2006; Van Aken, 2005; Van Aken & Romme, 2012).

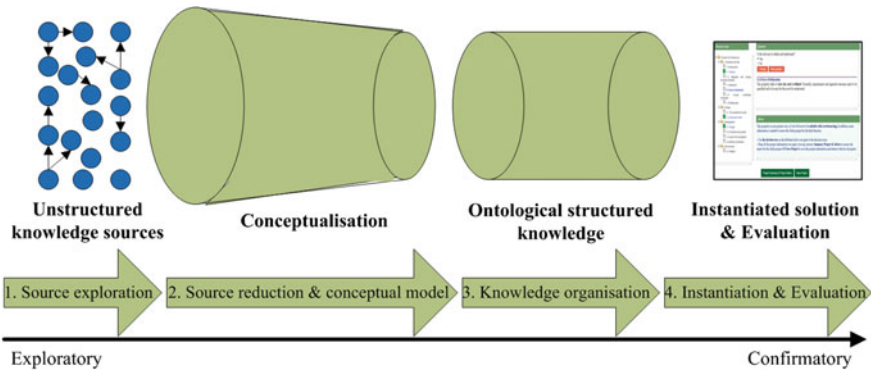

Fig. 7.1 Interrelated knowledge in structuring BPC

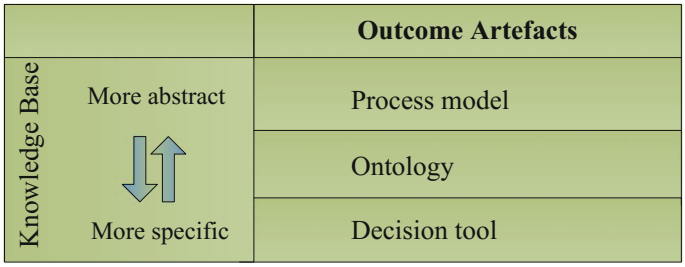

Fig. 7.2 Interrelated yet different levels of abstraction: outcome artefacts

The fourth and final integrated outcome is *the multiple iterations of build and evaluate activities* in the research process. Inspired by the design cycle suggested by Hevner and Chatterjee (2010), we designed and then evaluated each artefact before moving to the next research stage. These iterations allow us to better understand the design problem, its solution, and how the solution addresses the problem through evaluation. The iterations also enhance the relevance and rigour of the research stages by continuous evaluating the outcome artefacts (Hevner & Chatterjee, 2010; Sonnenberg & vom Brocke, 2012b). As a result, the build-evaluate iterations strengthen the relevance and rigour of the entire research process and its generated BPC knowledge.

7.1.1 Addressing the Research Objectives

This section summarises the research results in order to address the research objectives. Four research objectives have guided the book, which are recollected here.

1. RO1: To understand the main building blocks of BPC that can be identified in the domain.
2. RO2: To develop a model structuring the identified building blocks for conceptualising BPC.
3. RO3: To construct a domain ontology of BPC that organises the unstructured knowledge sources in the domain.
4. RO4: To construct a decision tool supporting organisations in establishing BPC.

These research objectives have been realised explicitly in Chaps. 3, 4, 5, and 6 respectively, which are now summarised. Table 7.1 provides a structured summary of main results that address each research objective. The table is organised around four columns. The first column shows the four stages of the research (presented in Chaps. 3, 4, 5, and 6). Then, as design science highlights both design processes and design products (Hevner & Chatterjee, 2010), the second and third columns present the research activities and research outcomes respectively. The final column refers to the research objectives being addressed in each research stage.

Table 7.1 Summary of results that answer the research objectives

Research stage	Research activity	Research outcome	RO
1. Scoping knowledge sources	**BPC Knowledge Base** • Identified and analysed 238 knowledge sources • Synthesised BPC building blocks supported by at least 10 sources • Synthesised factors influencing the decision to crowdsource	• 12 building blocks of BPC (Table 3.2) • Additional outcomes: nine factors and sixteen sub-factors influencing the decision to crowdsource (Table 3.3)	RO1
2. Develop the IS Artefact	**Conceptual Model** • Synthesised the most salient BPC building blocks • Applied the analytic framework to arrange the model components • Defined the components • Developed a framework supporting the decision to crowdsource	• A process model of BPC (Fig. 4.1) - 3 stages: decision to crowdsource, design, and configuration - 7 components in the three stages • Additional outcomes: A decision framework of the decision to crowdsource (Fig. 4.2)	RO2
	Case Study Evaluation (two crowdsourcing projects) • Collected multiple data sources, including interviews with key informants • Analysed the project activities, using the model • Analysed the utility of the model perceived by the interviewees	High representation of the projects' activities (Figs. 4.3 and 4.4) • Usefulness perceived by the interviewees for planning and running crowdsourcing projects (Sect. 4.3.3)	
3. Develop the IS Artefact	**Domain Ontology of BPC** • Ontology capture - Analysed the knowledge sources in detail - Identified ontological elements: concepts, hierarchical relationships, and decision-making relationships • Knowledge organisation - Synthesised the ontological elements - Organised the ontological elements using a layered structure	• Lightweight ontology of BPC (Fig. 5.2) - 39 salient concepts (Table 5.1) - Five types of hierarchical relationships • Heavyweight ontology of BPC - Decision-making relationships (Sect. 5.2.3), which turns the lightweight into the heavyweight ontology	RO2, RO3
	Triangulation Evaluation • Compared the BPC ontology with a version generated by OntoGen - Took abstracts of the same knowledge sources as input - Used OntoGen to generate an ontological version	• High coverage of domain concepts and relationships • High clarity of the domain semantics • Our ontology provides clearer meaning and capturing both hierarchical and decision-making relationships.	

(continued)

Table 7.1 (continued)

Research stage	Research activity	Research outcome	RO
	- Compared our ontology with the generated version		
4. Develop the Instantiated Artefact	**Decision Tool** • Based on the ontology • Developed two prototypes - Used the first one for gathering feedback - Developed the second prototype based on the feedback	• A decision tool with two main functions - Supporting the decision to crowdsource (Fig. 6.5) - Supporting process design (Fig. 6.6)	RO4
	Experimental Evaluation • Conducted six experiment sessions • 190 participants • Two experimental settings - One group used the tool - The other without the tool (baseline)	• Group using the tool shows higher performance than the baseline. - (p-value = 0.03 for the statistical difference in Tool 1) - (p-value < 0.001 for the statistical difference in Tool 2)	
	Focus Group Evaluation • Conducted 2 focus groups • 10 participants - 6 crowdsourcing experts - 4 Ph.D. students with related backgrounds	• Strong evidence that the tool provides structured information • Mixed evidence that the tool frames and changes participants' decisions • Strong evidence of ease of use • A few suggestions for improvements of the tool	

7.2 Research Contributions

Having been a design science endeavour, our work contributes knowledge throughout its research activities, from problem definition, to sound research process, to solutions and their reflection, and to communication of the research results. Consequently, as it is very hard to provide an exhaustive list of all research contributions, we have identified four major contributions. Each of them is discussed in the following sections.

7.2.1 A New Approach for Establishing Crowdsourcing as an Organisational Business Process

At the beginning of the book, we noted that organisations face the challenge of how to establish crowdsourcing as an organisational business process. Despite a decade

of research, most crowdsourcing research still relied heavily on an ad hoc perspective, studying individual aspects of the crowdsourcing process. In many cases, these studies explored and investigated crowdsourcing as a one-off process, rather than a common organisational practice. Consequently, the challenge still remains.

Our first approach to this challenge is *the introduction of a business process lens on crowdsourcing processes, designating the concept of BPC*. While the term BPC was coined in 2010 (La Vecchia & Cisternino, 2010), it was not widely used in the domain. It is this book that clarifies the BPC concept by balancing between the business process construct and the crowdsourcing construct. With BPC as a template, multiple instances of the same crowdsourcing process may be created. Our conceptualisation of BPC is partly theoretical, based on crowdsourcing literature and business process literature, and partly empirical, based on our observation that existing crowdsourcing processes have several activities that are repeatedly performed, as confirmed below.

The BPC conceptualisation can only stand if there are common repeatable activities of crowdsourcing processes. In this book, the condition has been satisfied. The book, through the scoping review, has confirmed that there is a set of common activities of the crowdsourcing processes, repeatedly found in multiple knowledge sources. These common activities, which have also been reinforced by other recent reviews (Amrollahi, 2015; Hosseini et al., 2015a), support the condition founding the BPC concept. Further, they suggest the main building blocks of BPC (Table 3.2).

Using the building blocks suggested by the scoping review, we *conceptualise BPC through a process model*. The model, on the one hand, clarifies the BPC conceptualisation through a process viewpoint with multiple structured activities that are necessary to establish crowdsourcing as an organisational business process. On the other hand, the model keeps the BPC conceptualisation focus. That is, the model focuses on the core repeatable building blocks of BPC, which defines the abstract structure of BPC. The abstract structure allows to build new crowdsourcing processes as real-life instances of the same core building blocks (Fig. 4.1). All in all, the process model, with its focus and business process lens, places BPC in a space quite distinct from one-off processes and their instances.

7.2.2 The Importance of the Ontology

Having introduced the concept of BPC, the book also proposes an ontology that offers knowledge structures around this concept. The ontology provides various unique benefits in BPC conceptualisation. We now discuss these benefits from three main research perspectives of the book: BPC, IS, and DSS.

Ontologies have played an important role in representing domains of knowledge (Fonseca & Martin, 2007; Guo, Schwartz, Burstein, & Linger, 2009; Wand & Weber, 1995). In this vein, our proposed *ontology represents the BPC domain.* More precisely, it defines BPC building blocks, processes, data, and data entities. It

also structures the domain by presenting the hierarchical and decision-making relationships (Figs. 5.2 and 5.3). As a result, the ontology offers a scaffold for understanding the BPC domain. The representation of the ontology can be further characterised in two aspects: clarity (Akdemir et al., 2008; Fan et al., 2016) and coverage (Fan et al., 2016; Shanks et al., 2003).

The BPC ontology *has high clarity contributing to the understanding of the domain*, which can be seen via three points. First, it defines not only domain concepts but also hierarchical relationships and decision-making relationships, which increases shared understanding in the domain. Second, the ontology helps reduce semantic ambiguity. As noted previously, conflicting views and opinions exist in the domain, which leads to certain levels of semantic ambiguity. The ontology manages the conflicts through the 'wisdom of researchers', using the majority of knowledge sources as an indicator to address the conflicts. Finally, a combination of the ontology with the conceptual model and decision tool has provided three levels of abstraction for understanding the domain. All these points contribute to the high clarity of the ontology.

The BPC ontology also has *a high coverage of domain concepts and relationships*. This high coverage comes mainly from our grounded approach, which allows the ontological elements freely emerge. As a result, the ontological elements cover diverse aspects of the domain. We note however that in the grounding process, we made a decision that might reduce the coverage level of the ontology. That is, the decision to focus on the concepts supported by at least ten knowledge sources. Acknowledging the concern, we however have retained our decision since we have to balance the trade-off between coverage and complexity. Further, the evaluation of the ontology has lately shown that our decision is appropriate. More precisely, the comparison of our ontology with a version generated by OntoGen has shown that the BPC ontology broadly covers the domain. These results confirm the high coverage of the BPC ontology.

Before moving to the next perspective, we note here the *nature of our ontology*. If we follow Sharman et al. (2004) classifying ontologies as: top-level, domain, and application, our ontology should be seen as a domain ontology since we strictly focus on the BPC area. Furthermore, it should be treated as an informal ontology, rather than a formal one that would be defined using representation formalism languages. We nevertheless note that developing an informal ontology before transferring it into a formal one is a common, acceptable practice (Wong, Liu, & Bennamoun, 2012). Considering the BPC ontology in the lightweight-heavyweight continuum (Corcho et al., 2003), our work is aligned to the heavyweight ontologies since we examine not only concepts but also decision-making relationships and business rules in the BPC domain. As a result, we have contributed a heavyweight informal ontology to the BPC domain.

The IS discipline also highlights the role of ontologies. While agreeing with the ontology roles aforementioned in the BPC perspective, the IS discipline, in particular design science, suggests the contributions of ontologies for building knowledge bases (Miah, Gammack, & Kerr, 2007; Miah et al., 2014; Osterwalder & Pigneur, 2004; Ostrowski, Helfert, & Gama, 2014). In the book, *the ontology has*

offered a BPC knowledge base. It builds the knowledge base through structuring the key concepts, hierarchical structures, and decision-making relationships, from which knowledge can be inferred. Furthermore, the knowledge base role of the ontology has been clearly revealed when the ontology formed the basis for tool construction. This is because founding artefact construction is a distinctive characteristic of knowledge bases (Hevner & Chatterjee, 2010). We note that the knowledge base offered by the ontology should not be limited only to construct the decision tool, but can also be used to constructing other IS artefacts, e.g. artefacts to standardise crowdsourcing processes. In short, we offer an ontological knowledge base for IS artefact development in the BPC domain.

Finally, we consider the ontology from the DSS (decision support system) perspective. In DSS literature, we identify two main roles of ontologies. The first role views ontologies as vocabulary frameworks defining terms, concepts and decision alternatives for certain DSS environments (Chen, Chen, Hsu, & Li, 2011; Van Valkenhoef, Tervonen, Zwinkels, De Brock, & Hillege, 2013). The second role, extending the first one, views ontologies as reasoning means, which structure logics of the DSS solutions (Amailef & Lu, 2013; Gennari et al., 2003; Miah et al., 2007). The BPC ontology in the current study is aligned with the second role, *ontology-supported reasoning*, for three reasons. First, the ontology helps develop reasoning knowledge, which has been showed via the exemplar of the decision tables (Tables 6.1, 6.2, and 6.3). Second, the reasoning role is aligned with the knowledge base role of the ontology, mentioned earlier in the design science perspective. Lastly, the ontology was actually integrated into the decision tool as a reasoning module (Fig. 6.1), which confirms its role as the ontology-supported reasoning means.

Overall, the BPC ontology plays several critical roles in the current research. It is a domain ontology clarifying and covering the BPC domain. It also serves as a knowledge base consolidating the existing knowledge for IS artefact development. Furthermore, it as a heavyweight ontology supports reasoning, which has been operationalised in the decision tool. These roles suggest the value of the BPC ontology.

7.2.3 Empirical Findings

In the above discussion, we have discussed BPC conceptualisation and its ontological structure for establishing crowdsourcing processes. In addition to these theoretical efforts, the book also brings empirical results that provide evidence on how our theoretical work can be operationalised to improve the establishment of BPC. Empirically, we constructed a decision tool and assessed it using experiments and focus groups.

The successful construction of the tool means four things. First, the tool construction has proved that BPC can actually be operationalised in practice. Second,

the tool, which was developed based on the BPC ontology, has demonstrated the feasibility of the ontology. That is, the ontology can be implemented in a working system. Third, the construction has created an instantiation artefact (Hevner et al., 2004; March & Smith, 1995), which is a decision tool providing a means for decision makers to establish BPC step-by-step and to guide them in this establishment. Finally, the tool enables concrete assessments of its utility towards BPC establishment.

A mixed method was used for empirical assessment of the tool. We deployed a sequence of (1) the experiments to test whether the tool is useful for improving performance on BPC establishment and (2) the focus group to understand what aspects of the tool's usefulness are perceived by the participants. In the experiments consisting of 190 participants, the findings confirm that the use of the tool leads to better performance on both functions of the tool: the decision to crowdsource and crowdsourcing process design. From the results, we suggest that the tool is useful for BPC establishment. We note that although both functions are useful, and both are statistically supported, the support for process design (p-value < 0.001) is stronger than for the decision to crowdsource (p-value $= 0.03$). The experimental results alone cannot explain the difference, which has addressed in the focus group evaluation. In summary, the experiments provide empirical evidence suggesting the usefulness of the tool. While this usefulness is supported statistically, some of its aspects should be further evaluated and discussed.

Serving our intention to further evaluate the tool, two focus groups were conducted to gain insights on what aspects of the tool utility were perceived by the participants. The focus group results show that the tool benefits in terms of structuring BPC establishment and providing additional information for making informed decisions. It is also found that participants when using the tool have a positive perception towards ease of use, and they suggest a few possible improvements. There are mixed results on whether the tool may change the participants' decisions. Overall, the focus group results are positive towards the tool utility. They also help as a support to compare with the experimental results, as presented below.

Together, the two evaluation results enable us to confirm the tool utility, using both quantitative, individual-based, and controlled experiments, as well as qualitative, group-based, and likely naturalistic focus groups. It is also interesting to discuss their complementary findings. The focus group findings suggest that the tool is more useful for providing additional information than for changing participants' decisions. This provides a possible explanation for the different levels of support for the tool's utility in the experimental results regarding the decision to crowdsource and process design. Possibly, the equal support regarding the decision to crowdsource comes from the moderate ability of the tool that might or might not change participants' decisions, while the strong support regarding the process design comes from the strength of the tool that provides additional structured information in the design process.

Overall, the importance of the book relies not only on theoretical efforts, but also on having as much empirical evidence as possible. We have discussed the evidence

from the experiments with 190 participants, and two focus groups. Apart from these, other empirical evidence was also collected and incorporated into the research results, including case studies of two crowdsourcing projects, and a pilot experiment with 46 participants. As a result, the empirical results have complemented and supported our theoretical efforts on BPC establishment.

7.2.4 Progression of Business Process Crowdsourcing

So far, we have presented our theoretical and empirical contributions to BPC establishment, which are expected to move the development of the BPC concept forward. To clarify this movement, we examine the progression of the concept in comparison with the literature review in Chap. 2. In that chapter, we reviewed three main research strands: the broad concept of crowdsourcing, crowdsourcing classifications, and crowdsourcing processes and the research foci of BPC. At that time, the three review strands covered quite broad aspects of crowdsourcing to form a foundation for our research. It is instructive if we re-examine these strands, focusing only on the concept of BPC.

Focusing on the BPC concept, we propose five phases of the concept progression. These phases are shown in Fig. 7.3. In the first phase, research conceptualised the overarching crowdsourcing concept by specifying its ideas and definitions (Estellés-Arolas & González-Ladrón-de-Guevara, 2012; Howe, 2006a), but did not mention BPC. The second phase started to classify different elements (Schenk & Guittard, 2011; Zhao & Zhu, 2014), in order to structure the crowdsourcing domain. At first, these structures were simple, just focusing on particular crowdsourcing elements. Also in this phase, a large number of studies researched ad hoc foci of crowdsourcing, which created a 'shopping list' of individual elements. Only in the third phase, the high-level building blocks of crowdsourcing processes became available. A few researchers were able to combine the individual elements forming an abstract crowdsourcing process and its building blocks (Amrollahi, 2015; Pedersen et al., 2013; Zogaj et al., 2014). Some of these building blocks are abstract and repeatable, which can be synthesised into BPC building blocks.

The fourth phase is the ongoing position of BPC. The target of this phase is to conceptualise and model the BPC concept leading to the proposition of reference models and ontologies. This phase is the focus of the book. The book conceptualised BPC using the building blocks synthesised from the scoping review (Chap. 3). We developed a process model (Chap. 4) and a heavyweight ontology guiding BPC (Chap. 5), which together provide a solid knowledge base for BPC establishment. Apart from our work, this phase also includes other recent models (Hetmank, 2014; Tranquillini et al., 2015), which enact and implement business processes based on crowdsourcing. Collectively, since this phase consists of our work that provides means to conceptualise, analyse, and design BPC, and the other work that provides means to enact and implement BPC (Hetmank, 2014; Tranquillini et al., 2015), this phase offers a solid scaffold supporting the whole

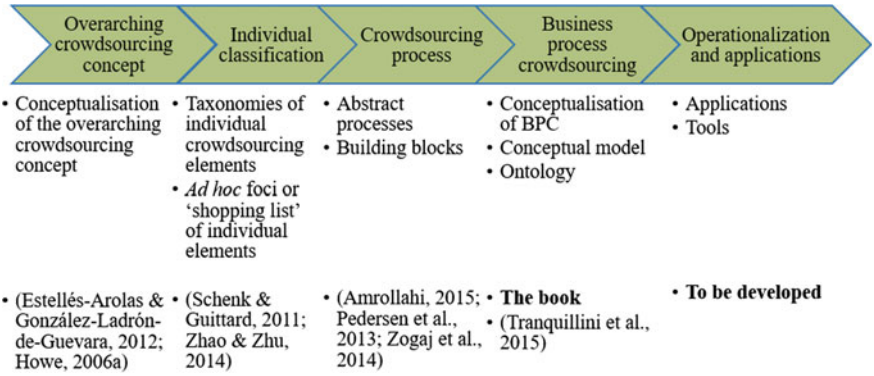

Fig. 7.3 Progression of business process crowdsourcing

business process based on crowdsourcing, from analysis, to design, and to implementation.

In the last phase, the models and ontologies of the previous phase can be applied to IS applications. Although our decision tool is an example of such applications (Chap. 6), we suggest that this is a to-be-developed area where diverse BPC tools and applications should be developed.

Overall, these five phases reflect the progression and expected development of BPC. They show the evolution of the domain, from an overarching concept, to individual structures, to abstract processes, to business process crowdsourcing, and to diverse BPC applications. Through this evolution of BPC, we think that the domain will continue progressing and further providing more applications to benefit organisations.

In summary, this section showed our contributions to the BPC domain. The contributions include the introduction of BPC conceptualisation, important roles of the ontology, empirical findings that show how our work operationalise and supports BPC, and progression of BPC. Together, they allow us to suggest that the book has contributed to move BPC forward in its progression in order to actually become an organisational business process.

7.3 Contributions to Practice

From a practical point of view, this book provides several practical contributions for organisations, decision makers, process designers, and project managers. The study provides organisations practical insights how to establish business processes based on crowdsourcing. In particular, organisations can use the conceptual model (Fig. 4.1) and ontology (Figs. 5.2 and 5.3) as a blueprint for analysing, planning and deploying crowdsourcing processes. The model provides defined steps on how

to establish a crowdsourcing process; and the ontology presents structured activities, data, and data attributes in order to accomplish these steps. Together, they enable organisations to take advantage by integrating crowdsourcing into their organisational business processes.

Another practical contribution comes from the proposed decision framework (Fig. 4.2) and the set of decision tables (Tables 6.1, 6.2 and 6.3). They support decision makers to evaluate whether crowdsourcing is an appropriate strategy. The framework guides decision makers on what factors should be considered when making crowdsourcing decisions. Based on the framework, the decision tables formulate decision rules, which interpret and ease the decision-making process (Huysmans et al., 2011). As a result, we suggest that organisations can use the decision framework and decision tables as a practical means to measure their readiness for crowdsourcing.

The study provides a computer-based tool supporting BPC establishment. The tool structures concepts, relationships, business rules, and what-if scenarios, which supports managers and process designers in their BPC decision. This practical support is highlighted in particular through the experiments, where the results show that the tool can improve decision makers' performance in both the decision to crowdsource and process design. Furthermore, while the tool supports are mostly important to process designers, they may also be relevant to crowdsourcing platforms. By examining the tool, platform developers can integrate similar supports to assist their crowdsourcing customers.

Finally, one interesting implication for the use of the tool comes from the focus group results, which show that the tool can remind users of certain crowdsourcing aspects that they forgot. This implies that the tool can be used for cross checking crowdsourcing projects. In particular, the tool can advise project managers what aspects that should be focused and what are possibly missing in their projects. Managers can also compare their project plan with what have been suggested by the tool in order to analyse and monitor the projects. This use of cross checking is further highlighted as the tool has been launched as a web tool, ready for managers to visit and exercise their crowdsourcing projects.

7.4 Limitations of the Research

Through a critical lens, the study reported in this book inevitably still has certain limitations. First, we understand the risk of building a knowledge base from very diverse knowledge sources, whose bias and limitations may be transferred to the knowledge base (Kitchenham, 2007). Understanding this concern, we however note that the use of diverse knowledge sources benefits from the 'wisdom of researchers', which utilises diverse opinions for developing a more comprehensive view of particular phenomena like BPC (Surowiecki, 2004).

Another limitation comes from our decision to choose the cut-off value of ten knowledge sources when applying the 'wisdom of researchers'. This decision might

exclude some interesting concepts and relationships in the 'long tail' that were supported by less than ten sources. We nevertheless note that this decision was made in order to balance between complexity and representation. If the chosen value was low, the complexity would increase since many concepts would be selected (Jonker & Pennink, 2010). In contrast, if the value was high, the representation would reduce since only a few building blocks would be selected. After testing different values, we finally chose ten as the cut-off value that balances complexity and representation.

There is another limitation related to the development of the decision tool, which focuses on "proof of concept" prototypes. The tool was developed through the rapid prototyping method, and thus targeted only at the level of evaluation and demonstration. Although the tool can be redesigned to meet industry targets, future research could implement the tool by applying proper software engineering methods. Besides, when we experimented with the tool, it was recognised that using students as proxies for crowdsourcing decision makers would be a limitation. Yet, we note that the use of students to experiment with software tools is an acceptable practice. Sjøberg et al. (2005) survey 113 software controlled experiments and show that "87 percent of the subjects were students" (p. 751). Furthermore, we have addressed the limitation with complementary data, where we used focus groups with crowdsourcing experts in order to triangulate our results.

7.5 Conclusion and Future Work

In this book we have presented our efforts towards establishing crowdsourcing as an organisational business process, particularly in establishing Business Process Crowdsourcing, BPC. Returning to our starting point, we have observed that organisations are often unsure about the way to best structure crowdsourcing activities and integrate them with other internal business processes. It also seems that this challenge comes from the predominant view in the domain that crowdsourcing is a one-off process. Furthermore, promising research stream from business, such as the use of a business process lens, has scarcely been adopted in the domain.

Addressing the challenge, one main contribution of the book is the introduction of BPC that views crowdsourcing as an integrated business process, rather than a one-off process. We have established BPC from the design-centric approach in that the majority of our work is centred on the iterations of design and evaluation. These iterations bring to the domain several IS artefacts, starting with a knowledge base constructed from scoping knowledge sources. Based on the knowledge base, we propose and validate a process model guiding organisations to manage the main building blocks of BPC establishment. Building on the process model, we propose an ontology that structures the BPC domain. It consists of the concepts, hierarchical relationships, and decision-making relationships necessary to establish crowdsourcing as an organisational business process. We note that both the process model

and ontology are founded on the knowledge base. Thus, they represent a synthesis of the domain knowledge and as a result add a step forward to the conceptual and ontological structure of the BPC domain.

As a benefit of the ontological approach, it enables us to implement a tool that assists managers and process designers addressing the complexity of BPC establishment. The tool helps make informed decisions in BPC establishment, including decisions in adopting, designing and configuring novel crowdsourcing business processes. Regarding its evaluation, the tool was assessed through experiments and focus groups, which have shown positive results towards the utility. These results, together with other evaluations throughout the research, suggest that the decision tool together with the conceptual model and BPC ontology should be utilised to establish BPC.

Overall, *our conclusions from this book are positive towards the establishment of crowdsourcing as an organisational business process.* The conceptual model, ontology, and decision tool, constructed and validated in the research, should be used to support the establishment. While some of these artefacts have been presented in our independent publications (Thuan et al., 2016, 2017, 2018; Thuan et al., 2015), it is this book that structure them into a set of integrated knowledge, which has a strong theoretical ontological basis and promising empirical results. Consequently, we offer a body of knowledge for business process crowdsourcing, as a first attempt to establish the chosen phenomenon. By doing so, we hope that our attempt will motivate future researchers to investigate this important BPC domain. In this hope, we outline below a number of possible paths for future research.

Future Work

This book opens several paths for further exploring the potential of BPC and analogous to the general research field of crowdsourcing. Future research should use the ontological elements: the concepts, hierarchical relationships, and decision-making relationships *to design crowdsourcing experiments and field studies*. In other words, the ontology serves as a basic for developing a broad research agenda in the area. In this agenda, additional research should focus on the decision-making relationships, given the low number of supporting sources for this type of relationships in the domain.

Future research should aim to move the knowledge provided by the artefacts built in this study forward to a higher level of abstraction with *BPC design theories.* This research direction, aligning with Gregor and Hevner (2013), suggests that with the proposed artefacts and instantiations, related design theories can be developed. Such BPC design theories can add generality to our proposed artefacts. For instance, the BPC process model has been grounded from knowledge sources in the domain, and thus it is expected to be applicable in a variety of BPC contexts. Therefore, future research should further apply the model in different contexts, which will show its application principles and thus provide a basis for a theory explaining and predicting its use.

Our work also presents large research *opportunities for further design-based efforts* in both academia and industry. In particular, as a solid knowledge base in the domain, the BPC ontology can be used to construct different artefacts. Some that we can think of at this point in time are knowledge-based and collaborative-based systems, which are some common applications based on ontologies (Chandrasekaran, Josephson, & Benjamins, 1999). Others, that only time could uncover, may emerge from the combination of interoperability, reasoning and knowledge organisation provided by the ontology.

From a technical perspective, while we have already proposed a decision tool for BPC, our work mainly focuses on the business process aspects of the crowdsourcing process. Thus, *it is interesting to further develop and integrate our work from a more technical standpoint*. We note that several toolkits that configure and program crowdsourcing processes have existed (Kittur et al., 2011; Pavel Kucherbaev et al., 2013; Little et al., 2010; Tranquillini et al., 2015). Given that, future research may investigate how to connect the decision-support focus in our work and existing technical toolkits. This connection would offer a decision support system that would assist organisations, from the time they analyse, model, and design BPC, until the time they instantiate it using a particular set of programming toolkits.

In conclusion of this book, it is clear that crowdsourcing has been an important sourcing strategy for organisations in the last decade, and this trend is expected to continue with business process crowdsourcing. By establishing crowdsourcing as an organisational business process, organisations can take full advantage of the strategy. This book proposes a set of BPC artefacts that supports the establishment. Furthermore, a solid knowledge base of BPC is built and enriched through theoretical, ontological, and empirical scaffoldings. This solid knowledge base is promising for the future development of the domain to progress towards a mature crowdsourcing strategy.