Bridging the Research-Practice Gap through Information Visualization - a Mixed Methods Approach to Involve Research Subjects in Data Interpretation

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Abstract

A fundamental challenge for management and organization studies is to produce research results that are theoretically rigorous, and at the same time of practical relevance for professionals. There is an increasing awareness of the need for a closer involvement of participants in the research process. Rapidly rising research streams, like Citizen Science, seek to involve research participants in the process of data gathering. The papers in this cumulative dissertation introduce and apply a mixed methods approach for involving research participants in the process of data interpretation through visual means.

Paper 1 applies the mixed methods approach by means of instant data visualization facilitates real-time data integration. Paper 2 applies the mixed methods approach by means of a computer system and a rigorous index (the Index of Disagreement). This paper demonstrates that correlational models can be revised in real time, based on explaining the reasons for discrepant survey results. Paper 3 applies the mixed methods approach by means of an visual interaction patterns. Visual interaction patterns are repeatable combinations of visualizations and an accompanying research procedure aimed at extending quantitative research results with qualitative data. Paper 4 is aimed at popularizing the mixed methods approach. This paper introduces an innovative visualization on which the interaction patters can easily be mapped.

The benefits of this dissertation include providing explanations for unexpected research findings and alternative explanations for expected findings, locating factors that might account for the lack of statistical confirmation of existing hypotheses and the emergence of newly-discovered correlational dependencies, enabling the formulation of post-hoc hypotheses, and improving the correspondence of correlational models with empirical realities.

Zusammenfassung

Eine grundlegende Herausforderung für Management- und Organisationsstudien besteht darin, theoretisch rigorose Forschungsergebnisse zu liefern, die gleichzeitig für Fachleute von praktischer Relevanz sind. Das Bewusstsein für die Notwendigkeit einer engeren Einbeziehung der Teilnehmer in den Forschungsprozess wächst. Schnell wachsende Forschungsströme wie die Citizen Science versuchen, die Forschungsteilnehmer in den Prozess der Datenerfassung einzubeziehen. Die Beiträge in dieser kumulativen Dissertation stellen einen *mixed methods Ansatz* vor, um die Forschungsteilnehmer in den Prozess der *Dateninterpretation* mit visuellen Mitteln einzubeziehen.

Paper 1 wendet den mixed methods Ansatz mittels sofortiger Datenvisualisierung an und erleichtert die Datenintegration in Echtzeit. In Paper 2 wird der mixed methods Ansatz mit Hilfe eines Computersystems und eines rigorosen Indexes (Index of Disagreement) angewendet. In diesem Artikel wird gezeigt, dass Korrelationsmodelle in Echtzeit überarbeitet werden können, indem die Gründe für diskrepante Umfrageergebnisse erläutert werden. In Paper 3 wird der mixed methods Ansatz anhand visueller Interaktionsmuster angewendet. Visuelle Interaktionsmuster sind wiederholbare Kombinationen von Visualisierungen und ein begleitendes Forschungsverfahren zur Erweiterung quantitativer Forschungsergebnisse mit qualitativen Daten. Paper 4 soll der Ansatz der gemischten Methoden popularisieren. In diesem Artikel wird eine innovative Visualisierung vorgestellt, auf die die Interaktionsmuster leicht abgebildet werden können.

Zum Nutzen dieser Dissertation zählen die Gewinnung von Erklärungen für unerwartete Forschungsergebnisse und alternative Erklärungen für erwartete Ergebnisse, die Lokalisierung von Faktoren, die möglicherweise die fehlende statistische Bestätigung vorhandener Hypothesen und die Entstehung neu entdeckter Korrelationsabhängigkeiten erklären und die Formulierung von Post-hoc-Hypothesen ermöglichen, die die Korrespondenz von Korrelationsmodellen mit empirischen Realitäten verbessern.

A INTRODUCTION

1. Main Topic and its Relevance

A fundamental challenge for management research is to produce results that are grounded in the theoretical debate and at the same time are of practical relevance for management professionals. Yet the gulf between research and practice is enlarging, due in part to a failure of scholars to involve practitioners in the research process (Bartunek 2007; Bartunek et al. 2015). There is an increasing awareness of the need for a closer involvement of participants in the research process, especially in the interpretation of collected data. Such an involvement can lead to greater reflexivity and criticism in the production of research findings, with participants corroborating, challenging, or adding to the theoretical explanations offered by researchers. In this line of thought, there is a growing realization that good research is conducted "with people rather than on people" (Heron & Reason 2006, p.144; Marti & Mertens 2014).

Burns et al. (2014) and Cherney (2015) called for co-producing knowledge through mixed methods, so as to provide more meaningful research results. To address this pressing issue by means of this dissertation, I have developed a mixed methods approach for involving research participants in the process of data interpretation through visual means. According to this approach, quantitative methods of data collection (e.g., surveys, experiments) and data analysis (e.g., survey data analysis, cluster analysis) are followed up by (focus) group conversations in which research participants are shown visualizations representing the aggregated results of the quantitative research phase. These visualizations are used as stimuli for the collection of qualitative data, and for the critical interpretation of the pre-collected data. The visualizations enable research participants to jointly produce interpretations that explain, extend, or challenge the quantitative results. Voice is given to the opinions of research participants and the rationale behind the results of quantitative research is revealed. The cognitive advantages offered by the visual language (i.e., showing aggregate visualizations) ensure that complex data is comprehended and processed with ease.

2. Background and Research Gaps

Mixed methods research is the type of research in which a researcher or team of researchers combine elements of qualitative and quantitative research approaches (e.g., use of qualitative and quantitative viewpoints, data collection, analysis, inference techniques) for the purposes of breath and depth of understanding and corroboration (Johnson et al. 2007, p. 123). A more recent and liberal definition treats mixed methods as a generic term to include "any research that involves multiple sources and types of data and/or multiple approaches to analysis of those data, *in which integration of data and analyses occurs prior to drawing final conclusions* about the topic of the investigation" (Bazeley 2018, p. 7).

Mixed methods researchers often experience difficulty in "bringing together the analysis and interpretation of the quantitative and the qualitative data and writing a narrative that link[s]

the analyses and interpretations" (Bryman 2007, p. 10; Bazeley 2018). A widely discussed mixed methods challenge is the need to make the process of data integration legitimate in the sense of seamless and involving tightly connected phases (Bustamante 2017; Guetterman et al. 2015, p. 554; Ivankova 2013; Leech et al. 2010, p. 20; Robinson & Mendelson 2012; Wall et al. 2013, p. 22). There is a need for novel research methods which facilitate integration. Attention is turned specifically to the "untapped potential in the development of descriptive and narrative accounts from numeric data" (Bazeley 2018, p. 223). With this dissertation, I am aiming at unleashing this untapped potential by offering a visual approach for the development of descriptive interpretative accounts from quantitative research results (i.e., data visualized in quantitative diagrams). Thereby, I am also aiming at unleashing the underutilized potential of visualization to involve research participants in data interpretation.

Howell (2016, p. xi) observed: "Statistics is not really about numbers; it is about understanding our world". However, statistical results do not automatically offer understanding of the research problems. As pointed out by Bazeley (2018, p. 175): "Numbers cannot always tell the whole story, and data do *not* speak for themselves. Interpretive caution is needed". Numbers do not answer the *why* question, i.e., they hardly ever reveal the rationale behind participant opinions. Only a qualitative interpretation of quantitative results can provide explanations for unexpected findings or alternative explanations for expected findings. As Campbell (1974, p. 30) reflected: "If we are to be truly scientific, we must re-establish the qualitative grounding of the quantitative".

According to Bazeley (2018, p. 57), quantitative data must be interpreted and "*how* they are interpreted determines their ultimate value and usefulness". Interpretive caution is needed because presumptions and choices made in the way we handle quantitative data modify the claims we make from data. One interpretation may be favored over another based on the interpreter's network of beliefs, practices, and interests. Interpretive caution is also needed because "when data are categorized, qualitative description and comparison are facilitated, but nuances within those data are lost" (Bazeley 2018, p. 231).

Shedding light on such nuances may be capable of answering the "why" question, or providing explanations as research projects unfold. Seeking for explanations is the centerpiece of data interpretation and can be done with or without involving the research participants. Participant involvement has been motivated by concerns regarding interpretation biases (MacCoun 1998), as well as more recent concerns that inferences drawn "should make sense to those who contributed the data" (Bazeley 2018, p. 55). It has been suggested that researchers and participants collectively negotiate the meaning of research results to help complement otherwise "incomplete" research (Alvesson et al. 2008, p. 483). One potential benefit would be to "unpack" variables and improve their construct validity (see, e. g., Deetz 2008).

Every research effort includes a "results interpretation" stage (or multiple interpretation stages) during which the research results are translated into conclusions. The idea to involve research participants in data interpretation stems from early concerns about the provisional nature of knowledge and the limits of objectivity (Popper 1959). Attempts to involve participants in data interpretation (as, e.g., "co-researchers") have been made by so called reflexive (or participatory) research methods. Such methods are abundant in fields like postmodern ethnography (e.g., Presnell 1994), anthropology (e.g., Feighery & others 2006), applied communication research (e.g., Deetz 2008), action research (e.g., Heron & Reason 2006; Reason & Bradbury 2008), and less abundant in management and organization studies (e.g, Bartunek 2007; Van Aken 2004; Van de Ven 2007). One proposed way to involve participants is to open up research texts to "multiple readings" by participants and audiences (see Alvesson et al. 2008; King & Learmonth 2015; Lukka & Modell 2010). These multiple readings may take place *(a)* during "data collection and initial analysis" (through events such as meetings and workshops), *(b)* during "interpretation" (through joint interpretive forums), *(c)* during "dissemination" (through co-authorship of research reports), and *(d)* during "implementation" (through guidance and advice on implementation) (Knight & Pettigrew 2007, pp. 7-9). Joint interpretive forums have been suggested by Mohrman et al. (2001) and Rynes et al. (2001) as events (like workshops or conversations) where researchers and practitioners jointly interpret results. Interestingly, both Mohrman et al. (2001) and Rynes et al. (2001) are conceptual epistemological papers, which suggest (but do not apply) "joint interpretive forums" as a concept.

In a comprehensive literature review of collaborative research articles, Kieser and Leiner (2009, p. 527) noted that "the overwhelming majority of articles resulting from collaborative research are of an epistemological kind". Kieser and Leiner also indicated that they did not know of any publications that contain jointly produced research output describing research *results* rather than processes and difficulties of collaboration between researchers and practitioners. There is a need for implementable methodological approaches and procedures which involve research participants in the process of data interpretation.

According to Howe and Eisenhart (1990), Bazeley (2018, p. 56) and Kuckartz (2018) "all scientific analysis involves acts of interpretation *by researchers*" [italic added]. According to Bazeley (2003) "the role of the researcher remains paramount in deciding issues relating to ... the meaning of codes, the interpretation of the data tables and displays produced using the computer" (Ibid., p. 418-419). Bazeley (2018) contends that "interpretation is influenced by research purposes, the underlying conceptual framework, the context in which the data were obtained, choice of methodology, and awareness, sensitivity and reflexivity *of the researcher*" (Ibid., p. 59). The interpretation of data still largely remains the prerogative of scholars (although participants commit substantial time and resources to the studies and numerous approaches have set out to involve participants).

3. Methodological Purpose

Motivated by the research gaps and methodological considerations described above, I formulate the *purpose* of this methodological dissertation as follows:

This methodological work is aimed at developing and testing a visual mixed methods approach in which instant data visualization is used to facilitate integration[1] and involve participants in data interpretation.

In particular, the purpose is to compile an inventory of visual interaction patterns – repeatable combinations of visualizations and an accompanying research procedure aimed at extending quantitative research results with qualitative data. More precisely, a visual interaction pattern is a systematic approach by which research results are visualized in quantitative diagrams, shown to the research participants and interpreted together with the research participants.

This dissertation is structured as follows. I begin with an introduction, with attention paid to the relevance, background, and methodological purpose of this work. I then provide a summary of the mixed methods approach, including an overview of how the approach is applied in the dissertation parts, a description of its scope of application, and an integral view of its theoretical base and potential benefits. An overall conclusion follows, with critical elaboration concerning the limitations of the mixed methods approach. Finally, I present selected papers that have resulted from this research project.

4. Related Dissertation Parts

The following part introduces the constituent parts of this cumulative thesis and explains the relationship between them.

4.1. Papers included in this Dissertation

The papers that are included as constituent parts of this cumulative thesis are listed in Table 1. Paper 1 (Chapter B), entitled *Integration: A Real-Time, Participant-Driven, and Visually Supported Method*, is aimed at facilitating quantitative-qualitative data integration and involving participants in data interpretation by using instant data visualization. The paper is written in co-authorship by Elitsa Alexander, Alice Comi, and Martin J. Eppler. The paper is accepted for publication in the Journal of Mixed Methods Research.

Paper 2 (Chapter C), entitled *Building on Disagreement Visually: The System and the Method*, presents an innovative computer system and research method for visually building on groups disagreement to involve research participants in the interpretation of quantitative

[1] "Integration" is a mixed-methods term used to denote the meaningful combination of quantitative and qualitative data for interpretation purposes.

research results. The computer system works based on a Java program written by Elitsa Alexander in Java 8.0. This paper is written in co-authorship by Elitsa Alexander, Martin J. Eppler, and Alice Comi. This paper is accepted, presented and published in the conference proceedings of the *European Conference of Information Systems* (ECIS 2018), Portsmouth, UK.

Table 1. Constituent Parts of this Cumulative Thesis

Name of Article	Authors	publication medium	Status of publication
Paper 1 Integration: A Real-Time, Participant-Driven, and Visually Supported Method	Alexander, Elitsa Eppler, Martin J. Comi, Alice	Journal of Mixed Methods Research	accepted as is
Paper 2 Building on Disagreement Visually: The System and the Method	Alexander, Elitsa Eppler, Martin J. Comi, Alice	European Conference of Information Systems (ECIS 2018), Portsmouth, UK	accepted, presented and published in the conference proceedings
Paper 3 Interaction Patterns: A Visual Approach to Mixed Methods Research	Alexander, Elitsa Eppler, Martin J. Comi, Alice	European Conference on Research Methodology for Business and Management Studies (ECRM 2018), Rome, Italy	accepted, presented and published in the conference proceedings
Paper 4 A Visualization for Teaching Mixed Methods Research	Alexander, Elitsa	SAGE Methodological Innovations Journal	submitted

Paper 3 (Chapter D), entitled *Interaction Patterns: A Visual Approach to Mixed Methods Research*, provides an overview of an inventory of visual interaction patterns – repeatable combinations of visualizations and an accompanying research procedure intended to extend quantitative research results with qualitative data. A definition of a visual interaction pattern was provided above, in Section 2. This paper is written in co-authorship by Elitsa Alexander,

Martin J. Eppler, and Alice Comi. This paper is accepted, presented and published in the conference proceedings of the *European Conference on Research Methodology for Business and Management Studies (ECRM 2018)*, Rome, Italy.

Paper 4 (Chapter E), entitled *A Visualization for Teaching Mixed Methods Research*, introduces an innovative visualization of basic mixed methods research designs and integration methods. The visualization can be used for teaching and didactic purposes. This paper is written by Elitsa Alexander. This paper is submitted for publication in the *SAGE Methodological Innovations Journal*.

4.2. Relationship between Dissertation Parts (the Red Thread)

As mentioned above, the purpose of the doctoral research project was to develop and test a visual mixed methods approach that includes an inventory of visual interaction *patterns – repeatable combinations of visualizations and an accompanying research procedure aimed at extending quantitative research results with qualitative data*. Table 2 presents the procedure (i.e., the mixed methods research design) for applying the visual interaction patterns. I have drawn this table in accordance with the guidance for visual modelling of mixed-methods design procedures provided in Ivankova et al. (2006, p.16). The procedure consists of seven phases: data collection, forming focus groups, data analysis (quantitative), data visualization (quantitative), data collection (qualitative), data analysis (qualitative), and critical interpretation. The mixed methods design is explanatory sequential because it is intended to explain initial quantitative results with a qualitative follow-up component (as in Creswell et al. 2011).

The data collection phase (a survey, a card sorting session, etc.) is followed by data visualization – quantitative visualizations (e.g., charts, dendrograms, word clouds) representing the aggregate quantitative results are produced. These visualizations are then shown to the research participants, who are randomly split into groups of 8 to 10 people. A large screen showing the visualizations serves as a central point around which the follow-up group conversations take place. The visualizations play the role of structuration devices guiding (Suthers & Hundhausen 2003) the group conversations. Each group conversation is facilitated by one of the researchers, but the true (and more important) facilitators are the visualizations. Each visualization is the center of a discussion and acts as an additional person in the room (the facilitator refers to what the visualizations are "saying" in the eyes of the participants). As a last phase, all qualitative and quantitative findings are interpreted critically (Phase 7 in Table 2). This is done by seeking confirmation of the quantitative results in the qualitative findings (triangulation), seeking clarification or illustration of the results (complementarity), seeking divergence of results (extension), and discovering paradoxes and contradictions that lead to the research questions being reframed or hypotheses being reformulated (initiation) (see Molina-Azorín 2011). Insights explaining, extending, or challenging the quantitative results are gathered.

Table 2 also explains the relationship between the dissertation parts, i.e. it indicates which interaction pattern is introduced in which paper, namely:

- Paper 1 (Chapter B), entitled *Integration: A Real-Time, Participant-Driven, and Visually Supported Method*, introduces the theoretical underpinnings and proposed application of the *labelling pattern*.
- Paper 2 (Chapter C), entitled *Building on Disagreement Visually: The System and the Method*, discusses the theoretical underpinnings and proposed application of the *disagreement pattern*.
- Paper 3 (Chapter D), entitled *Interaction Patterns: A Visual Approach to Mixed sMethods Research*, introduces, inter alia, the word cloud pattern.

Table 2. Relationship between Dissertation Parts – an Overview of the Mixed Methods Research Design (the Read Thread), the Interaction Patterns and the Respective Papers

Research Phase		Procedure	Product	Du-ration (time)
1. Data collection		Each research participant individually provides data. (Number of participants: 57 in our first study and 51 in our second study)	● data stored electronically (online)	30 min
Paper 1 (Chapter B) labelling pattern	electronic card sorting	Each research participant completes an individual electronic card sorting session online.	● numeric data stored electronically (online, at simplecardsort.com), containing all individual card sorts	
Paper 2 (Chapter C) disagreement pattern	electronic survey	Each research participant completes an individual electronic survey online.	● a .csv file containing all individual survey responses stored online	
Paper 3 (Chapter D) word cloud pattern	a semi-structured electronic survey (with an open question)	Each research participant answers the open question(s) of an individual electronic survey online.	● a .csv file containing all individual open-question survey responses stored online	
2. Forming focus groups		The research participants are randomly or systematically assigned to focus groups. (In our studies: all participants were randomly assigned to focus groups).	● focus groups of 8-10 people	2-10 min
3. Data analysis (quantitative)		The researchers run the data through an analysis tool.	● electronic files containing the quantitative results from the data analysis	15 min
Paper 1 (Chapter B) labelling pattern		The researcher runs the numeric data through simplecardsort.com. Simplecardsort.com performs the cluster analysis.	● electronic files containing the cluster analysis results from the card sorting	
Paper 2 (Chapter C) disagreement pattern		The researcher downloads the .csv file from the web and runs the .csv file through the "Smart Survey Reporter" Java program. The Java program:	● an .xls file containing the aggregate, sorted, descriptive statistical results from the survey	

	1) aggregates the individual survey responses by summing the response counts question-wise; 2) calculates the index of disagreement for the responses to each survey question and sorts the survey questions in a descending order accordingly.		
Paper 3 **(Chapter D)** word cloud pattern	The researcher downloads the .csv file from the web and runs the .csv file through the "Word Cloud Normalizer" Java program. The Java program: 1) splits the .csv file into two .xls files containing the results split by type of response (e.g., decision to invest versus decision *not* to invest); 2) normalizes the two .xls files by eliminating words repeated by the same respondent and making the two .xls files comparable (i.e., comparable independent on number of respondents per response type).	● two .xls files ready to be used for producing two comparable, normalized word clouds per response type	
4. Data visualization (quantitative)	The analysis tool is used to produce a quantitative visualization of the aggregate results (e.g., a bar chart, a quantitative word cloud, a dendrogram).	● electronic (interactive and annotatable) visual representation	5 min
Paper 1 (Chapter B) labelling pattern	Simplecardsort.com is used to produce an interactive dendrogram, which represents the aggregate cluster analysis results.	● an electronic (interactive and annotatable) dendrogram representing the aggregate cluster analysis result	
Paper 2 **(Chapter C)** disagreement pattern	The self-developed web platform is used to produce electronic bar	● electronic bar charts displaying survey	

	charts, stored and displayed online and fed dynamically by the .xls file.	questions sorted according to the disagreement in their responses	
Paper 3 (Chapter D) word cloud pattern	The self-developed web platform is used to produce two normalized word clouds per response type (e.g., decision to invest versus decision *not* to invest).	● two normalized word clouds per response type	
5. Data collection (qualitative) (collaborative data interpretation by participants and researchers/ data integration through instant merging)	The electronic visualization is shown to research participants in focus groups. The researchers facilitate focus group conversations aimed at interpreting the quantitative results displayed in the visual representation. The researchers ask the participants to explain the results. The researchers annotate the visual representation according to participants' input.	● audio recordings of the focus group conversations, which contain data interpretations extending (or challenging) the quantitative results ● annotated visual representation	45 min
Paper 1 **(Chapter B)** labelling pattern	The electronic visual representation is a dendrogram.	● audio recordings of the focus group conversations ● annotated dendrogram (the same dendrogram with multiple annotations)	
Paper 2 **(Chapter C)** disagreement pattern	The first bar chart (depicted in black) represents the index of disagreement of the answers given to each survey question, in descending order. The second bar chart (depicted in color) shows the spread of answers to each survey question, again in descending order	● audio recordings of the focus group (dissent) conversations ● annotated bar charts	

	according to the index of disagreement.		
Paper 3 (Chapter D) word cloud pattern	The electronic visual representations are two quantitative word clouds.	● audio recordings of the focus group conversations ● annotated word clouds	
6. Data analysis (qualitative)	The audio recordings are transcribed and coded.	coded transcripts of audio recordings	5 days
7. Critical interpretation of quantitative and qualitative results (data integration through a joint display)	The researchers interpret the qualitative and quantitative findings by merging: the annotated visual representation is compared to the coded transcripts of the audio recordings.	a joint display	10 days

Paper 4 (Chapter E) is aimed at popularizing the mixed methods research design presented in Table 2. This paper introduces an innovative visualization of basic mixed methods research designs and integration methods. Since the interaction patters (Table 2) facilitate real-time integration of quantitative and qualitative research data, the patterns can be easily mapped on the innovative visualization.

5. Scope of Application of the Dissertation Parts

The results of this dissertation project have a broad scope of application. The mixed methods approach introduced in this thesis is suitable to extend quantitative methods which produce results that can be aggregated in a quantitative visual representation (like a bar chart, a dendrograms, a quantitative word cloud, or another computer-supported visual representation). Examples include, without being limited to, surveys, experiments, and card sorting. We have tested the approach in survey and card sorting studies.

Table 3 presents an application matrix of the visual interaction patterns. Table 3 also indicates which pattern is introduced in which paper, as a constitutive part of this thesis. The application matrix (Table 3) is laid out according to *(a)* data collection method and *(b)* management area. Details on the application area of each pattern are provided in the papers (Chapters B to D). Table 3 also indicates that the interaction patters are especially applicable whenever *(a)* the voices of the targeted population have to be heard (participant-driven integration of quantitative and qualitative data), *(b)* linguistic or knowledge barriers have to be mitigated (visually supported integration), *(c)* time is a factor (real-time integration).

Table 3. Application Matrix of the Interaction Patterns and Respective Papers

paper/ pattern	application according to **data collection method**					
	structured survey (without open questions)	**semi-structured survey** (with open questions)	Delphi	Quanti-tative **experi-ment**	mixed-methods **experi-ment**	card sorting
Paper 1 (Chapter B) labelling pattern	V	V		V	V	V
Paper 2 (Chapter C) disagreement pattern	V	V	V	V	V	V
Paper 3 (Chapter D) word cloud pattern		V	V		V	
pattern	application according to **management area**					
	marketing			human resources		
	market research (e.g., retail data analysis)	new product develop-ment	marke-ting mix	recruit-ment	trai-ning	employee relations and welfare
Paper 1 (Chapter B) labelling pattern	V	V	V		V	V
Paper 2 (Chapter C) disagreement pattern	V	V	V	V	V	V
Paper 3 (Chapter D)	V				V	V

word cloud pattern						

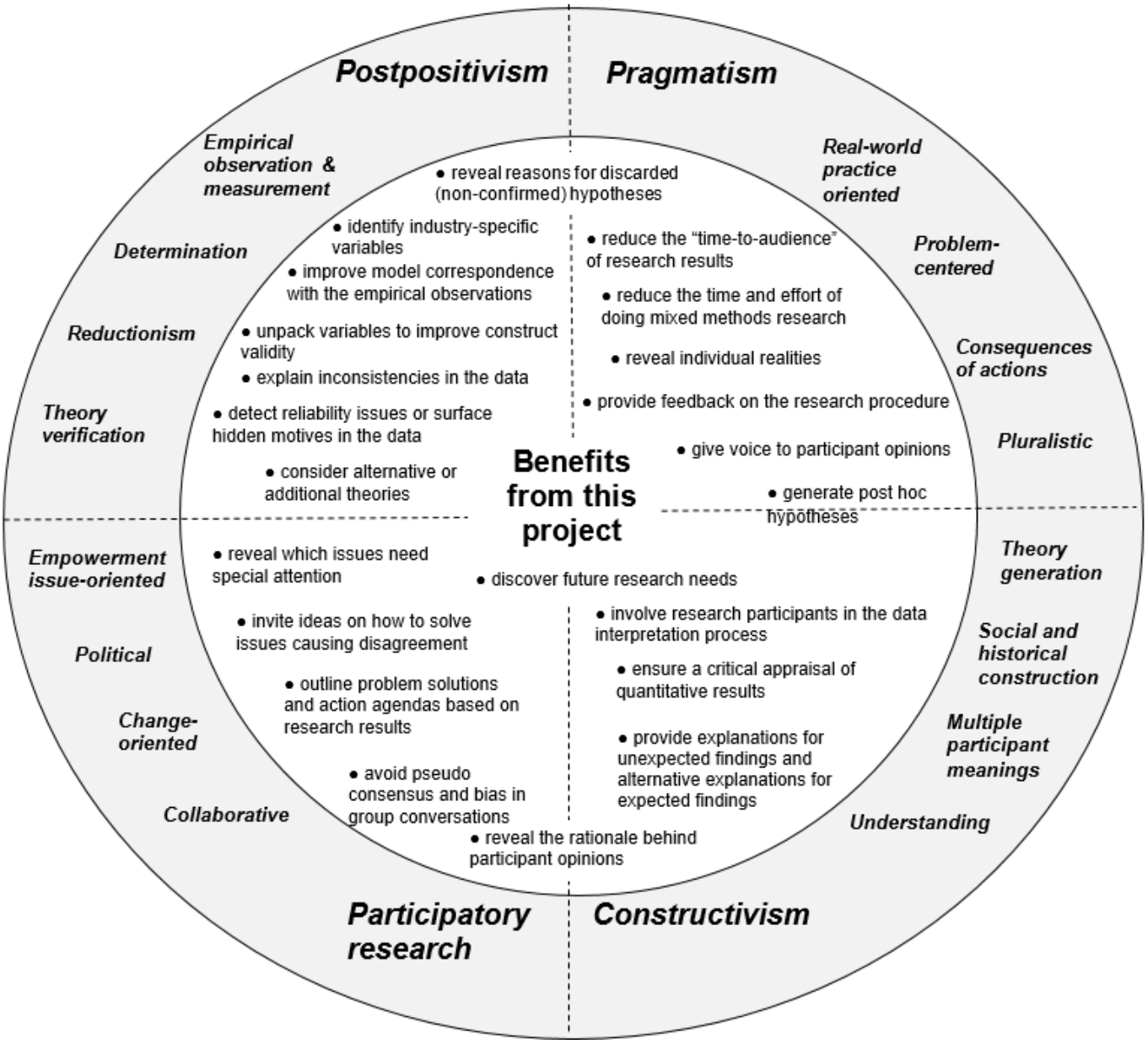
Note: The interaction patters are especially applicable whenever (a) the voices of the targeted population have to be heard (participant-driven integration of quantitative and qualitative data), (b) linguistic or knowledge barriers have to be mitigated (visually supported integration), (c) time is a factor (real-time integration).

The next section provides an integral view of the potential methodological benefits from applying the patterns and their accompanying mixed methods research design procedure, as well as their theoretical base.

6. Theoretical Base, Positioning and Potential Benefits from this Dissertation

The mixed methods approach developed in this dissertation may be described as participatory, because "the focus is on involving the voices of the targeted population in the research" (Fetters et al. 2013, p. 2139). The approach adopts the empirical measurement from postpositivism (the quantitative results serve as a base for further analysis), the ontological stance toward knowledge creation from constructivism (the quantitative results' meaning is constructed by the research participants as part of their interaction with the visualizations), the practice orientation from pragmatism (the quantitative results are visualized and fed back to the research participants, often practitioners, who initially produced them), and the empowerment orientation from participatory research. Empowerment is provided by the involvement of the research participants in the data interpretation process during the follow-up conversations. This type of prolonged engagement (Teddlie & Tashakkori 2009, p. 213) serves as a mixed methods credibility audit – an evaluation of the goodness (Ibid., p. 332) of the quantitative research output. Figure 1 provides an integral outline of the potential benefits of applying the mixed methods approach and its theoretical base.

Figure 1. Potential Benefits from this Doctoral Research Project & Theoretical Base (The grey part of this figure is adapted from Creswell 2013)



The benefits from the instant data visualization include reducing the "time-to-audience" (Dyllick & Tomczak 2009, p. 7) of research results, as well as reducing the time and effort of doing mixed methods research. The involvement of research participants in the data interpretation process enables a critical appraisal and enrichment of quantitative results. Insights extending (or challenging) the quantitative results are gathered, which may lead to identifying industry-specific variables, unpacking variables to improve construct validity, explaining inconsistencies in the data, detecting reliability issues or surfacing hidden motives in the data. Further potential benefits include improving the correspondence of correlational models with empirical realities, locating factors that might account for the lack of statistical confirmation of existing hypotheses and the emergence of newly-discovered correlational dependencies, enabling the formulation of post-hoc hypotheses based on the newly-discovered correlational dependencies. The interaction patterns are a visual elicitation tool, which allows researchers to reveal the rationale behind participant opinions, for

example by providing explanations for unexpected findings and alternative explanations for expected findings, or providing feedback on the research procedure. Such feedback may motivate researchers to consider alternative or additional theories or discover future research needs. The potential benefits from the visualization of disagreement (i.e., the disagreement pattern) include giving voice to participant opinions, which may reveal individual realities, or reveal which issues need special attention. The conversations spurred based on these revelations may invite ideas on how to solve issues causing disagreement, or may help outline problem solutions and action agendas based on research results. Importantly, the visualization of disagreement helps to avoid pseudo consensus and bias in group conversations.

7. Overall Conclusion

This dissertation builds on recent methodological literature contending that research participants need to be closer involved in the research process. By developing and applying a mixed methods approach for involving research participants in the process of data interpretation through visual means, this dissertation demonstrates that the so called (and widely discussed) *research-practice gap* can be bridged successfully through information visualization. In particular, this dissertation demonstrates that whenever initial quantitative results need to be interpreted, explained or enriched by, this can be done by using a qualitative follow-up component. In this follow-up component, the quantitative data can be comprehended, questioned, modified and augmented by research participants.

The mixed methods approach introduced in this dissertation potentially amplifies quantitative knowledge; the collaborative interpretations of visualized quantitative data add value. They permit challenging or extending of the quantitative results in a manner that would not have been possible otherwise. This is a value-adding research outcome of data integration, whereby the research participants are involved as co-interpreters. The implications of the mixed methods approach include its possible application whenever *(a)* the voices of the targeted population have to be heard (participant-driven integration of quantitative and qualitative data), *(b)* linguistic or knowledge barriers have to be mitigated (visually supported integration), *(c)* time is a factor (real-time integration).

This dissertation has also demonstrated that the interaction patterns can be applied to improve the correspondence of correlational models with reality and context. This is important, since correlational models are the basis of collective problem solving. Correlational models are also the basis of research because they represent pre-stages of theories. This dissertation has shown that the interaction patterns can facilitate the production of value-adding insights. Such value-adding insights can confirm, extend or question the goodness of the pre-produced quantitative data. Practitioners such as designers of group

interactions, coaches, and leaders are well advised to apply the patterns to involve practitioners in their processes of work-related inquiry.

The procedure of applying the patterns can play the role of a methodological boundary object between the two worlds – the world of researchers and the world of research participants. Through the interaction patterns, researchers can see their results with the eyes of the people who produced the data. This has the potential to yield insightful answers, like *explanations of unexpected research findings and alternative explanations of expected research findings*. Inferences are built by exploiting the differences in the knowledge bases of researchers and participants. The mixed methods approach introduced in this dissertation has the potential to help practitioners better understand research results. Practitioners become involved in a real-time interpretation of the research results – so that practitioners can base their practices on those results and research can have impact in the real world. Overall, these inferences suggest that the delving deeper into visual interaction patterns seems to be a promising path for future methodological research in the field of management.

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B PAPER 1: INTEGRATION: A REAL-TIME, PARTICIPANT-DRIVEN, AND VISUALLY-SUPPORTED METHOD

Integration: a Real-time, Participant-driven, and Visually Supported Method

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Abstract
We introduce a method in which instant data visualization facilitates real-time data integration and involves participants in data interpretation. The results of quantitative research (e.g., electronic card sorting) are represented visually (e.g., in a dendrogram) and fed back to research participants in follow-up focus group conversations. The visualized quantitative results are reviewed and discussed by participants. The visual display of the quantitative results is annotated with qualitative feedback generated by participants that explains, enriches, or challenges the quantitative results. We apply our method in a card sorting study of Fédération Internationale de Football Association's (FIFA) stakeholders. An approach that facilitates real-time data integration that is participant-driven and visually supported is the unique contribution of this article to mixed methods research.

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1. Background and Methodological Purpose

In mixed methods research, researchers combine elements of qualitative and quantitative approaches (e.g. qualitative and quantitative viewpoints, data collection, analysis, and inference techniques) to gain breadth and depth in understanding and corroboration (Johnson, Onwuegbuzie, & Turner, 2007, p. 123). According to a recent definition, mixed methods include "any research that involves multiple sources and types of data and/or multiple approaches to analysis of those data, in which *integration* of data and analyses occurs prior to drawing final conclusions about the topic of the investigation" (Bazeley, 2018, p. 7). Notably, "meaningful integration of qualitative and quantitative data remains elusive and needs further development'' (Guetterman, Fetters, & Creswell, 2015, p. 554). Researchers employing mixed methods often experience difficulty in integrating the analysis and interpretation of the quantitative and the qualitative data and writing a narrative that link[s] the analyses and interpretations (Bryman, 2007, p. 10).

Hence, there is a need to find ways to facilitate meaningful integration of quantitative and qualitative data. Our attention turned specifically to "development of descriptive and narrative accounts from quantitative (statistical) data" (Bazeley, 2018, p. 223). Such accounts result whenever researchers describe, interpret, or discuss their findings in prose. As integration of this kind is not often used as a deliberate analysis strategy in mixed methods projects, it may offer "untapped potential" (Bazeley, 2018, p. 223). In this article we unleash this potential by offering a visual approach to elicitation of qualitative participant interpretations of visualized quantitative data in a real-time data integration. The methodological purpose of our article is to provide a method which facilitates real-time integration that is participant-driven and visually supported.

Our work is structured as follows. We begin with a review of the literature on the use of visual representations in mixed methods research and on participant involvement in data interpretation. We then provide a summary of our method, including a description of its constitutive phases and their outcomes, as well as a description of an illustrative study in which the method was employed. Finally, we evaluate the method and discuss it with reference to its contribution and limitations. The following section aims to clarify what types of visual representations exist and to contextualize their role in mixed methods research.

2. Literature Review

2.1. Use of Visual Representations in Mixed Methods Research

Building on recent efforts to systematize the use of visual representations in mixed methods research (Archibald, 2018; Balomenou & Garrod, 2015; D'Angelo, Ryan, & Tubaro, 2016; Guetterman, Fetters, and Creswell, 2015; Onwuegbuzie & Dickinson, 2008; Shannon-Baker & Edwards, 2018), it is possible to identify three main (often overlapping) purposes of use.

Visual representations are used in mixed methods research for *data elicitation, data integration and interpretation,* and *data communication*.

First, mixed methods researchers use visual representations to *elicit* that which is difficult to verbalize or observe. Visual representations (e.g., diagrams, drawings) are produced by researchers or by the research participants. Visual representations that are produced by researchers are used as stimuli in the study to elicit responses from research participants. For example, Tubaro et al. (2016, p. 7) asked participants to fill in the blanks on a diagrammatic representation of concentric circles and Alexander et al. (2015, p. 38) asked participants to fill in the blanks on a metaphoric representation of a funnel. Visual representations that are produced by the research participants express feelings or illustrate situations introspectively and reflectively. For example, the participants in the studies of Brechet et al. (2009), O'Connell (2013), and Shannon-Baker (2015) produced self-portraits, drawings and photos to express feelings and illustrate situations.

Second, mixed methods researchers use visual representations to *integrate* and *interpret* quantitative and qualitative data in order to derive new insights beyond the information gained from the separate quantitative and qualitative results (Fetters, Curry, & Creswell, 2013, p. 2143) and hence to enhance their understanding of the phenomena under analysis (Onwuegbuzie & Dickinson, 2008). For example, mixed methods researchers use *joint displays* (Guetterman et al., 2015) to integrate quantitative and qualitative data by bringing them together with the purpose of direct comparison.

Third, mixed methods researchers use visual representations to *communicate* research results to the readers. For example, crossover *graphical displays* (Onwuegbuzie & Dickinson, 2008) summarize integrated quantitative and qualitative results in (interactive) line charts, georeferencing plots, bubble plots, scatterplots, pictograms, maps, and (decision) trees. The title "crossover" (Onwuegbuzie & Combs, 2010) comes from using techniques from one tradition (e.g., quantitative) to analyze data associated with the other tradition (qualitative).

Visually supported mixed methods studies can be conceptualised as involving different levels of visual representations. In his seminal work, Tufte identified five levels of visual representations (Tufte, 2001, p. 178): *text* (level 1); *tables* (level 2), which show exact numerical values; *text-tables* (level 3), which summarize and arrange numeric data by type (i.e., demographics, source, time, group membership, scale, level) to facilitate comparison; *supertables* (level 4), which provide organized, sequential detail, and reference-like quality and may contain pictures; and *graphics* (level 5), which combine words, numbers, and pictures.

The visual representation used in Nicca et al. (2012, p. 229) can be categorized as a text-table – corresponding to Tufte's third level of representations (Table 4). For the purposes of data integration/interpretation and data communication in a multi-phase mixed methods study, this table summarizes and arranges numeric data by "symptoms" according to a

questionnaire, “appraisal of symptoms” according to contrasting groups of participants in narratives elicited after the questionnaire, and the results of testing hypotheses regarding differences in the participants’ narratives.

Table 4. An Example Visual Representation Used in Mixed Methods Research Corresponding to Tufte’s Third Level

Visual representation	
Description	Level
text-tables – summarize numeric data by type (i.e., demographics, source, time, group membership, scale, level) by “arrang[ing] the type to facilitate comparison” (Tufte, 2001, p. 178)	**level 3** (Tufte, 2001)
Purpose: data integration/interpretation, data communication *Example*: This table summarizes and arranges numeric data by *a)* “symptoms” according to a questionnaire, *b)* “appraisal of symptoms” according to contrasting groups of participants in narratives elicited after the questionnaire, and *c)* the results of testing hypotheses regarding differences in the participants’ narratives.	

Concordance/Discordance of Reports of PLWH and Their CSPs on the Presence of Symptoms

Symptom (in Order of Appearance in Questionnaire)	Appraisal of Symptom by PLWH and CSPs (N = 122)		McNemar (Paired Test)		
	Yes by PLWH (n)	Yes by CSPs (n)	χ^2	p Value (Two-Tailed)	$H_0 = 1$ (q Value)
...					
Fever	6	10		.454[a]	.603
Chills	11	15	0.35	.556[b]	.712
Flushing	19	18	0.00	1.000[b]	1.000
Night sweats	20	11	2.07	.151	.262
Day sweats	12	3		.035[a]	.116
Sensitivity to insect bites	7	5		.774[a]	.869
Increased sensitivity to hematoma	3	5		.727[a]	.842
Weight gain	12	9		.664[a]	.822
Weight loss	8	14		.286[a]	.426
Weight gain in stomach area	19	21	0.025	.874[b]	.967
Hump on back of neck/shoulders	2	4		.687[a]	.836
Skinny arms and legs	13	5		.096[a]	.200
Swollen feet/legs	8	3		.227[a]	.365
Prominent leg veins	17	7		.064[a]	.146
Fear/worries	**30**	**12**	**6.88**	**.009[b]**	**.041**
Anxious	**31**	**12**	**7.54**	**.006[b]**	**.037**
...					

Note: PLWH = persons living with HIV; CSP = close support person.
a. Exact significance, two-tailed; binomial distribution. b. Asymptotic significance, two-tailed; continuity corrected. Bold: significantly discordant symptom reports.

Source: Nicca et al. (2012, p. 229), re-printed with permission from the authors and the publisher

The elaborate table used at the data interpretation stage for Alexander et al. (2015) can be categorized as a supertable – corresponding to Tufte's fourth level of representations (Table 5). This supertable contains numeric, textual, and visual data (i.e., the experimental conditions are visually represented). The supertable allows comparisons between the shared and withdrawn thoughts regarding project experiences. The horizontal rules divide the data into group-related paragraphs; the rows are ordered so as to tell an ordered story about the experimental groups and the individual members of the experimental groups (based on integrated thoughts). Further examples of elaborate tables may be found in Peroff et al. (2019, p. 8) and Flowers et al. (2015, p. 851).

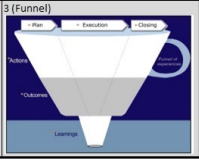
Table 5. An Example Visual Representation Used in Mixed Methods Research Corresponding to Tufte's Fourth Level

Visual representation	
Description	Level

supertables – "elaborate tables" which provide "organized, sequential detail, and reference-like quality" (Tufte, 2001, p. 178) and may contain pictures	level 4 (Tufte, 2001)

Purpose: data integration/interpretation

Example: This elaborate table, a supertable, contains numeric, textual, and visual data (the experimental conditions are visually represented). The supertable allows comparisons between the shared and withdrawn thoughts regarding project experiences. The horizontal rules divide the data into group-related paragraphs; the rows are ordered so as to tell an ordered story about the experimental groups and the individual members of the experimental groups (based on integrated thoughts).

Participant	Group	Condition	Individual Experiences	Integrated thoughts (No.) (available in pre-survey AND on template)	Withdrawn thoughts (No.) (available in pre-survey but NOT on template)	Total thoughts (no.) = integrated thoughts + withdrawn thoughts	Integrated thoughts (Percentage) = Integrated thoughts/ Total thoughts	Group Average: Integrated thoughts	Thought 1	Thought 2
26	9	2 (Grid)	7	5	2	7	0,71	0,54	Explain and communicate the need in front of the enterprise. Why? For what purpose? (negative)	INSIDE: monthly project info (positive)
27			7	4	3	7	0,57		PLAN: Communicating an idea with a well-defined goal, information sharing, learning from others and experience sharing (positive)	PLAN: Difficulty in synthesising the variety of ideas (negative)
28			6	2	4	6	0,33		During the implementation of a new IT strategy (CRM solution implementation) I supported the IT project team as a bridge betweent he IT and the business.	The business was not willing to accept the changes.
23	8	3 (Funnel)	9	4	5	9	0,44	0,20	Merge of different departments of my company (engineering) -- new label of the group after 30 years of history	No plan was prepared by the board of directors.
24			7	1	6	7	0,14		optimization of resources of 2 sectors: laboratory / production	formation of laboratories for 1) 2) 7 products 3) 1 single sector, single outlet plus
25			8	0	8	8	0,00		SIMPLEX: harmonization of suppliers and raw materials / purchasing	ACTIONS: matching of PM between suppliers /delivery / with existing product recipients

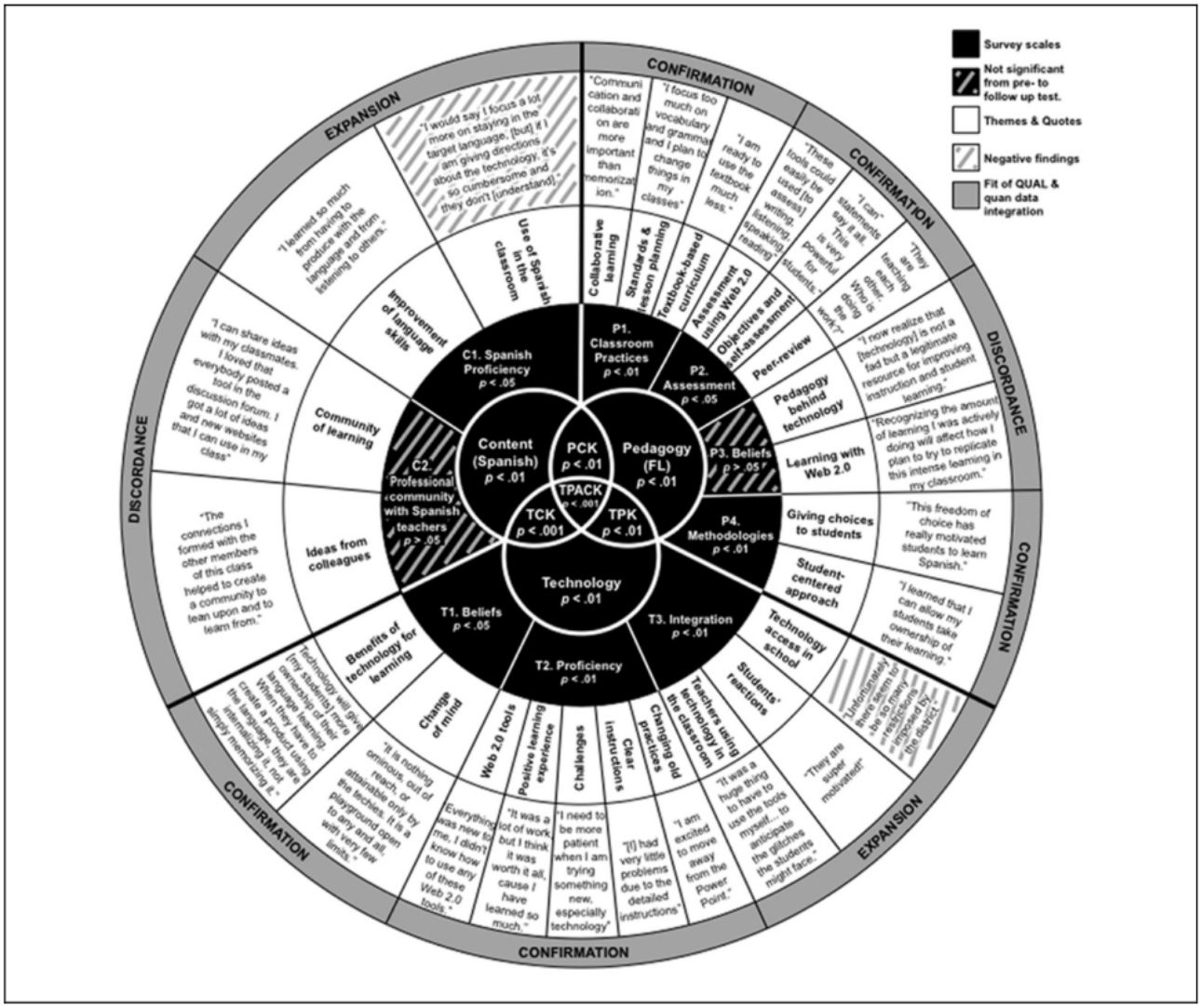
Source: the authors – table used at the data interpretation stage for Alexander et al. (2015)

The diagram used in Bustamante (2019, p. 171, Table 6) can be categorized as corresponding to Tufte's fifth level of representations. This diagram was used to represent the integration of quantitative and qualitative data: black represents quantitative data, white qualitative data, and gray represents the mixing of black and white – in this case, the outcome, or "fit", resulting from integrating the quantitative and qualitative data. The diagram used in Tubaro et al. (2016, p. 7) also corresponds to Tufte's fifth level of representations, but has been used for the purpose of data elicitation. The personal social network of each research participant (Table 6) contains concentric circles that represent relational proximity to ego, while the quadrants represent the context of relationships in the social network. Research participants were asked to fill in the blanks between the circles. Similarly, Alexander et al. (2015, p. 38) used a diagrammatic representation (a funnel metaphor) for the purpose of data elicitation.

The research participants were asked to fill in the blanks on the funnel in order to share their project-related experiences. The types of level-5 visual representations used in mixed methods include arts-based graphics. For example, Brechet et al. (2009), O'Connell (2013), and Shannon-Baker (2015) collected self-portraits, drawings and photos produced by participants and analysed them in mixed methods studies.

Table 6. Example Visual Representations Used in Mixed Methods Research Corresponding to Tufte's Fifth Level

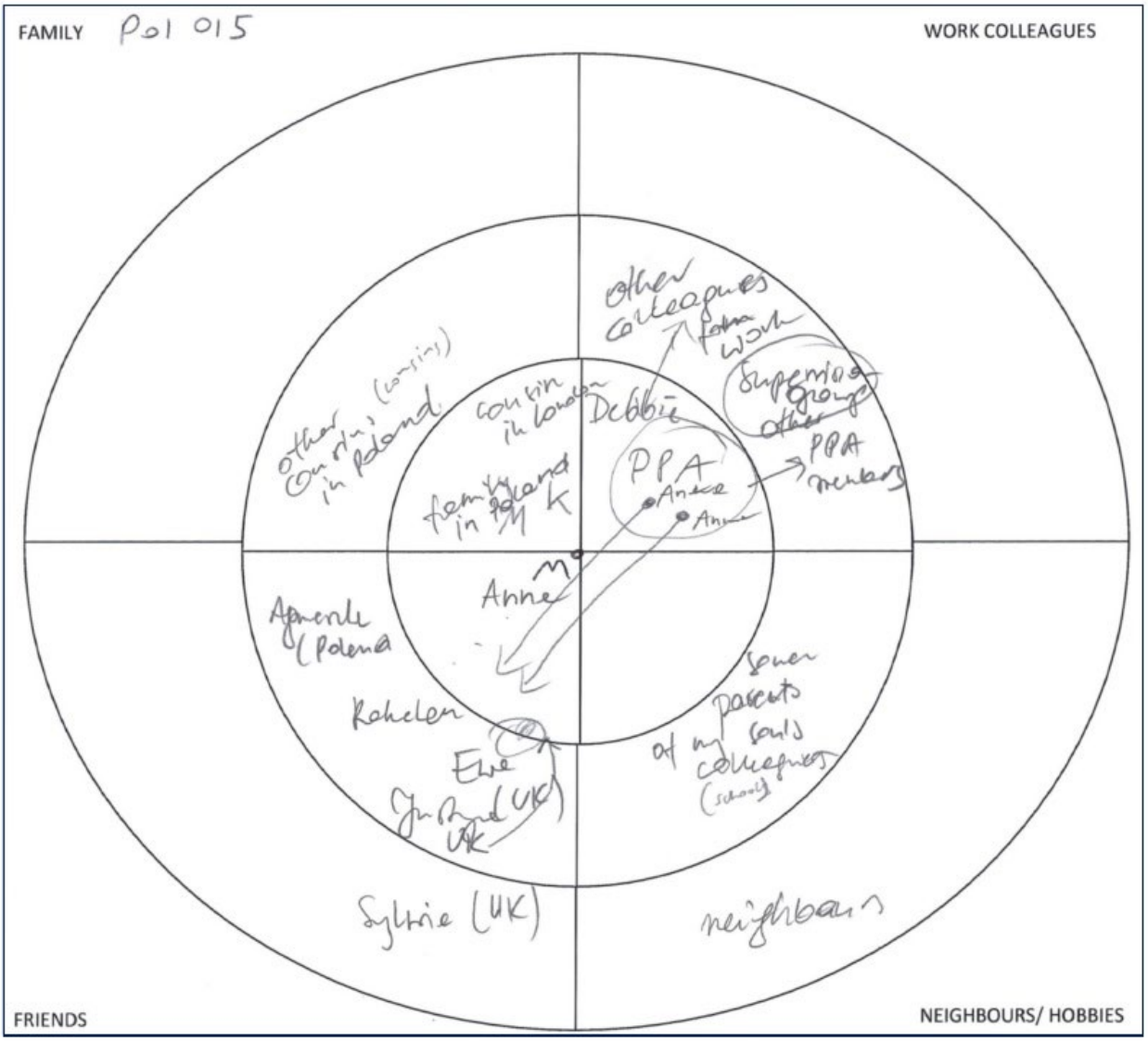
Visual representation	
Description	Level
graphics (e.g., **diagrams**) – "combine words, numbers" (Tufte, 2001, p. 178), show arrangement and relations, and "preserve explicitly the information about the topological and geometric relations among the components of the problem" (Larkin & Simon, 1987, p. 66)	**level 5** (Tufte, 2001)
Purpose: data integration, data communication *Example*: This diagram was used to represent the integration of quantitative and qualitative data: black represents quantitative data, white qualitative data, and gray represents the mixing of black and white – in this case, the outcome, or "fit", resulting from integrating the quantitative and qualitative data.	



Source: Bustamante (2019, p. 171), re-printed with permission from the author and the publisher

Purpose: data elicitation

Example: This diagram (a sociogram) depicts the personal social network of a research participant. The concentric circles represent relational proximity to ego, while the quadrants represent the context of relationships in the social network of each research participant. Research participants were asked to fill in the blanks between the circles.



The personal network of Agnieszka, a respondent from the Polish migrants study.

Source: Tubaro et al.[3] (2016, p. 7), re-printed with permission from the author Louise Ryan and the publisher

Visual representations have the potential to add to the inference-drawing capacity of researchers, but not necessarily to the integration of data. Bazeley (2018) points out that visual displays generated by "software are helpful to varying degrees in revealing and displaying patterns in data – sometimes more *for the researcher* [emphasis added] during the analysis process than for the reader of a report" (p. 297). But what about for *participants*, who are increasingly being drawn into the process of data analysis and interpretation?

2.2. Involving Participants in Data Interpretation

The idea of involving research participants in data interpretation stems from early concerns about the provisional nature of knowledge and the limits of objectivity (Popper, 1959). Participant involvement has been motivated by early concerns regarding interpretation biases (MacCoun, 1998) as well as by more recent concerns that inferences drawn "should

make sense to those who contributed the data" (Bazeley, 2018, p. 55). So-called reflexive (or participatory) research methods describe a partnership between researchers and research participants in order to use the knowledge and abilities of each (Van de Ven, 2007). Participatory methods have been used in attempts to involve participants in data interpretation (as e.g. "co-researchers"). Such methods are frequently used in fields like postmodern ethnography (e.g. Presnell, 1994), anthropology (e.g. Feighery, 2006), applied communication research (e.g. Deetz, 2008), action research (e.g. Heron & Reason, 2006; Reason & Bradbury, 2008), and less frequently used in management and organization studies (Bartunek, 2007; Van Aken, 2004; Van de Ven, 2007). In mixed methods, participatory research is "one expression of a pragmatist position" (Garner, 2015, p. 179). For example, community-based participatory research (Israel et al., 2013) combined with mixed methods research (Dejonckheere et al., 2018) engage research participants in the design and implementation of research that may benefit society (Molina-Azorin & Fetters, 2019). Ivankova (2015) first discussed intersecting mixed methods with action and participatory research approaches.

It has been suggested that researchers and participants collectively negotiate the meaning of results to help complement otherwise "incomplete" research (Alvesson et al., 2008, p. 483). Another proposal for involving participants is to open up research texts to "multiple readings" by participants and audiences (Alvesson et al., 2008; King & Learmonth, 2015; Lukka & Modell, 2010). These multiple readings may take place (a) during "data collection and initial analysis" (through events such as meetings and workshops), (b) during "interpretation" (through joint interpretive forums), (c) during "dissemination" (through co-authorship of research reports), or (d) during "implementation" (through guidance and advice on implementation) (Knight & Pettigrew, 2007, pp. 7–9). Joint interpretive forums have been suggested by Mohrman et al. (2001) and Rynes et al. (2001) as events (like workshops or conversations) where researchers and practitioners work together to interpret results. However, both Mohrman et al. (2001) and Rynes et al. (2001) are conceptual epistemological papers, which suggest (but do not apply) "joint interpretive forums" as a concept.

Kieser and Leiner (2009, p. 527) noted that the overwhelming majority of articles resulting from collaborative research [with participants] are of an epistemological kind. Kieser and Leiner also indicated that they did not know of any publications that contain jointly produced *research* output describing research *results* rather than processes and the difficulties of collaboration between researchers and research participants. Hence there is a recognized need to find ways to facilitate joint researcher-participant interpretation of research results.

According to Howe and Eisenhart (1990), Bazeley (2018, p. 56), and Kuckartz (2018), "all scientific analysis involves acts of interpretation *by researchers*" [italic added]. The role of the researcher remains paramount in deciding issues relating to ... the meaning of codes, the

interpretation of the data tables and displays produced using the computer (Bazeley, 2010, p. 418–419). Interpretation conducted by *researchers* is influenced by their research purposes, their subjective awareness and sensitivity, the context in which the data were obtained, the underlying conceptual framework, and the choice of methodology. Interpretation of data still remains largely the prerogative of scholars, even though participants commit substantial time and resources to the studies and numerous approaches have set out to involve them in the process. With this work, therefore, we aim to contribute by offering a visual approach to involve participants – by using visual representations to elicit qualitative participant interpretations of visualized quantitative data in a real-time data integration.

In this section, we have (1) reviewed the visual representations used in mixed methods research, and (2) shown that there is a recognized need to find ways to facilitate joint researcher-participant interpretation of research results. On the basis of these methodological needs, we now introduce an innovative method enabling research participants to review quantitative results through visual displays shortly after the research participants have provided the quantitative data.

3. The Method and an Illustrative Example

The method for data integration we introduce in this paper consists of seven phases: data collection, formation of focus groups, data analysis (quantitative), data visualization (quantitative), data collection (qualitative), data analysis (qualitative), and critical interpretation. Table 7 introduces the phases of our method, along with detailed information on associated procedures and products. We have compiled this table in accordance with guidance for visual modeling of mixed-methods design procedures provided in Ivankova et al. (2006, p. 16). The mixed methods design used is explanatory sequential (as defined by Creswell et al. 2011) because it is intended to explain initial quantitative results using a qualitative follow-up component.

Table 7. An Overview of the Method and its Application in our Study (italic)

Research Phase	Procedure	Product	Du-ration (time)
1. Data collection (quantitative)	Each research participant individually provides data by completing an individual task, such as an electronic survey or card sorting.	● numeric data stored electronically (online)	30 min
electronic card sorting in our study	Each research participant completed an individual electronic card sorting session online. Number of participants: 50	● numeric data stored electronically (online, at simplecardsort.com), containing all individual card sorts	
2. Forming focus groups	The research participants are randomly or systematically assigned to focus groups.	Focus groups of 8-10 people	2 min or longer
in our study	All 50 participants were assigned to focus groups.	6 focus groups	
3. Data analysis (quantitative)	The researchers run the numeric data through an analysis tool.	● electronic files containing the descriptive and inferential results from the quantitative phase	15 min
in our study	We ran the numeric data through simplecardsort.com. Simplecardsort.com performed the cluster analysis.	● electronic files containing the cluster analysis results from the card sorting	
4. Data visualization (quantitative)	The analysis tool is used to produce a visualization of the aggregate quantitative results (e.g., dendrograms, bar charts).	● electronic (interactive and annotatable) visual representation	5 min
in our study	Simplecardsort.com was used to produce an interactive dendrogram, which represented the aggregate cluster analysis results.	● an electronic (interactive and annotatable) dendrogram representing the aggregate cluster analysis result	

5. Data collection (qualitative): integration through instant merging	The electronic visualization is shown to research participants in focus groups. The researchers facilitate focus group conversations aimed at interpreting the quantitative results displayed in the visual representation. The researchers ask the participants to explain the results. The researchers annotate the visual representation according to participants input.	● audio recordings of the focus group conversations, which contain data interpretations extending (or challenging) the quantitative results ● annotated visual representation	45 min
in our study	The electronic visual representation was a dendrogram.	● audio recordings and annotated dendrogram (the same dendrogram with multiple annotations)	
6. Data analysis (qualitative)	The audio recordings are transcribed and coded.	coded transcripts of audio recordings and identification of key themes	5 days
in our study	The audio recordings were transcribed and coded.	coded transcripts of audio recordings and identification of key strategic suggestions	
7. Critical interpretation of quantitative and qualitative results (data integration through a joint display)	The researchers interpret the qualitative and quantitative findings by merging: the annotated visual representation is compared with the coded transcripts of the audio recordings.	a joint display	10 days
in our study	We compared the annotated dendrograms with the coded transcripts of the audio recordings. We merged the annotations and excerpts from the coded transcripts on a joint display.	a joint display, which contains insights further extending (or challenging) the quantitative results	

In order to showcase application of our method, we conducted a study in which we explored sensemaking of stakeholder groups by managers. The purpose of our study was to understand the reasoning managers apply when grouping stakeholders and when designing strategies for

dealing with each group of stakeholders. Our research question was the following: *How do managers make sense of stakeholder groups?*

Sensemaking has been defined as "the ongoing retrospective development of plausible images that rationalize what people are doing" (Weick et al., 2005, p. 409). This is an important yet under-researched aspect of stakeholder management (Davis, 2014, p. 192; Turner, 2014; Turner & Zolin, 2012; Turner & Müller, 2006). The participants' task in our study consisted of identifying groups among Fédération Internationale de Football Association's (FIFA) stakeholders. FIFA is a suitable case for exploring managers' sensemaking of stakeholder groups; it is beholden to a number of stakeholders who require different information about its performance (Schenk, 2011) and demand different strategic approaches. As revealed by recent scandals documented in the press (Poddar, 2014), FIFA seems to eschew formal mechanisms of accountability to its stakeholders (Pielke, 2013). Making the organization more accountable would require, among other things, making sense of FIFA's stakeholder groups and designing a strategy for dealing with each of them.

Our study participants were 50 managers enrolled in a part-time executive MBA program in Switzerland. Our sample was appropriate for uncovering how managers make sense of stakeholder groups. The participants were collectively experienced managers (with an average work experience of 8 years), cross-functional (coming from different functional areas), and international (coming from 17 different countries). No prior knowledge of FIFA was necessary. All participants were informed that their participation was voluntary, anonymous, and would not be graded

3.1. Phase 1: Data Collection

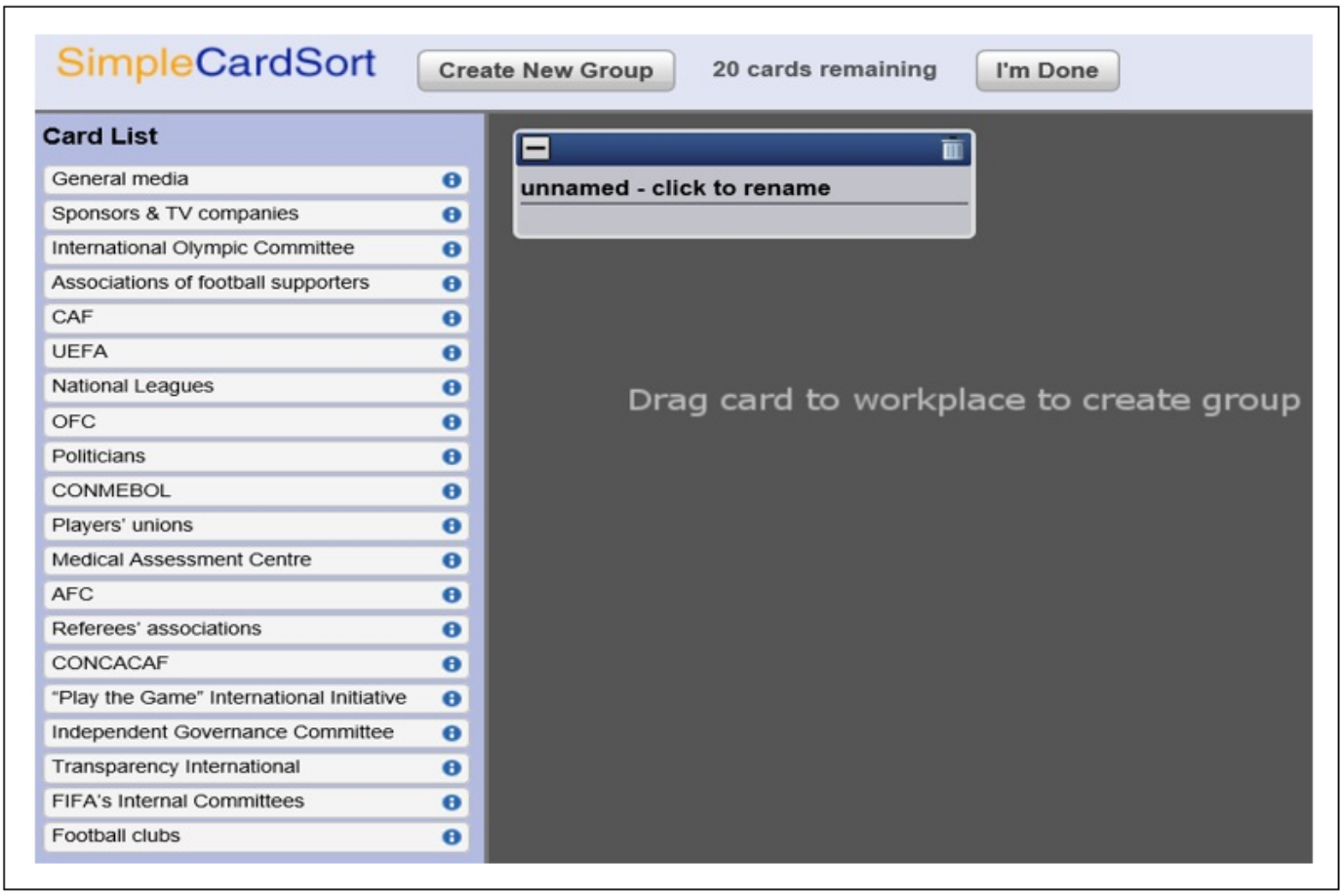
In this study, we collected quantitative data through electronic card sorting. To convey the card sorting instructions, we created a website (https://sites.google.com/site/cardsortingstakeholders) in which we uploaded information about FIFA and explained the task that participants were invited to complete. Each participant was given 10 minutes to read the background information (https://drive.google.com/file/d/1L1crREVbzFZfmIotZA8-84K-SLZRfR5c/view) and the task instructions (https://drive.google.com/file/d/1zaVF2PxxEkfwXnATGb8VcInn_VpWEaIh/view). The background information covered essentials about FIFA's stakeholders and the problems associated with managing them. The individual task that each participant had to complete was formulated as follows:

TASK: "You are a strategy consultant working for FIFA's president. The president is facing the challenges of stakeholder diversity and stakeholder pressure. Your task is to give him an overview of his stakeholder groups in order to help him better understand them. You will have to sort the stakeholder cards online (https://www.simplecardsort.com/sort.php?s=JLX122XD&p=454[1]). Each card will have the

name of a FIFA stakeholder written on it. **We would like you to sort the cards into groups**. You are welcome to use any criteria you like and any group labels and subgroup labels you like, including 'don't know,' 'not sure,' and 'not applicable.' You can create subgroups (and nest them into each other). Please read the background information about FIFA and its stakeholders before you start sorting. You can refer to this information at any time during the sorting task (you do not have to memorize any specific information)."

Each participant was then given 20 minutes to complete the individual electronic card sort for this first phase of our study (as outlined in Table 7). We designed the electronic card sorting task with the help of the simplecardsort.com online platform. The task was devised as an "open card sort," following the procedure documented in Rugg and McGeorge (2005). We provided no pre-supplied stakeholder groups, and thus aimed "to elicit criteria and categories" from the participants (Ibid., p. 97). We used the 20 most significant stakeholders of FIFA, as listed at fifa.com. Figure 2 contains a list of the 20 cards, each bearing the name of one of FIFA's 20 stakeholders. Each of these cards had to be dragged to the right and grouped with other cards.

Figure 2. The Individual Card Sorting Workplace



All participants were assembled in a big plenary room and accessed simplecardsort.com through their laptops or mobile phones. The participants finished their card sorting task

within 20 minutes. 50 individual card sorts were stored online at the end of the task. Figure 3 shows an example of an individual card sort. Each individual card sort shows how each manager distinguishes and labels FIFA's stakeholder groups.

Figure 3. Example of an Individual Card Sort

3.2. Phase 2: Formation of Focus Groups

We assigned all participants to 6 focus groups (3 groups of 9 people and 3 of 8). Eight to ten people is the optimal group size recommended by focus group researchers (Krueger & Casey, 2014). Each participant was randomly given a focus group number (from 1 to 6) written on a piece of paper together with the number for the room to which they should return after a break. We explained that participation in the focus groups was designed to help us understand the card sorting data. All participants then left the big plenary room for a break. Random allocation of focus group participants was designed to ensure a non-biased interpretation of the aggregate quantitative results.

3.3. Phase 3: Data Analysis (quantitative)

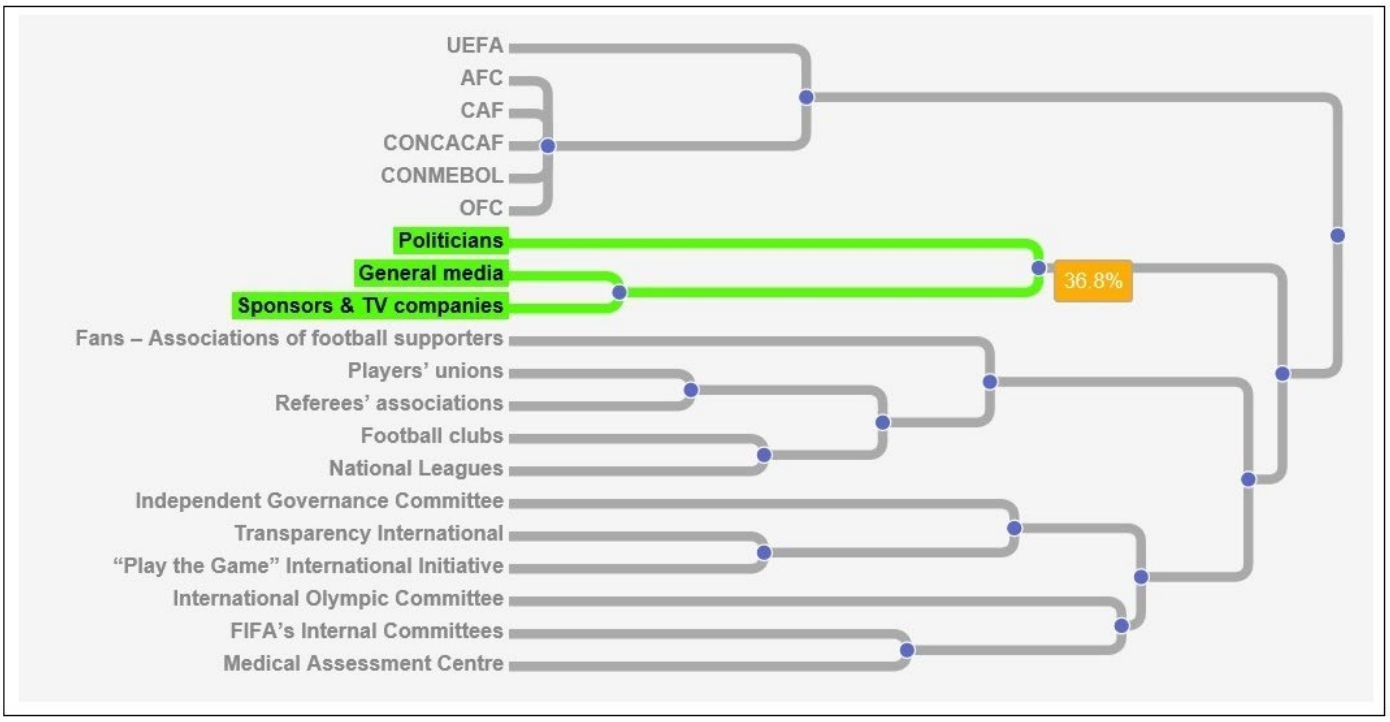
Simplecardsort.com produced and stored numeric data that contained all individual card sorts. We then ran a cluster analysis using all these card sorts through the simplecardsort.com platform. The cluster analysis files, available for download here (https://drive.google.com/file/d/1jOAyaRLefYLU2TZYHk1ZP3Dwi-cSWxm1/view?usp=sharing), include a card summary, a group summary, a groups-by-card summary, a maximum group agreement solution, a participant summary, participant-card raw data, and a similarity matrix.

3.4. Phase 4: Data Visualization (quantitative)

Simplecardsort.com was used to produce a dendrogram representing the aggregate cluster analysis results. A dendrogram is a tree diagram used to illustrate arrangement of the clusters

produced by hierarchical clustering. The percentages of agreement for each cluster popped up when the mouse rolled over a cluster in this electronic dendrogram (Figure 4).

Figure 4. An Interactive Electronic Dendrogram Representing the Aggregate Cluster Analysis Results for all 50 Individual Card Sorts.



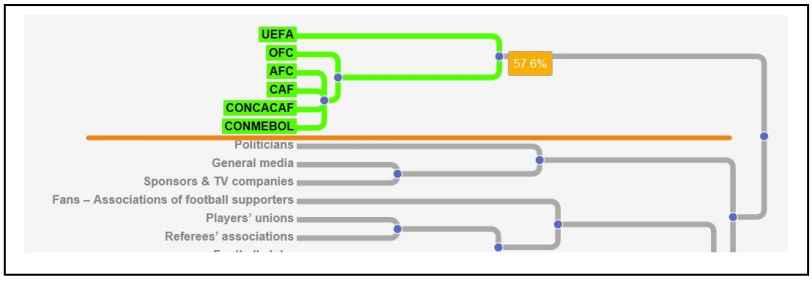
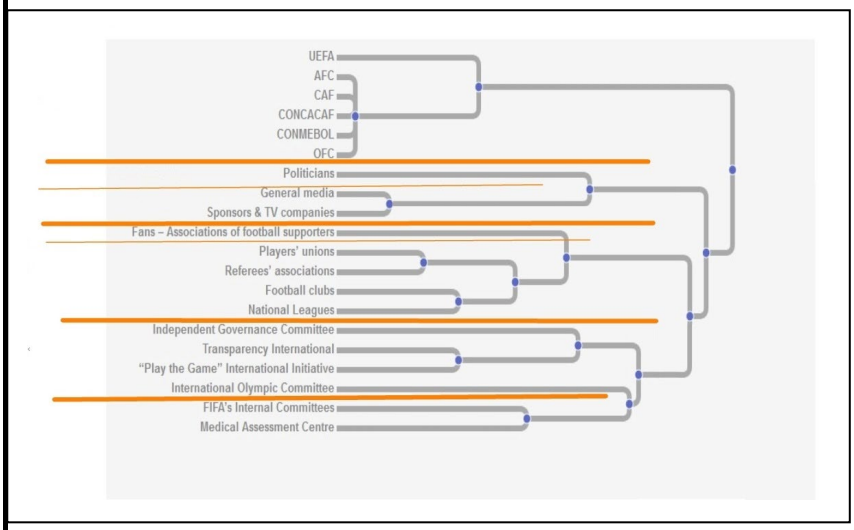
Notes: The percentage represents the level of agreement for a particular cluster.

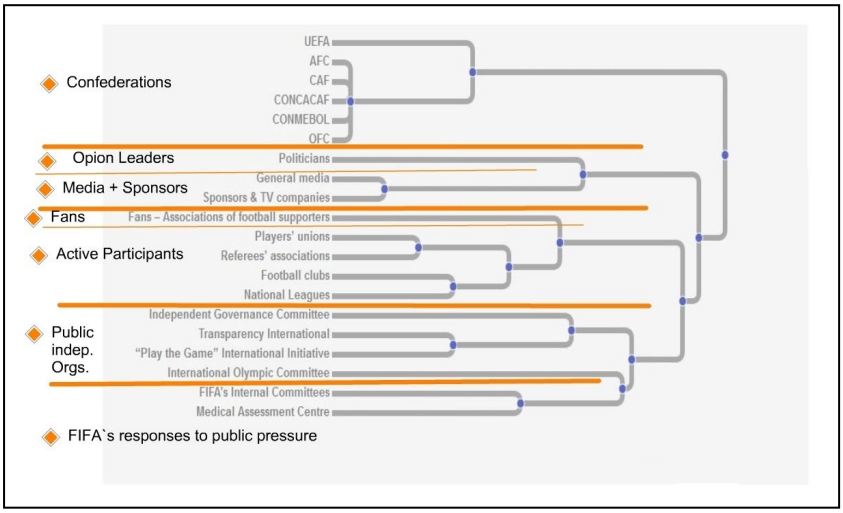
3.5. Phase 5: Data Collection (qualitative)

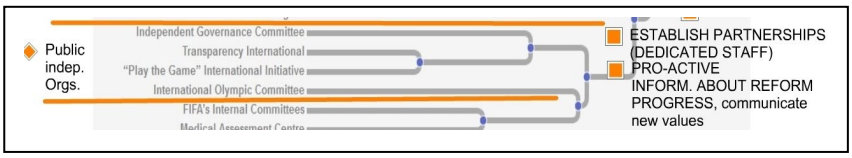
The participants entered the 6 separate focus group rooms after a 20-minute break. The same interactive dendrogram (see Figure 4 above) was shown on a large screen in each focus group room. We facilitated the focus groups by asking questions aimed at interpreting the cluster analysis results displayed in the dendrogram. The same questions were used in all groups. Table 8 shows the questions and examples of visual outputs (i.e., how the dendrogram was annotated based on the answers to the questions).

Table 8. Questions Asked, Examples of Answers, and Visual Outputs

Questions (asked by the facilitator in each focus group) & Example Answers (by focus group participants)	Visual outputs (how the dendrogram was annotated based on the answers to the questions)
Question: Facilitator: In your opinion, which clusters of the dendrogram are worth labeling? Please suggest where to draw the lines of what is worth labeling.	Threshold lines (in orange) were added to indicate what was worth labeling:

Answers: Participant F: I think … around sixty percent. Participant G: OK, this makes sense, let's label all around … fifty percent, and neglect all of the ones that are below this line… Facilitator: Does everyone agree with fifty-sixty percent? Participant G: Yes, it is a good idea, so that we know what to label. Participant F: Let us neglect the ones with a small percentage. Let's concentrate on the middle ones, because they are the most… Let's draw a line there, hmm…, at around fifty-sixty percent agreement. Participant B: Yes, this makes sense. Facilitator: Ok, let us do this. [Facilitator starts drawing lines on the dendrogram.]	 

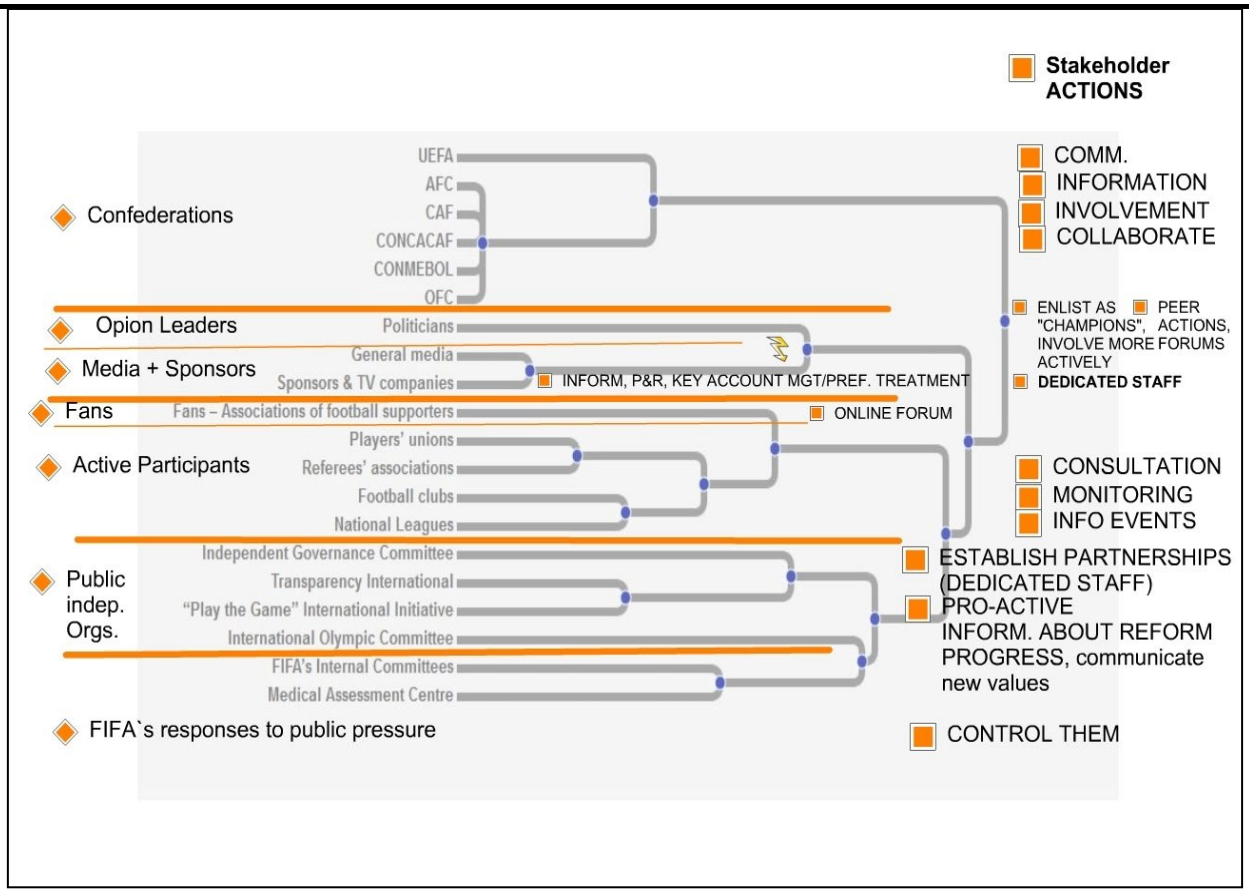
Question: Facilitator: What labels would you give to the clusters of the dendrogram? Please suggest the best possible labels. Answers: Participant G: The thing is, they aren't running to any clubs, or any confederations – they are general. Participant F: Independent? Participant G: Yeah, … Participant F: No…hmm… [Participant C points toward Participant F and helps him find the right word]. Participant C: Public. Participant F: Yes, exactly, they are public. Participant A: How about the internals – ex controllers? Participant F: The medical assessment centre was created thanks to public pressure. Participant C: Yea, so the public intervened to regulate an issue. Facilitator: What's a good label here? Participant F: Public influencers? Participant A: FIFA founded the Medical Assessment Center just in order to avoid the risk of being excluded from the Olympic Games. Participant F: So, responses to public pressure? Facilitator: OK, responses to public pressure [Facilitator writes this label on the dendrogram.]	Labels were added to the clusters of the dendrogram:  

Does everyone agree that this is a good label?	
Question: Facilitator: What strategic measures should FIFA undertake to manage each labeled cluster (of stakeholders)? Answers: Participant B: Of course, they need to participate. Participant C: With “Play the Game”? Facilitator: And who else? Participant B: “Transparency International” – would you make your opponent part of your decision process? Participant C: You can question them, but… Participant A: No, no… Participant C: They cannot say that a decision was wrong, because they were part of it. Participant B: You can establish partnerships with them. Participant A: Proactively…	Suggested strategic measures were added to the dendrogram (on the right-hand side): 

The participants answered our questions, but they were also free to add further and unprompted interpretations. We annotated the dendrogram according to participant input while the group conversation unfolded. The group decided what was to be annotated and how. The annotated dendrogram in Table 9 represents a final version of the dendrogram with the annotations produced in one of the focus groups.

Table 9. A Joint Display of Dendrogram Annotations from the Focus Groups and Verbatim Quotations from the Transcripts of the Focus Group Conversations

Annotated dendrogram (example from one focus group)



Suggested measures (for… stakeholder group)	Quotes from the transcripts of the focus group conversations
communicate, inform, involve, collaborate (for "Confederations" – see annotated dendrogram above)	TOPIC: Seeking agreement (collaboration) with media partners Facilitator: What strategic measures should FIFA undertake to manage this cluster of stakeholders? … Participant: Involvement, that is the most important. Participant: … and collaborating. Participant: Collaborating meaning following their rules, or... playing their game? Participant: No, I think, helping them grow their regions, supporting them in reaching agreement with their regional media partners, … collaborating in reforming FIFA governance.
	TOPIC: Peer collaboration among stakeholders
enlist as champions, involve more actively support peer actions, hold forums (for	Facilitator: … Any other ideas regarding opinion leaders or politicians? Participant: Probably, to organize more peer actions involving those people. Like forums, or invite them to give speeches. Participant: Keep them closer, together.

"Opinion Leaders" – see dendrogram)	
consult, monitor, organize info events (for "Active Participants" – see dendrogram)	Participant: Involvement: that is the core. Involve them, make them partners, in some committees. Participant: But do you mean "involvement" as to make decisions? Bypassing the confederations, that's a bit tricky. You don't want to alienate your owners. Participant: It's probably more partnership in actions. … Participant: Organizing events where they get to know each other. Because unions and clubs aren't communicating with each other, they may communicate with FIFA, but… Participant: Yeah, and they never contact FIFA, they hear the negative things only through the press. They may want to get a little bit closer.
establish partnerships (dedicated staff), provide pro-active information about reform progress, communicate new values (for "Public Independent Organizations" – see dendrogram)	Participant: I would do something else with the independent organizations as well. Facilitator: What should I write? Participant: Be more pro-active. Participant: I would even say that they need to develop their governance together. Participant: Yeah. Facilitator: Oh, really? Participant: Yeah. Participant: I don't know. I know they are important, but I think it would be too much for FIFA to involve all these external organizations, and, moreover, to try to get consensus between all of them to make a decision in FIFA. So, then you would have multiple opinions on issues, on where you want to go, and – never a decision, so… Participant: Yeah, if you engage stakeholders, they might contradict themselves. So, let's delete "involve". Participant: But if they would come together as a group with a recommendation for FIFA, that would be different. Participant: Yes, but you don't want to really support them, so that they can speak in one voice against you? Participant: The thing is, how would the Olympic Committee agree with Transparency International? I mean, at Transparency

	International we even have concerns regarding the Olympic Committee, so?
establish partnerships (dedicated staff), pro-active information about reform progress, communicate new values (for "Public Independent Organizations" – see dendrogram)	TOPIC: Non-traditional media
	Participant: If FIFA is to be held accountable, as most of its stakeholders demand, this can hardly be achieved by traditional means. The reasons for this are two-fold: first, unlike a public company, FIFA is not answerable to stakeholders. So, do we have to consider this point? They are not answerable, so is this mandatory? Facilitator: Legally, they are not answerable. But, based on the pressure they are getting – they are. Participant: They can't do everything for everyone. They have to segment their actions.
online forum (for "Fans" – see dendrogram)	Facilitator: Moving right along to the fans… What's the right way to deal with them? What's FIFA's role in managing this stakeholder group? What would you recommend? Participant: An online forum – for sure. It would be really appreciated by the fans if they would count on their opinion. Participant: Yeah, and FIFA can be more active in participating in a dialogue. Facilitator: A very good suggestion. Does everybody agree? Participant: Yeah.

The annotated dendrogram shows that the focus group agreed on the following labels for the clusters of the dendrogram – "confederations," "opinion leaders," "active participants," "FIFA's responses to public pressure", etc. We compared these with the labels provided in the individual card sorts and found that the focus-group labels were more detailed and exhaustive. In 25 percent of the cases, the individual participants had labeled their groups of cards either "internal stakeholder", "external stakeholder", or a variation containing the word "internal" or "external" (see "group summary" folder in the cluster analysis files; see also "max group agreement solution" in the cluster analysis files, where the "internal stakeholders" group label received the highest agreement).

Once the clusters were labeled, the focus group participants were asked to suggest strategic measures that FIFA should undertake to manage each labeled cluster (i.e., group of stakeholders). These suggested strategic measures were also added to the dendrogram. We obtained two products from our focus groups: 1) six annotated versions of the (same)

dendrogram (archived as jpg. files) and 2) six audio recordings of the focus group conversations.

3.6. Phase 6: Data Analysis (qualitative)

We transcribed and thematically coded the audio recordings from the focus groups (following the procedure described in Gläser and Laudel, 2010 and Krueger and Casey, 2014). We performed three coding cycles – we used peer debriefings to discuss codes and assess if the conclusions that were reached were plausible. We re-formulated our codes during the process. The following themes emerged as main topics: "seeking agreement (collaboration) with media partners", "peer collaboration among stakeholders", "non-traditional media", and "involvement" (see Table 9 and Meta-inference 2 below). The transcripts of the audio recordings also showed that the participants often changed their minds about what is worth labeling and how the stakeholders should be grouped and labeled accordingly. For example, a fifty-sixty percent agreement threshold was agreed upon in the beginning of most focus group conversations, but modified later on (see Meta-inference 1 below).

3.7. Phase 7: Critical Interpretation

We compared the dendrogram displaying the results of the cluster analysis (quantitative) with the transcripts of the focus group conversations as well as the textual annotations on the dendrogram (qualitative). We depicted this comparison on a joint visual display, an excerpt of which is presented in Table 9. At the top of Table 9 is an example of a dendrogram with the annotations added during a focus group conversation. The right-hand column in Table 9 contains verbatim quotations from the transcript of this focus group conversation. These quotations reveal the reasoning behind the strategic measures suggested for each stakeholder group. For example, according to the thinking behind the measures suggested for "public independent organizations," traditional means of communication do not work because FIFA is not formally accountable to this stakeholder group. Non-traditional channels should therefore be used in conveying new values, pro-actively providing information about progress made by FIFA in reform, and establishing partnerships. Accordingly, the following strategic measures were suggested: "establishing partnerships (dedicated staff), providing pro-active information about reform, and communicating new values."

Comparing the coded transcripts with the annotations on the dendrogram, as well as with the dendrogram itself (which was an aggregate visual representation of the quantitative results), allowed us to derive the following meta-inferences, which provided answers to our research question, i.e., "how do managers make sense of stakeholder groups?".

Meta-inference 1: In making sense of stakeholder groups, managers dynamically redefine the boundaries of those groups.

As can be seen from the annotated dendrogram (Table 9), the orange lines (added during the focus group conversation) set labeling thresholds that do not follow the dendrogram's clusters blindly. One example is UEFA, which is included under the general "confederations" label, although UEFA is displayed in a separate cluster on the dendrogram (a cluster with 57 percent agreement). This was explained by our focus group participants by the necessity to treat all confederations equally, although some, like UEFA, exhibited unique courses of action, including engagement in public campaigns against FIFA's president. This challenged the quantitative results.

It is also apparent from the dendrogram that the orange lines do not always follow the fifty-sixty percent agreement threshold that were tentatively agreed upon in the beginning of the focus group conversation (see Table 9). For example, politicians were included under a separate "opinion leaders" label, although the level of agreement corresponding to this dendrogram cluster was only twenty to thirty percent. This was explained as follows – politicians are a special group that has to be approached separately, as a group of potential opinion "champions" (see annotated dendrogram in Table 9). "Fans" were also labeled as a separate group. This also challenged the quantitative results – i.e., approximately 50 percent of all individual card sorts (as depicted by the respective cluster in the dendrogram) agreed that fans should be placed in the same group as the unions, associations, clubs, and leagues. Our focus group participants disagreed, arguing that "*the fans are, in fact, a unique group, which deserves unique treatment,*" and should be strategically approached through an online forum created especially for them.

Meta-inference 2: Managers make sense of stakeholder groups by primarily trying to figure out which level of involvement is appropriate for each stakeholder group.

Involvement was recommended as an essential strategic measure ("*Involvement: that is the core. Involve them, make them partners ...*" and "*Involvement, that is the most important*"). Involvement was intended in a broad sense – from consultation to taking part in FIFA's decision-making. Although involvement was recommended for most stakeholder groups (e.g., so that "*...they cannot say that a decision was wrong, because they were part of it*"), our participants were notably careful about which stakeholder groups should actually be involved. For example, they did *not* recommend active involvement of fans. Had the quantitative results (i.e., the dendrogram) been merely replicated, the fans would probably have received the same label and consequently the same recommendation for active involvement as the "active participants." As indicated by a high-voltage sign in the annotated dendrogram in Table 9, participants perceived conflict between the "opinion leaders" and the "media and sponsors". Hence active pursuit of consensus between the latter two

stakeholder groups would need to be encouraged by organizing peer events. The media representatives could be involved only on the condition that they had settled their conflict with the politicians beforehand. This revelation would not have been possible based solely on the quantitative results, i.e., the qualitative input extended the quantitative results.

In a third case, in which involvement was *not* recommended for the stakeholder group labeled "FIFA's responses to public pressure," the qualitative input explained the quantitative results. Had we relied solely on the quantitative results, it would have remained unclear why FIFA's internal committees had been clustered in one group together with the medical assessment center. The "internal committees" label, which had been produced quantitatively, would not have helped in clarifying the grouping for these two stakeholders. The label produced during the focus group conversation, namely "FIFA's responses to public pressure," was more effective in explaining the recommendation for controlling these two stakeholders groups. The following explanation was provided by our participants: stakeholders like FIFA's internal committees, which had been created solely in response to public pressure, should be controlled because of their damaged reputation and their historically-evidenced inability to act credibly.

4. Discussion

Our method produced meta-inferences challenging and extending the quantitative results. The dendrogram annotations challenged the quantitative clustering. As the focus group conversations unfolded, participants shifted the threshold lines for some stakeholder groups and contradicted the dendrogram by dynamically redefining the boundaries of those groups. Neither was labeling in complete agreement with the dendrogram. Compared with the quantitative labels, the cluster labels that were added to the dendrogram during the focus group conversations were more detailed and exhaustive.

Exploring disagreement with the quantitative results, therefore, led to expanded understanding. According to Fetters et al. (2013, p. 2143), "expansion occurs when the findings from the two sources of data diverge and expand insights of the phenomenon of interest... For example, quantitative data may speak to the strength of associations while qualitative data may speak to the nature of those associations." In our study, the cluster analysis results spoke to the strength of association with the clusters of the dendrogram. Conversely, the qualitative focus-group interpretations spoke to the nature of those associations. The final product of the focus groups – the interpretative annotations added to the Table 9 dendrogram (as labels or "strategic measure" proposals) – were an integrative reflection of quantitative explicitness merged with nuances of qualitative thoughtfulness.

4.1. Contribution to the Field of Mixed Methods

A widely discussed challenge to mixed methods is the need to make the process of data integration legitimate in the sense of being meaningful and seamless (Bustamante, 2019;

Guetterman et al., 2015; Ivankova, 2013; Leech et al., 2010; Wall et al., 2013). The unique contribution of this article to the field of mixed methods research is an approach that facilitates *participant-driven*, *visually supported*, and *real-time* data integration.

First, the method employs the potential of data visualization to facilitate *participant-driven data integration*. Using interactive and annotatable visual representations, researchers and participants work together to integrate quantitative and qualitative data. Spontaneous interpretations of results by the participants – in the form of qualitative responses – are inserted as annotations in the quantitative data visualizations. Hence integration of quantitative and qualitative data becomes seamless and authentic. The focus is placed "on involving the voices of the targeted population in the research" (Fetters et al., 2013, p. 2139).

Second, the method facilitates *visually supported* data integration. The interactive data visualizations are diagrams, i.e., computer-generated drawings that display information about the geometric and topological relations among the components of the research problem and express it explicitly. For example, the geometric and topological relations among the clusters in our study explicitly represented the aggregate results from the card sorting task. By so doing, these diagrams serve as a guide (Gibson, 1978; Silver, 2008; Suthers & Hundhausen, 2003) during the follow-up group conversations (in our study, the percentages of agreement that popped up when the mouse rolled over a cluster within the dendrogram guided sensemaking).

Third, the method facilitates *real-time* data integration. "Rapid research feedback" (Wenger-Trayner et al., 2017, p. 13) is obtained from research participants by conducting focus groups shortly after the initial quantitative phase. Our research participants join the focus group conversations with fresh memories of the quantitative phase. By so doing, they are able to provide credible and meaningful interpretations of the visualized quantitative results. "Time-to-audience" (Dyllick & Tomczak, 2009, p. 7) of the quantitative research results is reduced from months (or years) to twenty minutes.

4.2. Scope of Application

The method has a broad scope of application. It is useful whenever initial quantitative results need to be explained or enriched by using a qualitative follow-up component (e.g., in an explanatory sequential mixed methods design). The latter can be applied provided that the initial quantitative results can be aggregated in a visual representation (like a bar chart, a dendrogram, or another computer-supported visual representation). Examples include results of surveys, experiments, and card sorting, with the latter having been illustrated in our study.

The application of this method is especially suitable for situations in which participant-driven, visually supported, and real-time data integration is needed. For example, *participant-driven* integration is needed in the field of management, where the voices of the targeted population have to be heard to understand the context. The voices of the targeted population may help researchers understand constituencies affected by wicked problems (see

Mertens, 2015). When practitioners become involved in interpretation of research results, they are better able to base their subsequent practice on those results – so that mixed methods research can help in "building a better world" (Molina-Azorin & Fetters, 2019).

Visually supported integration is particularly helpful within heterogeneous or multi-disciplinary groups or teams. In this case the fact that "different constituencies and stakeholders do not all value the same kind of information" (Molina-Azorin & Fetters, 2019, p. 280) becomes especially relevant. Here, the universal nature of the visual language can mitigate linguistic, disciplinary, or knowledge barriers and provide integrated mixed methods findings that are compelling for all stakeholders. *Real-time data integration* would be useful in any managerial or research situation in which time is a factor.

4.3. Limitations

To ensure a broad scope of application for our method, a few basic considerations should be taken into account in designing the quantitative visual representation (Bresciani & Eppler, 2015). Generally, a visual representation depicts information less precisely than a number or a table (Few, 2006; Kosslyn, 2006). Researchers need to apply a visual representation which is adequate for the information to be represented. Some visual representations based on predefined forms or (technology-driven) templates do not meet this standard (Few, 2006; Tufte, 2001). For example, if a visual representation is designed to place a focus on some items (Lurie & Mason, 2007), this might channel thinking in a set direction (Mengis, 2007). The large screens needed to display the visual representation (e.g., the dendrogram) in the center of each focus group room for our study are another limitation on our method. If large screens prove unfeasible, white walls for data projection or smaller (e.g., laptop or tablet) shared screens can be used instead. In any case, screens shared via the Internet will be necessary in remote settings. A further limitation of our method is connected with the risks of ineffective focus group facilitation. To allow participants to express their genuine thoughts and feelings associated with the quantitative results displayed in a visual representation, facilitators must refrain from "explaining" the representation.

4.4. Conclusion

In this paper we discussed the theoretical underpinnings and proposed application of a method in which instant data visualization facilitates real-time data integration and involves participants in data interpretation. We have proposed an application of this method within the context of mixed method research, whenever initial quantitative results need to be interpreted, explained or enriched by using a qualitative follow-up component – quantitative data can be comprehended, questioned, modified and augmented by research participants. We illustrated our arguments with an examination of an example study (in an explanatory sequential mixed methods design), hence providing a discussion of the advantages of our method.

According to Ketokivi and Mantere (2010) reasoning is "incomplete" (p. 315) if it fails to amplify our knowledge; in other words, the conclusion should be more than a restatement of the premises. The method introduced in this paper potentially amplifies quantitative knowledge; the collaborative interpretations of visualized quantitative data offer a "1 + 1 = 3" integration formula (Fetters & Freshwater, 2015, p. 116). They permit challenging and extending of the quantitative results in a manner that would not have been possible otherwise. This is a value-adding research outcome of data integration, whereby "analytic density" (Fielding, 2012, p. 127) is achieved by involving the research participants as co-interpreters.

The implications of the method include its possible application whenever (a) the voices of the targeted population have to be heard (participant-driven integration), (b) linguistic or knowledge barriers have to be mitigated (visually supported integration), (c) time is a factor (real-time integration). The method has the potential to help practitioners better understand research results, become involved in a real-time interpretation of the collected data, and base their practices on those results – so that research can have impact in the real world.

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6. Endnotes

The simplecardsort.com online shut its online services down on October 1st, 2019. Other online card sorting tools include OptimalSort, Proven by Users Online Card Sorting, UserZoom, uzCardSort, xSort, UsabiliTest Card-Sorting (for a list see http://www.measuringuserexperience.com/CardSorting/index.htm).

C PAPER 2: BUILDING ON DISAGREEMENT VISUALLY: THE SYSTEM AND THE METHOD

Building on Disagreement Visually: The System and the Method

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Abstract
In this paper we introduce an information system and a research method that use disagreement in order to provide value adding insights relevant for research and work practice. The system includes an innovative electronic survey platform which reports and visualizes disagreement in survey results. Based on an index of disagreement algorithm, survey results are automatically aggregated into visualizations. Survey questions are displayed in descending order, with the questions that have received the most discrepant answers being placed on top. The researcher shows the visualizations to the survey participants in follow-up group conversations (dissent conversations) and uses the visualizations as focal points to guide the conversations. The visual display of disagreement spurs an exchange of interpretations and insights. Based on a study with 57 managers, we show that applying our system and method enables researchers and research participants to jointly produce interpretations that enrich survey results and revise correlational models. The system and the method introduced in this paper contribute toward improving collaborative thinking in groups by unpacking the reasons for disagreement, revealing unpopular truths and individual motivations and perceptions, and leveraging on cognitive diversity in knowledge creation.

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1. Introduction

"To say, I disagree; I refuse; you're wrong; etiam si omnes – ego non – these are the words that define our individuality, give us our freedom, enjoin our tolerance, enlarge our perspectives, seize our attention, energize our progress" (Stephens 2017).

Consensus is rare and disagreement is frequent. Our ability to utilize disagreement as an asset, rather than avoid it as a potential source of conflict, may be vital to the continuation of human progress. The discomfort of unsettled disagreement might encourage discussion avoidance (Huckfeldt et al. 2004), the emergence of a spiral of silence (Leigh et al. 2013; Noelle-Neumann 1974) and groupthink (Janis 1971) in groups and organisations. Research has demonstrated that disagreement (or "dissent") enables creative problem solving (Edmondson & Munchus 2007; Mitchell et al. 2009) even when the dissenter is incorrect (Garner 2015; Schulz-Hardt et al. 2006). Dissent can facilitate decision quality (Landier et al. 2009) and nurture decreased turnover (Spencer 1986) and decreased burnout (Avtgis et al. 2007) in organisations.

2. Literature Review

"To disagree well you must first understand well. You have to read deeply, listen carefully, watch closely" (Stephens 2017).

The system and the method we propose enable to watch closely and see disagreement in a way that enables comprehension. Our system is the first to visualize dissent in survey results based on a rigorous algorithm. Other available web-based survey platforms like Survey Monkey, Survey Planet, etcetera, do not offer this feature. Disagreement is an under-represented topic in IS research. A rare attempt to tackle issues of disagreement (conflict, to be precise) is Poole et al.'s (1991) study. This study examined how a GDSS influenced conflict management in small groups. Some web based systems are designed to provide consensus support for decision making (e.g., Alonso et al. 2010). One promising field for building on disagreement is computer-aided argument mapping. The effects of computer-aided argument mapping, however, have only been studied in the field of education (e.g., Carrington et al. 2011) and are under-researched in the context of IS and management. The field of interactive information visualization is increasingly turning attention towards social visualization, with rare occasions of touching on issues of consensus (e.g., Kim, Reinecke, & Hullman, 2017). Numerous computer systems have been developed to support problem solving, decision making, strategizing, collaborative sense making, and prediction in groups. Many of these systems have the (often unfulfilled or unexplored) potential to indirectly tackle issues of disagreement. The ability of these systems to facilitate change (towards using constructive disagreement as an asset) will be impossible in isolation from the endeavours of people (Alvesson & Spicer, 2012). Disagreement in human communication is a social

process and should be explored more deeply as part of the sociotechnical approach in IS research (Baxter & Sommerville, 2011; Mohr & Van Amelsvoort, 2016).

From a methodological point of view, literature shows a turn toward qualitative (as distinct from quantitative) research (Myers 1997; Kaplan & Maxwell 2005; Myers 2013) or mixed methods research (Venkatesh et al. 2013; Molina-Azorin 2011) in IS and management studies. According to Prasad and Prasad (2002), this turn toward qualitative and mixed methods research denotes an intense dissatisfaction with the use of increasingly complex statistical techniques which have often proven to be somewhat decontextualized, reductionist, aphilosophical, and nonreflexive. The predominance of survey research has also spurred dissatisfaction with the weaknesses of this type of research. One weakness is that survey research is incapable of revealing the full narrative regarding an issue. Other weaknesses of survey research include the "limitations of asking" or the "now that you mention it effect" (see, e.g., Weisberg 2008; Visser et al. 2005).

The need to make survey results more "realistic" has been consistently noticed by mixed methods scholars. For example Schoonenboom (2017) proposed the "realist survey" – a methodology for using respondents' voices to test and revise correlational models (i.e., the models that served as a basis for formulating the survey questions). In a realist survey, a researcher presents his or her theory to the survey respondents for evaluation. The researcher asks to what extent the theory applies to the respondent. Over several rounds of feedback, the theory is adapted, presented again, reviewed, and further elaborated in a collaborative effort by the researcher and the respondent.

Like Schoonenboom's method, ours also is a method of democratic participation in mixed methods research (Torrance 2012), because we involve survey respondents in the process of data interpretation. What we add is the power of visualization to make disagreement surface and become meaningfully discussable. Another difference from Schoonenboom is that our method is fully digital – the time and trouble of doing mixed methods research (Freshwater 2013) is considerably reduced. Our dissent conversations yield valuable revelations quickly and efficiently, because they are digitally and visually supported.

The system and method introduced in this paper have one core component – the visually supported dissent conversation. A dissent conversation is one in which a survey respondent explains his or her dissenting survey response and another person responds to that explanation. The qualitative insights based on the dissent conversations extend or challenge the quantitative survey results. It is important to review how existing literature has mapped the potential benefits of dissent conversations. The rest of this section provides a literature review on the potential benefits of dissent conversations for teams (or work-related collaborative ensembles of people) and for research. It also reviews various ways of measuring disagreement within groups and explains our choice of the "index of disagreement" as a measurement best suited for our purposes.

2.1. The Benefits of Dissent Conversations for Work

Work-related dissent occurs where one or more employees explicitly disagree with current practices or policies (Garner 2012; Kassing 2007). The defining element of dissent is that the dissenter is challenging the status quo in a way that is counter to managerial expectations (Garner 2015). Dissent conversations are ones during which an employee expresses a contrary opinion and another person responds to that expression (Garner 2015, p.180). The contrary are conversations in which the dissenter is ignored and/or punished by a manager. Research has examined dissent conversational outcomes and has emphasized that what the dissenter says is beneficial for the team, even when the dissenter is wrong. Dissenter views help managers make effective decisions (Ibid., p.180), lead to perceptions of procedural justice (Korsgaard & Roberson 1995), and to perceptions of increased job satisfaction (Lutgen-Sandvik et al. 2011). Outcomes of past dissent conversations determine whether employees will be willing to express dissent in the future (Milliken et al. 2003), which means that dissent conversations in which the employee is rejected will likely lead others to withhold their ideas, resulting in less dissent, more myopic decision making (Garner 2015, p.181), functional stupidity (Alvesson & Spicer, 2012) and wilful blindness (Heffernan 2011) in work-related situations.

2.2. The Potential Benefits of Dissent Conversations for Research

Dissent conversations are rare in research and dissenting views are under-represented in research findings. This is especially problematic in social, including IS and management research, because findings here are derived mostly based on human perception rather than factual evidence. The interpretation of research results is largely seen as a prerogative of the researcher in both quantitative and qualitative research. Stark dissenters, or outliers, are normally deleted from quantitative data sets before the actual analysis of the data. Precious insights might be lost, because parts of the data remain unpacked (see, e.g., Burgelman et al. 2013; Gibbert et al. 2014; Lewin 1992; Välikangas 2013; White 2000). In qualitative research data interpretation is also done by the researchers, usually without involving the research participants in the data interpretation process.

Weakly-supported findings are often omitted from the presentation of research results, presumably in an effort to comply with criteria for academic rigor. Weiner-Levy & Popper-Giveon (2013) called this purposefully excluded data the missing “dark matter” (p.1) in research reports. According to Baruch et al. (2006) there is a publication bias against studies without statistically significant results – the emphasis on psychometric standards of measurement characteristic of rigorous research has led to a focus on what is readily observable and measurable and neglect of those variables that are important but not as subject of rigorous analysis. The treatment of research participants as a homogenous mass of objects to be manipulated and controlled often leads to pseudo-scientific research results, because the “objects” start acting like such – they outwit the researchers or passively submit

to researcher demands (similar to employees working to rule). This may lead to producing correlational models that have little to do with reality. In particular, correlational models that may seem realistic on a group level, are often disentangled from individual realities.

We believe that dissent conversations are potentially beneficial for research, as they can (a) question the conceptualizing of work-related phenomena as belonging to a world of "facts", (b) challenge the givenness of group reality, for example by revealing individual realities, and (c) revise correlational models by challenging or extending them (see e.g., Prasad & Prasad 2002; Denzin & Lincoln 2000).

3. Measuring Disagreement within Groups

One of the most common and easiest to calculate measures of disagreement (or consensus) is the percentage agreement measure. It estimates the percentage of group members who endorse a particular belief (Gailbreath et al. 1997; Prapavessis & Carron 1997). However, this measure works only for binary responses. Another measure often used as a measure of disagreement is the variance. High variance is seen as a high disagreement in a group. However, since the range of the variance is a function of the mean, this implies that for a mean close to the end points of the survey's Likert scale, the range of the variance is relatively small and for a mean at the centre of the Likert scale the range of the variance is larger (Akiyama et al. 2016). This means that for two or more survey questions that have yielded different means (which happens in most of the cases), the two resulting variances will not be comparable. In other words, the level of disagreement will also not be comparable (see Conway III & Schaller 1998). A slightly more refined measure of consensus that can be applied to Likert data is the within-group agreement index (rWG). This index is calculated by dividing the variance by an estimate of the amount of variance that would be expected by chance alone, and then subtracting this value from one (James et al. 1993). The problem with the rWG is that it is a function of the variance, which in turn is a function of the mean. This again means that for two or more survey questions that have yielded different means the resulting rWG indices will not be comparable.

Akiyama et al. (2016) developed a new index of disagreement (or measure of consensus) which takes into account both the mean and the variance by exploiting the conditional distribution of the variance for a given mean. We have chosen this new index as most suitable for our needs because of the following reasons. First, it allows for comparison between survey questions based on the disagreement among survey respondents, including for cases when the answers of different survey questions have yielded different means. We are building on this crucial advantage of this index – our system compares and sorts survey questions based on disagreement. Second, the index of disagreement can be applied to data collected using a five-point Likert scale (like in our study). Third, the index of disagreement is not affected by sample size, can be used for across-time and across-study comparisons and

controls for chance by exploiting a conditional probability distribution (these characteristics are not provided by other measures).

4. The Proposed System and Method

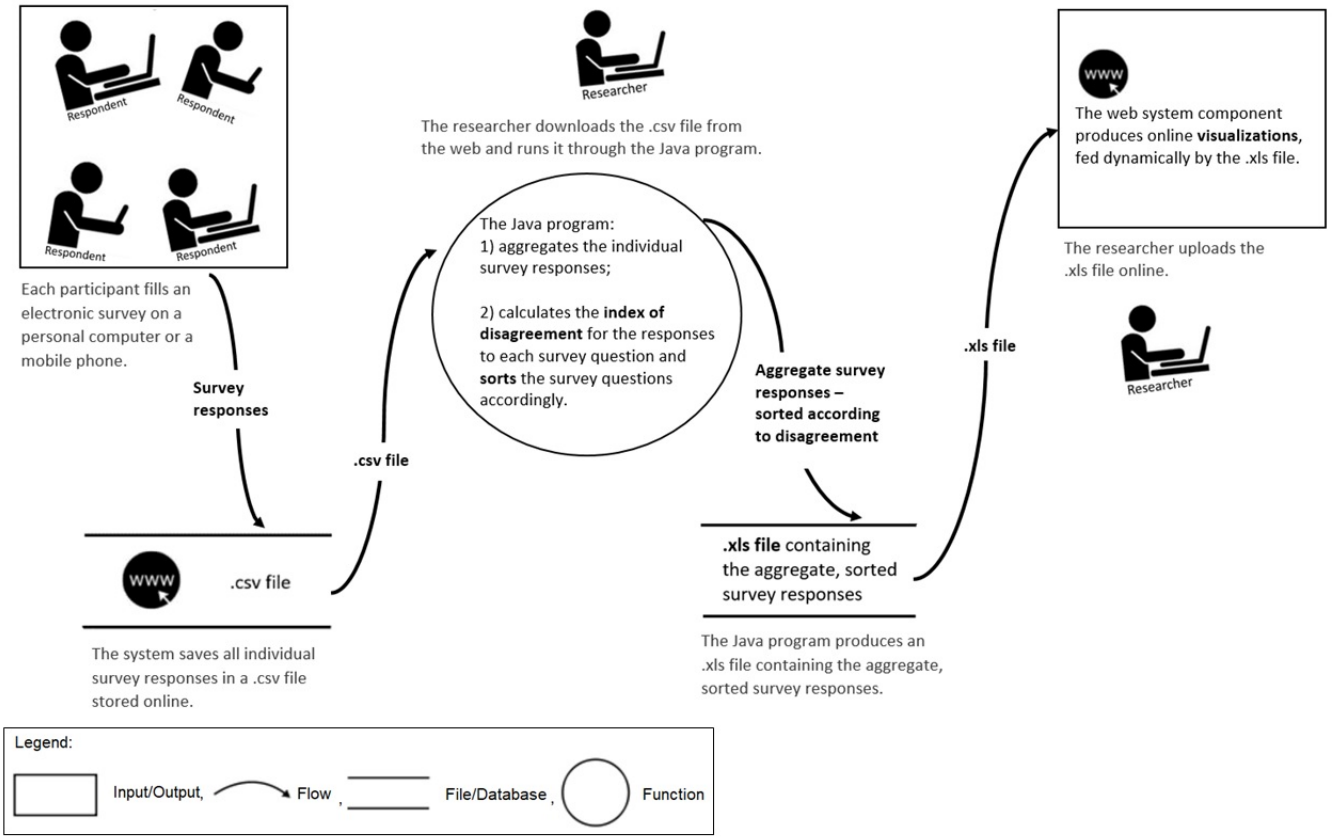
"Disagreement is neither an accident nor an anomaly. Rather, the survival of disagreement is the systematic consequence of complex social organization. But if disagreement is fostered by the dynamic logic of complex social organization, it must also be introduced and sustained by particular mechanisms" (Huckfeldt et al. 2004).

According to Huckfeldt et al. (2004) the opportunity for collective disagreement-driven deliberation must be given because individuals tend to resist information with which they disagree. In other words, constructive disagreement as a way of thinking must be introduced and sustained by particular mechanisms. The system and method we propose provide one such mechanism. We use the power of digital visualization as a means to facilitate the identification of disagreement in survey data. Respondent-generated rich feedback is subsequently produced. We hold dissent conversations within groups of our survey respondents shortly (on the same day) after the respondents have filled in the survey. During these conversations, we show visualizations of the aggregated results which display the level of disagreement in survey answers. We facilitate the conversations by systematically inviting feedback on the reasons for disagreement and on individual motivations and perceptions.

4.1. Overview of the System

Figure 5 describes the system using a data flow diagram symbolic notation (explained in the legend). As a first step, each participant fills an electronic survey on a personal computer or a mobile device like a smart phone. The system saves all individual survey responses in a .csv file stored online. As soon as all respondents have submitted their survey responses, the researcher downloads the .csv file from the web. As a next step, the researcher runs the .csv file through the Java program. The Java program has been written by the first author in Java 8.0. The Java program performs two basic functions. First, it aggregates the individual survey responses by summing the response counts question-wise, thus enabling the data to be visualized in charts at a later stage. Second, the Java program calculates the index of disagreement for the responses to each survey question and sorts the survey questions accordingly. Finally, the Java program produces an .xls file containing the aggregate, sorted survey responses. As a next stage, the researcher uploads this .xls file online. The web system component, then, produces online visualizations fed dynamically by the .xls file. These visualizations are then shown to the respondents and discussed in groups of eight to ten people.

Figure 5. Overview of the System



We performed a unit test to make sure that our calculations for the index of disagreement were correct and that the Java code exactly represented the formula of the index. The unit test was successful for multiple randomly chosen values of the mean and the variance. We also made sure (based on a series of tests) that our calculations of the index of disagreement yielded values between 0 and 1, which are compliant with Tastle & Wierman's (2005) set of rules that must be satisfied before any measure can be considered a viable measure of disagreement/consensus: for a given (even) number n of respondents, if an equal number of respondents, n/2, separate themselves into two disjoint groups, each centered on the strongly disagree and strongly agree Likert categories, the index of disagreement will be equal to 1; if all respondents assign themselves to the same (any one) category of the Likert scale, the index of disagreement will be equal to 0. If at least n/2+1 respondents assign themselves to any one category, the index of disagreement will be greater than 0; as the number of categories to which respondents assign themselves increases, the index of disagreement must increase, eventually approaching 1.

4.2. Overview of the Method

Figure 6 presents an overview of the method as part of which the system is to be applied. As a first step, each respondent fills in an electronic survey. Next, each respondent takes part (during the same day) in a group conversation (in a group of eight to ten people). These conversations are facilitated by the researchers. Importantly, the central facilitating role during these conversations is played by the visualized survey results and not by the

researchers. Our system visualizes the survey responses into online charts (visualizations). These visualizations display survey questions in a descending order, according to the disagreement in their answers. The descending order is based on the index of disagreement ranking algorithm, i.e., the survey questions with the highest index of disagreement are placed on top.

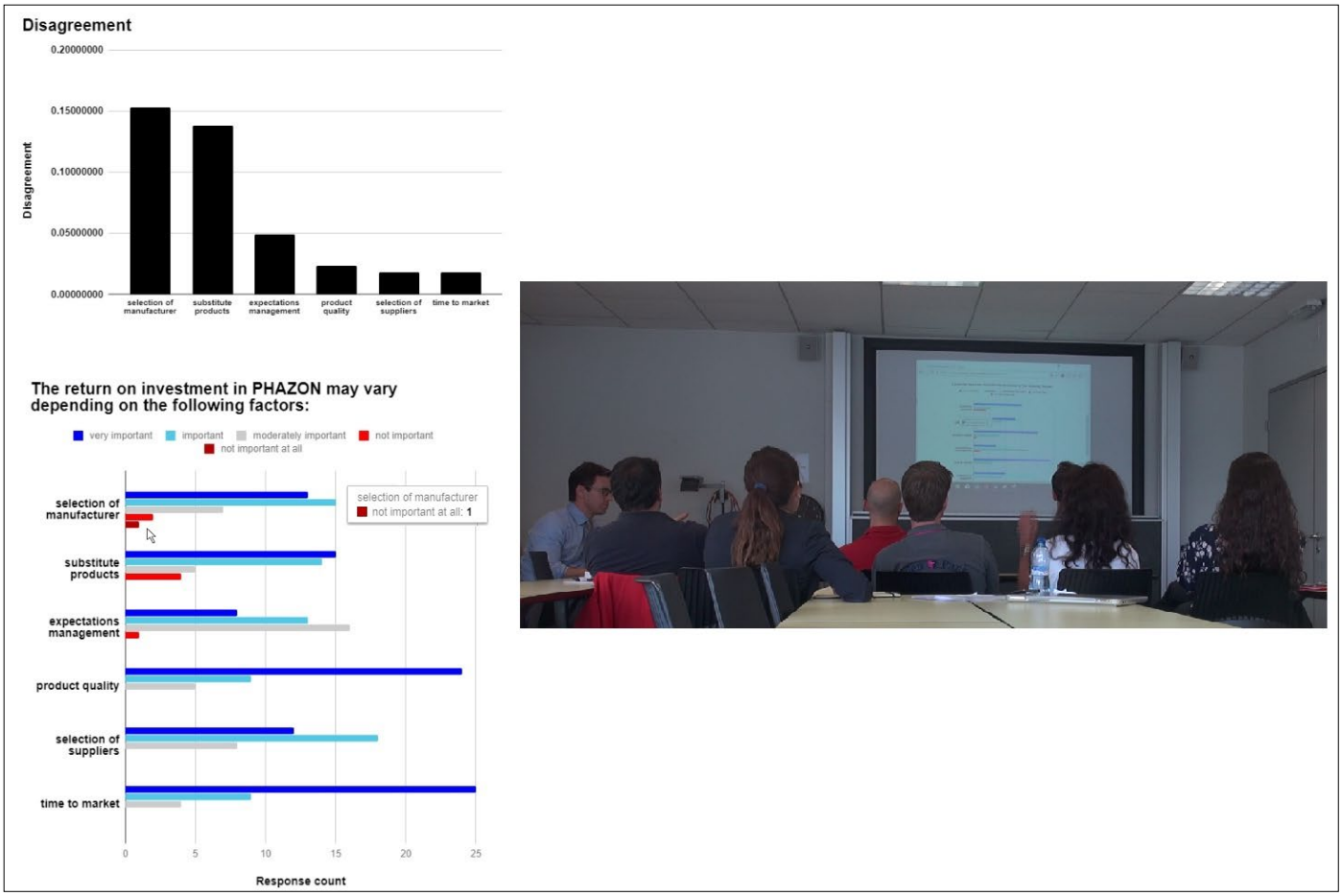
Figure 6. Overview of the Method

Phase	Procedure	Product
Data collection – electronic survey (quantitative)	Each respondent fills an electronic survey on a personal computer or a mobile device.	A .csv file containing all individual survey responses stored online
Data analysis (quantitative)	The researcher downloads the .csv file from the web and runs the .csv file through the Java program. The Java program: 1) aggregates the individual survey responses by summing the response counts question-wise; 2) calculates the **index of disagreement** for the responses to each survey question and sorts the survey questions **in a descending order** accordingly.	An .xls file containing the aggregate, sorted survey responses
Data visualization (quantitative)	The web system component produces online **visualizations**, fed dynamically by the .xls file.	Online **visualizations** displaying survey questions sorted according to the **disagreement** in their answers
Data interpretation (qualitative)	The online **visualizations** are shown to survey respondents, who are gathered in groups of eight to ten people. The researcher facilitates group **conversations** (**dissent conversations**) aimed at interpreting the disagreement shown in the visualizations. The researcher asks the respondents to explain the reasons for disagreement. The conversations are audio or video recorded.	Audio recordings of the dissent conversations
Data analysis (qualitative)	The audio recordings are fully or partially transcribed and coded.	Coded transcripts of audio recordings
Data analysis (quantitative)	The survey results are analysed with the help of a statistical tool (like SPSS).	Descriptive and inferential statistical results; re-tested correlational model
Critical interpretation	The qualitative and quantitative findings are interpreted critically. Post-hoc hypotheses are formulated and existing hypotheses are re-formulated based on qualitative findings.	**Revised or extended** correlation **model**

Figure 7 provides an example of a visualization. An online version of this figure is available on https://research-democratisation.org/dissensus1. The first bar chart (depicted in black) represents the index of disagreement of the answers given to each survey question, in descending order. The second bar chart (depicted in colour) shows the spread of answers to

each survey question, again in descending order according to the index of disagreement. The visualizations are shown to each group of respondents on a large screen projector in the room. The screen serves as a central point around which the group conversations take place. The visualizations play the role of "structuration devices" (Massey & Wallace 1996) guiding (Silver 2008; Suthers & Hundhausen 2003) each group conversation. The researcher-facilitator asks trigger questions like, "If we look at this, you gave varied answers to this question. Help us understand why. What might have prompted you to answer so diversely? What are the reasons for your high disagreement regarding this issue? Could you explain?". Such trigger questions spur collaborative interpretations and surfacing of insights which explain the reasons for disagreement and shed light on individual motivations and perceptions.

Figure 7. Example of a Visualization of Survey Results (based on Disagreement) used to Guide a Dissent Conversation



Two types of analysis – qualitative and quantitative – follow after the dissent conversations (see Figure 6). These analyses may be performed simultaneously. The correlational model, which initially served as a theoretical basis for the survey, is revised based on a critical interpretation of the qualitative and quantitative findings. The quantitative analysis of the

survey data basically (re-)tests the correlational model. Some hypothesis may get (re-)confirmed and others may not. The insights from the qualitative analysis of the group conversations, then, explain why some hypothesis get reconfirmed and others do not. The researchers are able to reformulate existing hypotheses and formulate post-hoc hypotheses or develop new variables based on this critical interpretation of quantitative results and qualitative findings.

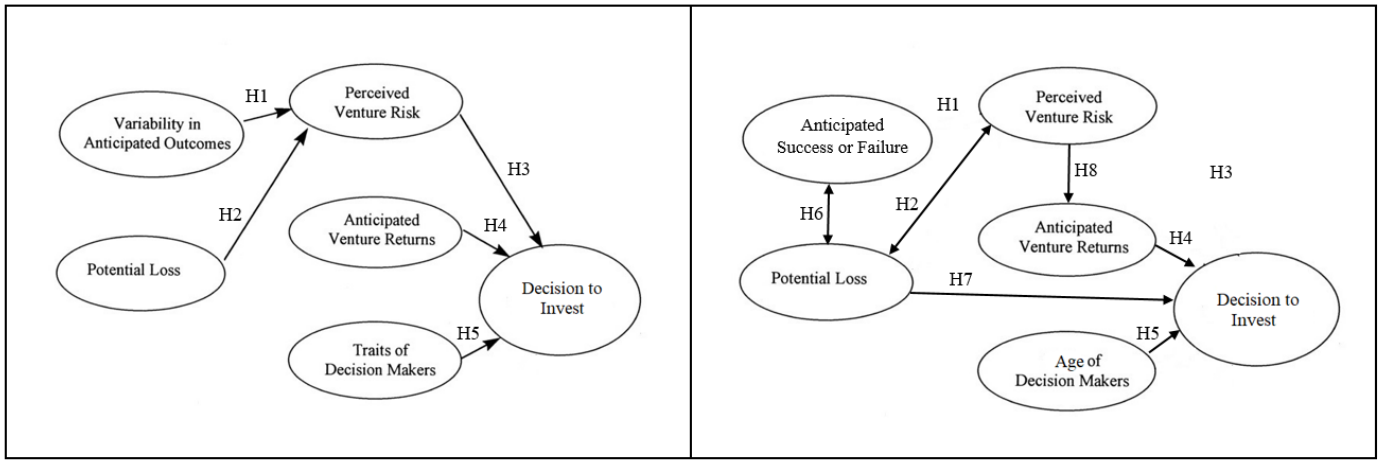
5. Applying the System and the Method: a Study

We applied our system and method in a study with a total of 57 experienced managers coming from 17 different countries enrolled in an executive MBA program in Switzerland. (All participants were informed that their participation in the study is optional and is not graded). We simulated investment decision making – our participants played the role of investors and had to make an investment decision as part of an online survey. We were interested in uncovering the motivations of the participants-investors, with particular attention to dissenting views within survey responses. The participants first watched a short introductory video and read our self-authored two-page case study (available at https://research-democratisation.org/) about Phazon – a crowdfunded start-up, which aims at developing the world's first one-size-fits-all wireless earbuds. Our participants-investors had to decide whether to invest $500,000 in order to get 10 percent of the Phazon company. The participants filled the online survey (Table 12 in the Appendix), which contained the "invest or not invest" question. Following this, we randomly assigned all participants to 7 focus groups (of 8 to 9 people). Each participant was randomly given a focus group number, written on a piece of paper, together with a room number (the latter identified the focus group room, which each participant was asked to join after a following break). All participants then left the big plenary room for a break. The random selection of focus group participants was necessary in order to obtain a non-biased interpretation of the visualization (of the aggregate quantitative results), which was to be shown later, in the focus groups. The size of the focus groups (8 to 9 people) was chosen because this is the optimal focus group size recommended by focus group researchers (see Krueger & Casey, 2014). After a break of 30 minutes, the participants discussed their visualized survey results in the focus groups. A total of 7 group conversations were held, with one of the authors facilitating each conversation. We followed the procedure described above and depicted in Figure 6. We used Forlani and Mullins's (2000) model of risk perception in investment decision making as a basis for formulating our survey questions. We revised and modified this model based on critical interpretation of our quantitative survey results and our qualitative findings from the group conversations. The original model and the revised model are presented in Figure 8.

Table 10 provides a list of the original hypotheses (as in Forlani & Mullins 2000) and the post-hoc hypotheses which were reformulated or newly formulated based on our mixed

methods analysis. We tested the hypotheses with the help of ordinal regression analyses. The quantitative analysis is available to the reviewers on request. We did not get renewed confirmation for Hypothesis 1 and Hypothesis 2 and therefore discarded these two hypotheses from the model (see Figure 8, where the lack of an arrow means a lack of correlational dependence). We reformulated Hypothesis 3 by adding a new direction in this correlational dependence, namely from "risk" to "loss". By testing Hypothesis 5, we did not get renewed confirmation that the "risk propensity" trait of the decision maker influenced his or her decision to invest. Another trait influenced the decision, and that was the age of the decision maker (as our check for the effect of demographic control variables revealed), with younger decision makers deciding to invest more often. Our quantitative analysis also revealed the existence of additional statistically significant correlational dependencies. The formulation of new hypotheses (Hypotheses 6, 7 and 8 – see Figure 8) based on these dependencies, however, only became possible at a later stage – i.e., based on our qualitative analysis of the dissent conversations. In other words, the quantitative analysis revealed the significant correlations, while the dissent conversations explained these correlations and enabled the development of post-hoc hypotheses.

Figure 8. Original Model (Forlani & Mullins 2000) and our Revised Models



Original Model

Revised Model

Legend
H: Hypothesis
The lack of an arrow means lack of correlational dependence.

Table 10. Original and Post-hoc Hypotheses

Original Hypothesis (H) as in Forlani and Mullins (2000)	**Based on our analysis the hypothesis was…**	**Post-hoc Hypothesis (H)**
H1. The greater the variability in predicted outcomes of a proposed new venture, the greater will be its perceived risk.	not confirmed and discarded	N.A.

H2. The greater the magnitude of a proposed new venture's largest potential loss, the greater will be its perceived risk.	reformulated (a new dependence direction was added)	H2. The greater the perceived magnitude of a proposed new venture's largest potential loss, the greater will be its perceived risk and vice versa.
H3. The greater the perceived risk of a proposed new venture, the less likely it will be selected for funding.	not confirmed and discarded	N.A.
H4. The greater the anticipated venture returns of a proposed new venture, the more likely it will be selected for funding.	confirmed	H4. The greater the anticipated venture returns of a proposed new venture, the more likely it will be selected for funding.
H5. The greater the risk propensity of the decision maker, the more likely he or she will be to select new ventures having higher levels of risk.	reformulated	H5. The younger the decision maker is, the more likely he or she will be to select new ventures having higher levels of risk.
N.A.	newly formulated	H6a. The greater the magnitude of a proposed new venture's success, the smaller will be its perceived potential loss. H6b. The greater the magnitude of a proposed new venture's failure, the greater will be its perceived potential loss.
N.A.	newly formulated	H7. The greater the perceived potential loss of a proposed new venture, the less likely it will be selected for funding.
N.A.	newly formulated	H8. The smaller the perceived risk of a proposed new venture, the greater will be its anticipated returns.

The visual ranking of dissent (see Figure 7) triggered the exchange of comments and opinions during the conversations. We then compared our quantitative survey results with the qualitative findings from the dissent conversations. This comparison: 1) explained why some original hypotheses were not confirmed, 2) enabled us to formulate new hypotheses (Hypotheses 6, 7, and 8), and 3) provided insight, which prompted us to modify one of the variables in the model – what was "Variability of Anticipated Outcomes" in the original model became "Anticipated Success or Failure" in our model. Table 11 provides examples of utterances from dissent conversations and their corresponding effect in the model.

Table 11. Examples of Utterances from Dissent Conversations and their Corresponding Effect in the Model

Example Utterances from Dissent Conversations	Corresponding Effect in Model	Type of Effect in Model
Participant: *If you go to the bank and apply for a loan, or if you invest in a fund, they will say – the bigger the risk the higher the return.* Participant (**dissenting view: differs from the typical perception of risk-return dependence**): *but doesn't it depend on the type of risk?* Facilitator: *aha, so you thought the other way round.*	There is no variability in anticipated outcomes on a continuum, but only two anticipated outcomes – huge success or complete failure (see H1).	modified variable in model (success or failure instead of variability)
Participant: *I was just thinking, according to the information that we have, they gave a lot of information out, and that's what makes it riskier. So it is risky in terms of the idea itself. Because of this, it can either yield a lot of returns, or not be profitable at all.*	The perceived venture risk lies in making the idea itself public and this influences the anticipated venture returns (see H8).	newly discovered and confirmed correlational dependence (H8)
Participant (**dissenting view: voted that Selection of Manufacturer was not important – see Figure 7**): *There is a bit of a bias. Nowadays China is one of the highest creators of [incomprehensible], for example, and competitors have to have a partner in China. They create faster than you do…. You are worrying about putting information online, but the way we have to see this in another way is – he was giving a try to see the product work. The product is good, it fits the market. So, it is a bit of a risk but it pays off if you are quick enough to put your product to market.* Participant (**majority view: voted that Selection of Manufacturer was important to very important**): *But – another thing about China. I think they are very fast. They can duplicate whatever. They need... just show them a picture or design of it and they can do it very fast. And I did not like the fact that this guy, he put every step of his product he put online. For me there can be only one outcome – failure...*	There is no variability in anticipated outcomes on a continuum, but only two anticipated outcomes – huge success or complete failure (see H1).	disconfirmed correlational dependence (H1); modified variable in model (success or failure instead of variability)
Participant (**majority view: decided not to invest**): *We did not believe that the market*	Potential loss influences the	newly discovered and confirmed correlational dependence (H7)

segment was big enough... I decided not to invest. The potential loss is too big… Participant: *The format can be adapted to 95 percent of the people, I don't think so…* Participant: *They got traction, which shows that people are really inspired.* Participant (**dissenting view: decided to invest**): *I don't know how many have seen Kickstarter. I'm not saying that there is a direct correlation, but if you get funded, you get funded way after. I mean – it's a very good technology. For me there is no risk, the market has been proven.* Facilitator: *So you said "yes", you would invest?* Participant: *I was one of the crazy ones that said "invest".*	decision not to invest (see H7).	
	The perceived venture risk is low/constant because of crowdfunding (see H3).	disconfirmed correlational dependence (H3)
Participant (**dissenting view**): *Like, if you have a slow start, you will still make a big loss. If you get the buzz because your orders go to the roof, then it can give you a boost and it can really help drive your ROI. But if expectations are badly managed, it may mean that it's actually resulting in loss.*	The anticipated venture returns depend on managing the expectations of the crowdfunding supporters (see H8).	newly discovered and confirmed correlational dependence (H8)
	Potential loss can be influenced by expectations management (see H2).	newly discovered direction in correlational dependence (in H2)

The lack of (re-)confirmation for Hypothesis 1 and Hypothesis 3 was surprising. It sounded counterintuitive not to find a correlational dependence between perceived risk and the decision to invest (H3) and between the variability of the anticipated outcomes and the perceived risk (H1). We found an explanation of this surprising finding in the transcripts of our dissent conversations. Interestingly, our investors anticipated two possible outcomes – either huge success or complete failure ("Because of this, it can either yield a lot of returns, or not be profitable at all", "For me there can be only one outcome – failure..."). Our investors perceived "variability in outcome" as a binary construct, with some accepting the likelihood of two outcomes, and others excluding one of the two outcomes categorically. This was probably the reason why Hypothesis 1 was not confirmed and had to be discarded (H1: The greater the variability in predicted outcomes of a proposed new venture, the greater will be its perceived risk). The qualitative phase in our analysis helped to look inside the "Variability in Anticipated Outcomes" variable and we found out that the construct validity of this variable was pretty low in the case of crowdfunding (like the case of Phazon). In order

to improve construct validity, we reformulated this variable into "Anticipated Success or Failure". The expression of dissenting views (e.g., by a dissenter who was not affected by the "worry" bias – see Baker & Ricciardi 2014 and Table 11) prompted the revelation that, in our case, there was no variability (on a continuum) in anticipated outcomes, but binary variability (either anticipated success or anticipated failure).

The expression of another dissenting view uncovered that it was questionable whether "perceived risk", thought of as a variable on a continuum, was a valid construct in the context of crowdfunding either. A woman who described herself as "one of the crazy ones that said "invest"" shared that "I don't know how many have seen Kickstarter. I'm not saying that there is a direct correlation, but if you get funded, you get funded way after… For me there is no risk, the market has been proven.". In this case, the perceived venture risk was pretty low, as it was split among the crowdfunding supporters. The Phazon company had received the support of thousands of backers who had pre-ordered Phazon's earbuds and had paid over 2 million dollars in advance (before the final product had even been developed) on an online crowdfunding platform. This made some of our investors think that the market was proven and there was little to no risk. Probably for such reasons, Hypothesis 3 did not get confirmed in a crowdfunding context, i.e., the perceived risk could not possibly become greater (or smaller) on a continuum in a crowdfunding context, as it was perceived as low and relatively constant (H3: The greater the perceived risk of a proposed new venture, the less likely it will be selected for funding).

Paradoxically, even though the market for Phazon's product was perceived as proven and the risk was perceived as little to none, the majority of our participants decided not to invest in Phazon. The reasons for that were revealed in the dissent conversations and, again, had to do with the crowdfunding context. The participants were concerned about patent right issues and issues of intellectual property protection online. Concerns were also voiced about whether Phazon would be able to manage the expectations of its crowdfunding supporters – e.g., "If expectations are badly managed, it may mean that it's actually resulting in the loss". Such concerns were voiced in relation to perceived return on investment and potential loss and allowed us to formulate the post-hoc Hypotheses 6, 7, and 8 (Table 10).

6. Discussion

The empirical findings from our study showed that an established model of risk perception in investment decision making can be considerably modified in the context of crowdfunding. Similar thoughts have been formulated as "open questions" of crowdfunding in Agrawal et al. (2014) and in Hsu et al. (2016). More importantly, our system and method worked well in order to provide these empirical findings. We involved our research participants in the data interpretation process by feeding their visualized survey results back to them. The digital visualizations of the survey results were based on the index of disagreement algorithm

and provided a glance into the level of disagreement on each survey question. The index of disagreement visualization enabled displaying the spread of opinions, which in its turn provided an affordance (Gibson 1978) to express dissenting opinions. The meaningful use and reflection-upon-use (Bednar & Welch, 2009) of our system and method afforded meaningful action (Cabitza & Simone, 2012) – the research participants engaged in data interpretation during the dissent conversations and we, as researchers, reflected upon this joint data interpretation. Each dissent conversation revealed contrasts between dissenting and majority viewpoints and became a rich sense making experience. We gave voice to dissenting opinions by looking into the minds of those who are normally ignored. The dissent conversations provided explanations for our unexpected research results. They also enabled us to look inside variables, so as to be able to revise a correlational model.

The importance of our work is threefold. First, our system and method provided a mechanism to display the spread of opinions, which in its turn provided an affordance (Cabitza & Simone, 2012; Gibson 1978) to articulate dissenting opinions. Second, our system and method provided a mechanism to sustain disagreement as a way of collective thinking and constructive interpretation. And third, our visually supported dissent conversations revealed multiple realities of the individuals who had to make a decision. This enabled us to unpack variables and modify a correlational model, thus improving the model's correspondence with our empirical observations. We ultimately improved the usefulness of the model in a given context.

Our system and method can be applied by managers who are willing to build on constructive disagreement in their work practice. Our system can show them where the highest disagreement is, so that they can start their meetings with these issues. Our method can help managers introduce and sustain constructive disagreement as a way of thinking in their teams. Constructive dissent conversations during meetings can help avoid apathy, silence, and dysfunction.

Our system and method are, of course, not without limitations. One limitation comes from the risk of visualizing disagreement on delicate issues. This limitation is mitigated by the fact that we are visualizing aggregate (group) survey results, while the individual survey results remain anonymous. This limitation is also mitigated by the power of visualizations to bring tough issues to the surface in a subtle way, since visualisations are typically perceived as interactively neutral, as pure information (see Meyer et al. 2013). Another limitation of our method is its reliance on human facilitators. This limitation is mitigated by the fact that the true (and more important) facilitators in our group conversations are the visualizations themselves – they are the centre of the discussion and act as an additional person in the room (the facilitator is constantly referring to what the visualizations are "saying" and how to interpret this). In our future work we are planning to further enrich the functionalities of the Java program to consider various decision-making scenarios and

develop a graphical user interface for the Java program. We shall also add various visualizations of disagreement (e.g., scatter plots) to our web interface in order to provide a set of visual alternatives for researchers and facilitators to choose from. We are also planning to replicate further test studies in other survey and decision making contexts to see if the system and the method work just as well in other situations and to further test the potentialities and limits of the system.

7. Conclusion

In this paper we introduced a system which visualizes dissent in survey results. We accompanied the system with a method, within which it is to be applied. The method is aimed at enriching survey research with qualitative insights derived by involving survey respondents in the interpretation of survey results. By means of a test study, we have shown that the system and the method are impactful by leveraging the qualities of the visual language to support respondents' understanding and involvement. Central for us was the socio-technical idea that visually supported dissent conversations can enable value adding research insights. The dissent conversations in our study enabled such value adding insights. The power of digital visualization made disagreement surface and become meaningfully discussable. We used disagreement as an elicitation mechanism. We thus revealed the reasons for disagreement by giving voice to individual motivations and perceptions. The meaningful use and reflection-upon-use of our system enabled us to unpack the variables in a correlational model and improve the model's usefulness and correspondence with our empirical observations. The ability to improve the usefulness of correlational models is important, since correlational models are the basis of collective problem solving, decision making, strategizing, and prediction in groups. Correlational models are also the basis of research. The system and the method introduced in this paper are a step toward enhancing our human ability to utilize disagreement as an asset, rather than avoid it as a potential source of conflict – an ability which may be vital to the continuation of human progress.

8. Appendix

Table 12. Survey

Please answer to the following statements clicking on the response that best matches your feelings toward the statement. There are no right or wrong answers. Your answers will be kept confidential.

Q. 1. An investment in PHAZON would be risky.

strongly agree		neutral		strongly disagree
5□	4□	3□	2□	1□

Q. 2. An investment in PHAZON may yield a return that falls within a wide bandwidth.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 3. PHAZON may yield a negative return on investment.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 4. I would invest in PHAZON.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 5. The return on investment in PHAZON may vary depending on the following factors:

product quality

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

time to market

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

selection of manufacturer

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

selection of suppliers

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

substitute products

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

expectations management

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

Q. 6. How often do you practice active sports?

very often sometimes never

5□ 4□ 3□ 2□ 1□

Q. 7. I take risks regularly.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 8. A potential loss from PHAZON may be caused by the following factors:

product quality

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

time to market

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

selection of manufacturer

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

selection of suppliers

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

substitute products

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

expectations management

very important important moderately important not important not important at all

5□ 4□ 3□ 2□ 1□

Q. 9. I prefer to avoid risks.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 10. An investment in PHAZON would yield high return.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 11. I really dislike not knowing what is going to happen.

strongly agree neutral strongly disagree

5□ 4□ 3□ 2□ 1□

Q. 12. Please tell us your first name.

_____

Q. 13. Do you have any comments?

_____

_____

_____

___

9. Acknowledgement

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D PAPER 3: INTERACTION PATTERNS: A VISUAL APPROACH TO MIXED METHODS RESEARCH

Interaction Patterns: A Visual Approach to Mixed Methods Research

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Abstract
In this paper we describe an inventory of visual interaction patterns – repeatable combinations of visualizations and accompanying questions aimed at extending quantitative studies with qualitative data. More precisely, a visual interaction pattern is a systematic approach by which quantitative research results are visualized, shown to the research participants and interpreted together with the research participants. After a quantitative research phase (like a survey, experiment or card sorting), we produce visualizations (bar charts, matrices, etc.) which display the quantitative results. We then show these visualizations to our research participants in follow-up group conversations and ask questions in order to spur an exchange of interpretations and insights. We involve our research participants in the data interpretation process. We use the visualizations as centers around which we facilitate the group conversations by referring to what the visualizations are "saying" and asking what this means in the eyes of our research participants. The visual interaction patterns are elicitation mechanisms which enable researchers and research participants to jointly produce value-adding research insights. For example, the disagreement pattern provides value-adding insights by visualizing the spread of opinions and using constructive conflict as a way of collective thinking. The outlier pattern visualizes extreme dissenting views and gives voice to them. The benefits of applying the patterns include improving the correspondence of correlational models with empirical data, providing explanations for unexpected findings and alternative explanations for expected findings, enabling the formulation of post-hoc hypotheses based on the newly-discovered correlational dependencies, and providing feedback on the research procedure. The involvement of research participants in the data interpretation process enables a critical appraisal and enrichment of quantitative results. Insights extending (or challenging) the quantitative results are gathered, which leads to confirmed, revised or extended correlational models and revised or extended research procedures. These value-adding research outcomes are important for management research because they contribute to theory development, they create ideas on how to solve work-related problems, identify industry-specific dependent and independent variables, or foresee future management trends and developments.

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1. Introduction

We introduce visual interaction patterns – a series of light-weight, easy to use mixed methods instruments, which employ the power of digital visualization in order to, inter alia, reduce the "time and trouble of doing mixed methods research" (Freshwater 2013, p.299). The patterns involve tightly and reliably connected steps and thus contribute toward making the process of quantitative-qualitative data integration "seamless" (Leech et al. 2010, p.20). The patterns are repeatable combinations of visualizations and accompanying questions aimed at extending quantitative studies with qualitative data. More precisely, a visual interaction pattern is a systematic approach by which quantitative research results are visualized, shown to the research participants and interpreted together with the research participants in group conversations (these conversations follow the initial quantitative phase). Each pattern is easily repeatable and replicable. According to Dyllick and Tomczak (2009) qualitative studies often suffer from overreliance on descriptiveness, enthusiastic surrender to "expert" opinions, and accumulation of a ballast of anecdotal data. Our patterns have the potential to alleviate these disadvantages of qualitative studies by providing a systematic approach of eliciting qualitative insights which extend quantitative results. As part of the patterns, certain types of visualizations are used to depict certain types of data, certain questions are discussed during the follow-up conversation. The patterns are structured enough to avoid ballast accumulation. The follow-up group conversations unfold guided by the pattern-specific questions and the visualizations are (ideally) projected on a large screen in each focus group room. The patterns are, thus, structured but also flexible enough to allow for the elicitation of qualitative nuances – the participants answer the pattern-specific questions, while being free to add further and unprompted considerations during the follow-up conversations.

We hold the follow-up conversations with our research participants (shortly) after they have taken part in a survey (or experiment, or card sorting, or another type of quantitative research). During the follow-up conversations, we show visualizations that represent the quantitative results and we systematically invite feedback on these visualizations. We use the visualizations as triggers and annotation devices for deriving rich feedback from the research participants by facilitating the expression of their opinions. Our follow-up conversations yield value-adding revelations. By using the interaction patterns we involve our research participants in the data interpretation process. This is in line with the growing

realization in management research that knowledge needs to be co-produced together with the research participants.

The purpose of this compilation of visual interaction patterns is to give researchers who have employed quantitative research methods an array of visual facilitation options of how to involve research participants or stakeholders in the data interpretation process. This prolonged involvement of the research participants allows to reveal the rationale behind quantitative results and trigger insights extending (or challenging) the quantitative results. The latter helps to, inter alia, confirm, revise or extend correlation models, get feedback on the quality of the research procedure, map future research needs or outline research-inspired action agendas. The visual interaction patterns are applicable to extend quantitative studies like, e.g., surveys, experiments, card sorting.

This paper is structured as follows. We start by a brief review on the most relevant literature. We then describe the visual interaction patterns – we provide a step-by-step procedure for applying the patterns, with examples. We discuss the theoretical background of the patterns and their value for researchers, managers, and facilitators. We offer reflections on the implications of the patterns, and conclude with a call to action for the management research community.

2. Literature Review

Methodological "patterns" are rare in business and management research. One example are De Vreede and Briggs's (2005) thinkLets – repeatable, predictable facilitation patterns. The thinkLets are aimed at eliciting certain patterns of thinking among people who are making an effort toward a goal while using a group support system (GSS). De Vreede and Briggs (2005) formulated seven basic patterns of thinking (diverge, converge, organize, elaborate, abstract, evaluate, and build consensus) and demonstrated that by focusing data collection efforts on thinkLets, rather than on the use of GSS itself, field and laboratory studies may become more replicable and better able to inform GSS development and use. Comi, Franco, and Eppler (2017) introduced five visual interaction patterns for facilitators to sustain collective sensemaking in management teams. These have the potential to improve the quality of data collected in an action research mode (i.e., by the researcher acting as facilitator), but are not geared to extend quantitative results from surveys, card sorting, or experiments alike. In this paper, we introduce visual interaction patterns, which mixed methods researchers can use to extend or challenge the results of quantitative research.

Molina-Azorín and Cameron (2015) called for more mixed methods studies in business research, so as to provide more meaningful research results. Molina-Azorín (2011) found that mixed methods studies add value to management research with regard to their generic and specific contributions. For example, they may permit to develop or extend theory, identify industry-specific dependent and independent variables, determine the adequate level

of analysis, or give more attention to process research. A mixed methods study that addresses one or some of these aspects may be considered pioneering work. However, mixed methods studies require more time, effort, and resources than studies that use only a single method, which poses an important barrier to carrying out mixed methods research (Bryman 2007). In this paper we address the call for more mixed methods in management research and we also address the challenge of reducing the time and effort required by mixed methods. The following two subsections are devoted to elaborating on our patterns as visual and mixed methods research tools.

2.1. The Interaction Patterns as Visual Research Tools

By reviewing the literature on visual research methods (Bell et al. 2014; Meyer et al. 2013), it is possible to identify two basic approaches – practice approach and methodological. The practice approach argues that the use of visual models, maps, and representations supports organizational learning and knowledge building (see, e.g., Ewenstein & Whyte 2009; Nicolini et al. 2012). The methodological approach argues that visual artefacts (e.g., drawings) can be used as stimuli in the research encounter (e.g., interview) to elicit deeper responses from participants (see, e.g., Wheeldon 2011; Warren 2008). Our visual interaction patterns involve aspects of the methodological and practice approaches. The patterns are methodological because they envision the use of visualizations as stimuli in the research encounter (the group conversations) to elicit deeper responses from the research participants. The patterns are also practical because they support organizational learning and knowledge building "in situ". They function as devices that structure group conversations. The visually-mediated interaction unfolds effortlessly. This affords (Gibson 1978) and triggers a process of meaning negotiation (Paroutis et al. 2015) among participants. Such a process of meaning negotiation enables the production of qualitative data that is grounded in the interpretations of research participants, and that extends (or challenges) the results of quantitative research.

2.2. The Interaction Patterns as Mixed Methods Research Tools

In a purely quantitative research endeavor, the visualization of the results (if any) would be the "end" of the research process – the quantitative chart (or diagram) would be deemed unquestionable and nearly unmistakable. The interpretation of quantitative results would be seen as a prerogative of the researcher, predominantly without the involvement of the research participants. Our visual interaction patterns enable the involvement of research participants in the data interpretation process. They enable researcher-participant dialogue, motivated by the intent to exploit differences in the knowledge bases of researchers and researched to produce more insightful answers to problems of organization and management. A widely discussed mixed methods challenge is the need to make the process of quantitative-qualitative data integration "seamless" – i.e., involving tightly and reliably connected steps (Leech et al. 2010, p.20). In response to this challenge, our visual interaction patterns offer

a seamless mixed-methods integration mechanism – by means of visually discussing and reviewing the quantitative output. Thus, the process of quantitative-qualitative data integration becomes more intuitive and easily operable. As a byproduct, the application of the patterns has the potential to reduce the "time and trouble of doing mixed methods research" (Freshwater 2013, p.299), thus alleviating an important barrier to the further uptake of mixed methods research in management (Bryman 2007).

3. The Procedure of Applying the Patterns

Figure 9 presents the procedure for applying the visual interaction patterns. The quantitative data collection phase (a survey, an experiment, a card sorting session, etc.) is followed by data visualization – visualizations (e.g., charts) representing the aggregate quantitative results are produced. These visualizations are then shown to the research participants, who are randomly split into groups of 8 to 10 people. A large screen showing the visualizations serves as a central point around which the follow-up group conversations take place. The visualizations play the role of structuration devices guiding (Suthers & Hundhausen 2003) the group conversations. Each group conversation is facilitated by one of the researchers, but the true (and more important) facilitators are the visualizations themselves. Each visualization is the center of a discussion and acts as an additional person in the room (the facilitator refers to what the visualizations are "saying" in the eyes of the participants). The researcher-facilitator uses the visual interaction patterns to guide the group conversations. Each pattern (as described in the following section) contains a visualization and accompanying questions to ask the participants. As a last step, all qualitative and quantitative findings are interpreted critically. This is done by seeking confirmation of the quantitative results in the qualitative findings (triangulation), seeking clarification or illustration of the results (complementarity), seeking divergence of results (extension), and discovering paradoxes and contradictions that lead to the research questions being reframed or hypotheses being reformulated (initiation) (see Molina-Azorín 2011). Insights extending (or challenging) the quantitative results are gathered, which leads to confirmed, revised or extended correlation models and revised or extended research procedures.

Figure 9. Procedure for Applying the Visual Interaction Patterns

Phase	Procedure	Product
Data collection – electronic survey, experiment or card sorting (quantitative)	Each respondent fills an electronic survey on a personal computer or a mobile device (or takes part in an experimental or a card sorting session).	numeric data / quantitative results
Data visualisation (quantitative)	Visualizations of the quantitative results are produced. 	visualizations of the quantitative results (charts)
Data interpretation by participants (qualitative)	***Group conversations***: the visualizations of the quantitative results are shown to the participants, who are gathered in groups of 8 to 10 people. The ***visual interaction patterns*** are used to guide the group conversations. The group conversations are audio or video recorded. The facilitator may choose to annotate the visualisation according to the participant input. 	• audio recordings of the group conversations • (optional) annotated visualizations
Data interpretation by researchers (qualitative and quantitative)	The qualitative and quantitative findings are interpreted critically. Post-hoc hypotheses are formulated and existing hypotheses are re-formulated based on qualitative findings from the group conversations.	• insights extending (or challenging) the quantitative results • confirmed, revised or extended correlation models • confirmed or revised research procedure

4. The Patterns

We describe five patterns in this section – disagreement pattern, outlier pattern, labeling pattern, tag cloud pattern, and interactive correlational model pattern. We selected these five patters (among a larger patterns repository) as most promising based on our research experience. Each interaction pattern is explained below in terms of purpose, procedure, trigger (discussion) questions, as well as outlined benefits. The documentation is common for all patterns – the group conversations are audio or video recorded. The facilitator may choose to annotate the visualizations according to the participant input. Alternatively, the facilitator may provide the participants with laser pointers or highlighters to mark areas of

the visualizations, or with electronic pens in order to annotate the visualizations with question marks or comments.

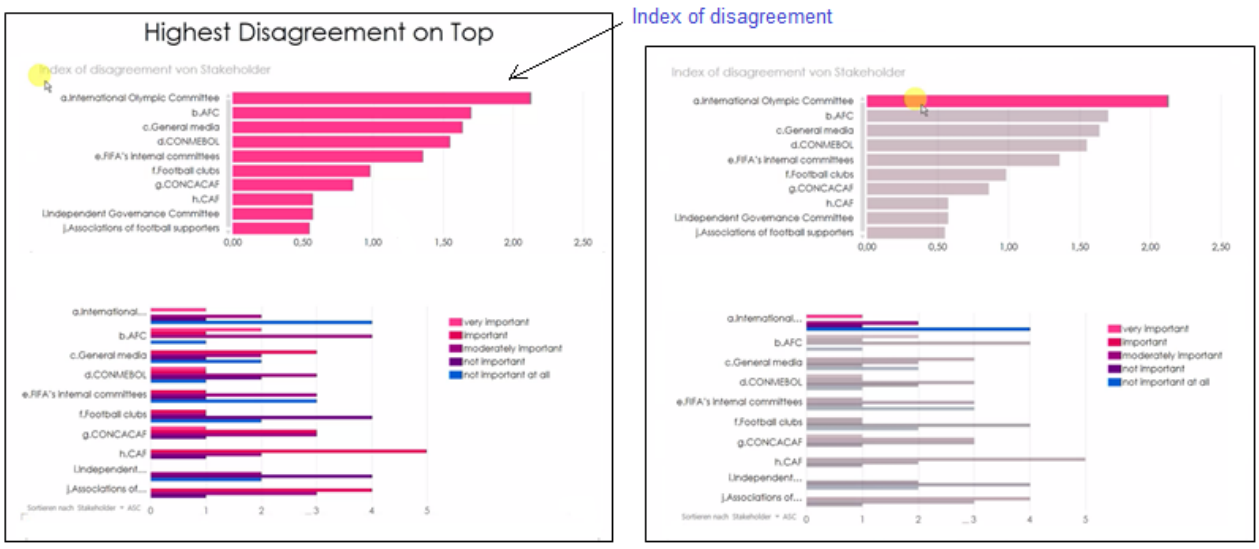
4.1. Disagreement Pattern

The purpose of the disagreement pattern is to get feedback from the research participants on the reasons for their disagreement (e.g., in the answers of survey questions). Table 13 contains an example of a visualization of the survey results which can be used to guide a group conversation as part of the disagreement pattern. The first bar chart (on top) represents the "index of disagreement" (Akiyama et al. 2016) of the answers given to each survey question, in descending order. The index of disagreement is calculated for each survey question by a Java-based software program. This program (the "Smart Survey Reporter") was written by the first author in Java 8.0. Apart from calculating the index of disagreement, the Smart Survey Reporter aggregates the individual survey responses, so as to enable their visualization in online charts. The second bar chart (at the bottom, Table 13) shows the spread of answers to each survey question, again in descending order according to the index of disagreement. The spread of possible answers can be on a 5-point Likert scale (e.g., from "very important" to "not important at all"). The survey questions that yield the most discrepant answers also yield the highest index of disagreement.

Table 13. The Disagreement Pattern

Disagreement pattern

Purpose: use visualization of quantitative results to get feedback from participants on the reasons for group disagreement (dissent)



Example of a visualization of survey results (sorted in descending order based on the index of disagreement) which can be used to guide a follow-up group conversation

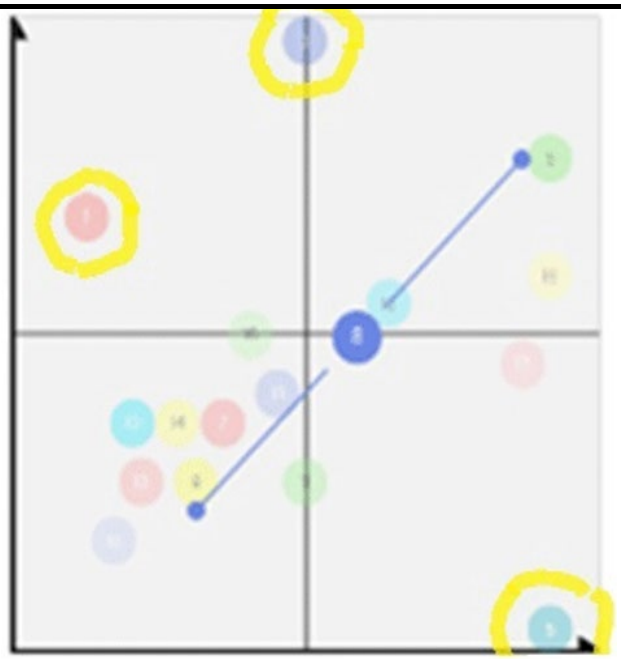
Procedure: Display the survey questions in a descending order based on the "index of disagreement" ranking algorithm, i.e., place the survey questions with the most discrepant answers on top. Ask the participants to explain the reasons for their discrepant answers to survey questions.	**Trigger questions**: If we look at this, you gave discrepant answers to this question. Help us understand why. What might have prompted you to answer so diversely? What are the reasons for your high disagreement regarding this issue?
Benefits for researchers: Explain the reasons for high group disagreement or reformulate/delete survey questions yielding the most discrepant answers; revise correlational models. "Unpack" variables – show whether the operationalization of variables actually reflects the underlying constructs that the variables are intended to reflect, i.e., help improve construct validity.	**Benefits for managers and facilitators:** Show managers and facilitators where the highest disagreement is, so that they can discuss these issues promptly and not rely on a pseudo consensus.

4.2. Outlier Pattern

The purpose of the outlier pattern is to get feedback from the research participants on the reasons for outlier opinions. An outlier opinion is an individual survey answer that lies an abnormal distance from other survey answers in the sample. The outlier pattern involves asking questions aimed at eliciting the rationale behind outlier viewpoints. The facilitator points to any visible outliers on the visualization and looks for an explanation of the outlier opinions. Trigger questions to be asked include: "If we look at this, there are a small number of people who answered very differently. They are over here (show outliers on the chart). Help us understand their viewpoint. What might prompt someone to answer like this?". Potential benefits for researchers include giving voice to outlier opinions, taking outliers into consideration and revising correlational models. Potential benefits for managers and facilitators include giving voice to unpopular truths and individual realities (Table 14).

Table 14. The Outlier Pattern

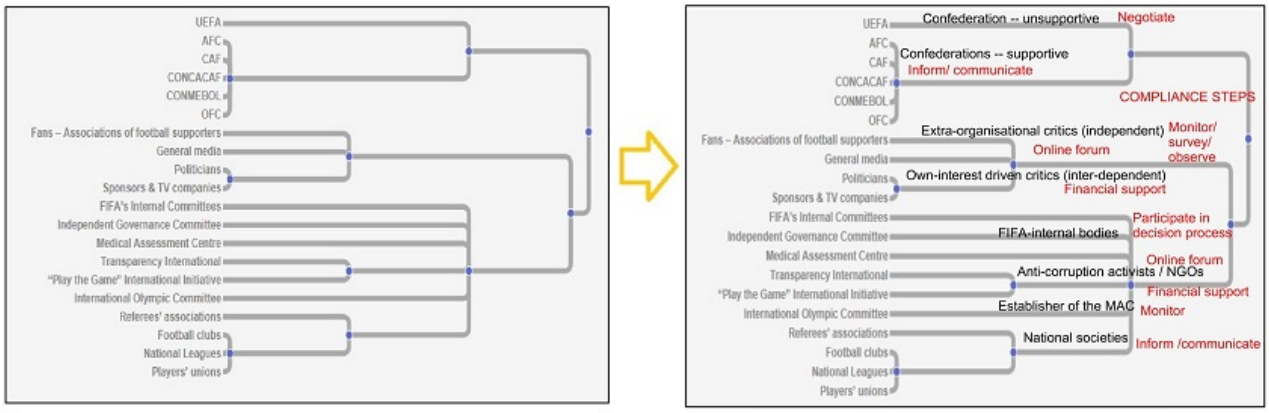
Outlier pattern
Purpose: use visualization of quantitative results to get feedback from participants on the reasons for outlier opinions

 Example of a visualization of survey results (showing outliers) used to guide a follow-up group conversation	**Procedure:** Ask questions aimed at eliciting the rationale behind outlier viewpoints. Point to any visible "outliers" on the visualization and look for an explanation of the outlier opinions. **Trigger questions**: If we look at this, there are a small number of people who answered very differently. They are over here (show outliers on the chart). Help us understand their viewpoint. What might prompt someone to answer like this?
Benefits for researchers: Give voice to outlier opinions; take outliers into consideration; revise correlational models.	**Benefits for managers and facilitators:** Give voice to unpopular truths and individual realities; foresee the future based on outlier views.

4.3. Labeling Pattern

The labeling pattern involves asking research participants to attribute labels to clustered results from quantitative analysis. For example, the figure to the left of Table 15 displays a tree (dendrogram) produced by the simplecardsort.com platform and based on a cluster analysis of 104 individual electronic card sorts. The simplecardsort.com platform is unable to produce meaningful labels of the emerged tree clusters. In fact, no card sorting software or electronic platform is able to do this. The tree on the left-hand side of Table 15 is therefore without cluster labels. One way to produce meaningful cluster labels is through discussion in a group conversation with the research participants. We did this together with 104 research participants. We tested the labeling pattern with 104 experienced managers enrolled in a part-time executive MBA program in Switzerland. The study was in the context of organizational stakeholder analysis. It can be seen in the figure on the right-hand side of Table 15 that one example group conversation has resulted in meaningful labels for the stakeholder clusters.

Table 15. The Labeling Pattern

<table>
<tr><td colspan="2">Labeling pattern
Purpose: use visualization of quantitative results to get labeling suggestions for parts of the visualization from participants
 

Example of a visualization used for the labeling pattern (a tree and the same tree – labeled)</td></tr>
<tr><td>Procedure: Ask the participants to suggest the best possible labels for parts of a visualization.</td><td>Trigger questions: What labels would you give to … this cluster on the tree /this group of stakeholders / the four quadrants on this grid, etc.?</td></tr>
<tr><td>Benefits for researchers: Get clarity on the perceived meaning of parts of the visualization which depict emerging categories; if the quantitative analysis was cluster analysis, produce labels of the clusters (no software can produce meaningful labels of clusters).</td><td>Benefits for managers and facilitators: Produce meaningful labels for clusters (perceived groups) of e.g., stakeholders, products, etc.</td></tr>
</table>

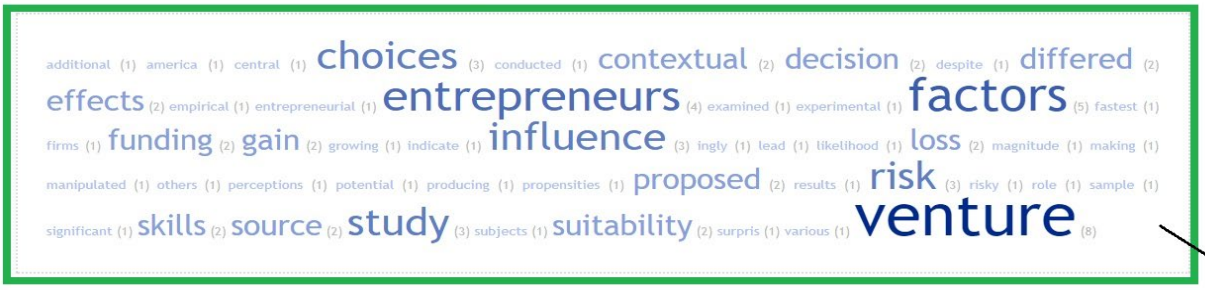
4.4. Tag Cloud Pattern

The tag cloud pattern (Table 16) works by producing tag clouds (with a free tool like tagcrowd.com) from the combined text of the comments written by the, e.g., survey participants (such comments are typically written at the end of a survey). In case of two opposing decisions made as part of the survey (e.g., invest or not invest), the researchers produce two corresponding tag clouds (from the comments accompanying the two opposing decisions). The researchers then place the two tag clouds next to each other and show them to the participants during the group conversation. The trigger questions to be asked are aimed at explaining the displayed differences between the two tag clouds (see Table 16). Discussing the differences between the two clouds sheds light on the rationale behind participants' decisions (e.g., to invest or not to invest).

In the example visualization (Table 16) the first tag cloud is "normalized" with the help of the "Tag Cloud Normalizer" Java-based software program. This program was written

by the first author in Java 8.0. The program enables a normalized comparison of two tag clouds by producing a normalized (i.e., magnified by a factor, which is the ratio of the tag counts of the two clouds) bulk text for the smaller tag cloud. This normalized bulk text is to be (re-)fed into the online tool (like tagcrowd.com) instead of the original bulk text of the smaller cloud tag. The interpretations elicited during the group conversations shed light on the meaning of certain keywords in the two tag clouds, with a focus on explaining the differences between the two tag clouds. These interpretations reveal insights which can allow to revise the construct validity of variables, i.e., they can show if the operationalizations of some variables reflect the underlying constructs that the variables are intended to reflect. Looking inside variables in order to (re)-check their construct validity is important, especially in a management context. The latter can permit to identify industry-specific dependent and independent variables (Molina-Azorín 2011) or reformulate existing variables to match a certain context.

Table 16. The Tag Cloud Pattern

<table>
<tr><td colspan="2">Tag cloud pattern
Purpose: use visualization of the survey comments to get feedback from participants on the rationale behind their survey answers
Bulk text of comments of participants who agreed to invest (normalized):
 

sample text
Bulk text of comments of participants who disagreed to invest:
 

Example of a visualization which can be used as part of the tag cloud pattern (a tag cloud of the comments of survey respondents who decided to invest in green color and a tag cloud of the comments of survey respondents who decided not to invest in red color)</td></tr>
<tr><td>Procedure: Produce tag clouds (with a tool like tagcrowd.com) from the comments written by the participants as part of a survey. In case of two opposing decisions made as part of the survey (e.g., invest or not</td><td>Trigger questions: If we look at this, you gave varied comments: the people who decided to invest were mostly concerned about “venture” and the</td></tr>
</table>

invest), place the two tag clouds (of the comments accompanying the two opposing decisions) next to each other. Ask the participants to explain the differences between the twfo could tags.	people who decided not to invest were mostly concerned about "risk". Help us understand why. Would you explain?
Benefits for researchers: Reveal the rationale behind participants' decisions (e.g., to invest or not to invest).	**Benefits for managers and facilitators:** Reveal the rationale behind decisions. Help groups make better decisions.

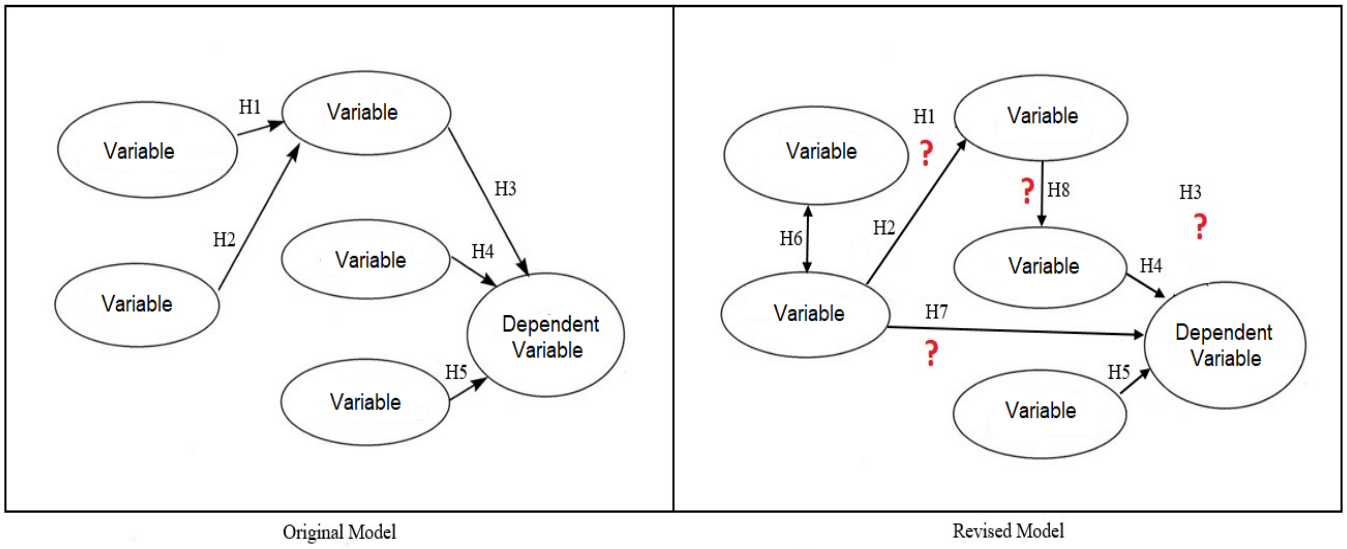
4.5. Interactive Correlational Model Pattern

The purpose of the interactive correlational model pattern (Table 17) is to improve correlational models' correspondence with the empirical observations. In a survey context, the correlational model is the one which served as a theoretical base for the development of the survey questions. The benefits for researchers include providing explanations for non-confirmed (discarded) hypotheses, providing explanations for newly emerged significant correlational dependencies, formulating new hypotheses or reformulating existing hypotheses. New variables can also be added to the model or existing variables can be reformulated. The benefits for managers include improving the usefulness of correlational models utilized for collective sensemaking, problem solving, decision making, strategizing, and prediction in groups.

Table 17. The Interactive Correlational Model Pattern

Interactive correlational model pattern

Purpose: use participants' voices to revise correlational models



Legend
H: Hypothesis / The lack of an arrow means lack of correlational dependence.

Example of a visualization which can be used as part of the interactive correlational model pattern (an original model and a revised model)	
Procedure: Perform a quick statistical analysis (e.g., of survey results) to test the original correlational model (the one which served as a theoretical basis for formulating the survey questions) and produce a visualization of the revised model. Show the two models on a big screen next to each other – the original model next to the revised model – and discuss the differences between them with participants. Ask the participants why some hypotheses were not confirmed, and why new hypotheses emerged. Ask also if something is missing in the revised model (if new variables should be added).	**Trigger questions**: If you look at the revised model, Hypotheses 1 and 3 were not confirmed. Help us understand why. Would you explain? / If you look at the revised model, new hypotheses have emerged. Can you explain? / Is there any variables that are absent in the revised model? What kind of additional hypotheses can be tested in the future?
Benefits for researchers: Improve a correlational model's correspondence with the empirical observations. Provide explanations for non-confirmed (discarded) hypotheses. Provide explanations for newly emerged significant correlational dependencies. Formulate new hypotheses or reformulate existing hypotheses. Add new variables to the model or reformulate existing variables.	**Benefits for managers and facilitators:** Improve the usefulness of correlational models utilized for collective sensemaking, problem solving, decision making, strategizing, and prediction in groups.

5. Discussion

In this paper we discussed the theoretical underpinnings and proposed application of an inventory of visual interaction patterns – mixed methods research tools aimed at enriching quantitative studies with qualitative insights derived by using visualizations to involve participants in the interpretation of research findings. With the patterns, it is no longer exclusively the researcher's task to develop theory on the basis of data interpretation. Instead, the researcher involves the research participants in the process of data interpretation. Data interpretation becomes a dialogue between researcher and participants, in a form of co-construction of knowledge (Torrance 2012).

Our patterns are, of course, not without limitations. One limitation comes from the risk of visualizing opinions on delicate issues. This limitation is mitigated by the fact that we are visualizing aggregate (group) research results, while the individual research results remain

anonymous. This limitation is also mitigated by the power of visualizations to bring tough issues to the surface in a subtle way, since visualizations are typically perceived as interactively neutral, as pure information (see Meyer et al. 2013). Another limitation comes from the reliance of our patterns on human facilitators. This limitation is mitigated by the fact that the true (and more important) facilitators in our group conversations are the visualizations themselves – they are the center of the discussion and act as an additional person in the room (the facilitator is referring to what the visualizations are "saying" and how to interpret this).

6. Conclusion

We would like to conclude with a call to action for the management research and practitioner communities. In particular, we recommend employing the patterns to enable the production of new understandings. Such new understandings can confirm, extend or question the goodness of the pre-produced quantitative data. Practitioners such as team leaders, coaches, and designers of group interactions, are well advised to apply the patterns to involve practitioners in the process of work-related inquiry. The visual interaction patterns can help researchers elicit value-adding insights about the goodness and usefulness of quantitative results. The procedure of applying the patterns can play the role of a methodological boundary object between the worlds of researchers and research participants. Researchers are able to see their results with the eyes of the people who produced these results. This has the potential to yield more insightful answers to problems of organization and management. Inferences are built by exploiting the differences in the knowledge bases of researchers and participants, so that management research can make a difference in the real world.

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E PAPER 4: A VISUALIZATION FOR TEACHING MIXED METHODS RESEARCH

A Visualization for Teaching Mixed Methods Research

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Abstract
I introduce an innovative visualization of basic mixed methods research designs and integration methods. The visualization can be used for teaching and didactic purposes. I provide examples of how mixed methods studies from the field of management can be mapped on this visualization. The visualization represents three basic mixed methods designs – exploratory sequential, explanatory sequential, and convergent, and three basic mixed methods integration methods – building, connecting, and merging. The methodological contribution of this paper is threefold. The proposed visualization can potentially facilitate the process of teaching mixed methods to beginners, it can help researchers find orientation in the field of mixed methods or decide which mixed methods design to apply in their work, and it can be used as a heuristic device to explicate the type of mixed methods designs and methods utilized by various studies.

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1. Background and Methodological Purpose

Teaching mixed methods research can be challenging, mainly because even the basic mixed methods research designs require solid explanation. Early career researchers often struggle with figuring out which mixed methods research design they could or should apply. Existing visualizations of basic mixed methods research designs and integration methods do not always provide rapid help to mixed methods beginners, as my teaching experience with doctoral students has led me to believe. A simple visualization of mixed methods designs for teaching purposes is necessary (and still lacking), in order to serve as a heuristic device to explicate the type of mixed methods design researchers can apply. To fill this gap, the purpose of this paper is to introduce a simple visualization of basic mixed methods research designs and integration methods.

The methodological contribution of this paper is threefold. The proposed visualization can potentially facilitate the process of teaching mixed methods to beginners, it can help researchers find orientation in the field of mixed methods or decide which mixed methods design to apply in their work, and it can be used as a heuristic device to explicate the type of mixed methods designs and methods utilized by various studies. This is important, since mixed methods research is becoming mainframe. It is widely trusted to enable researchers to produce meaningful and impactful insights, with a value-added compared to mono-method research. For example, mixed methods research is trusted to equip researchers with the means to explore wicked problems (see, e.g., Mertens 2015). Because mixed methods research invites a multiplicity of ways of knowing and ways of seeing, it is also trusted to enable researchers to meaningfully explore multi-cultural issues (see, e.g., Tashakkori & Teddlie 2010). Participatory, critical and transformative mixed methods studies can help solve major human problems, in the pursuit of worthwhile human progress.

This paper is structured as follows. I begin with a review of the literature on the challenges of teaching mixed methods. I then provide a quick evaluation of existing visualizations of mixed methods designs and methods and present the proposed visualization as a methodologically innovative alternative. Finally, I present examples of how mixed methods studies can be mapped on the visualization and discuss he visualization with reference to its contribution and limitations.

2. Literature Review

Pedagogical and teaching considerations relevant to mixed methods have been expressed in literature since the early 2000s. Onwuegbuzie and Leech (2005) highlighted the importance that "research courses be taught at different levels that simultaneously teach both quantitative and qualitative techniques within a mixed methodological framework" (2005, p. 268). Ivankova et al. (2006) developed the first visualization of a mixed methods research design (the Model for Mixed-Methods Sequential Explanatory Design Procedures, p.16). Some

publications are available that visually describe the basic mixed methods designs and methods (see Onwuegbuzie et al. 2007; Leech & Onwuegbuzie 2009).

Strategies for teaching mixed methods have been published (Christ 2009; Collins & O'Cathain 2009; Creswell 2009; Teddlie & Tashakkori 2009), and challenges to consider when teaching mixed methods have been outlined (Onwuegbuzie & Leech 2009). Teaching students how to integrate quantitative and qualitative data (i.e., the widely discussed mixed methods integration challenge) has its share of challenges. Although numerous publications are available that describe how integration can be done (Bazeley 2018; Fetters & Freshwater 2015; Fielding 2012; Moran-Ellis et al. 2006), one single source outlines the basic mixed methods integration methods in a tabular form (see Fetters et al. 2013, p. 2136). This seems unbalanced, since paradigmatic considerations have been highlighted as central when teaching mixed methods research (Tashakkori & Teddlie 2010; Biesta & Burbules 2003; Bryman 2006; Johnson & Onwuegbuzie 2004; Morgan 2007). No publication outlines the basic mixed methods integration methods visually and with relation to the corresponding mixed methods designs in which they are typically applied.

3. Existing Visualizations of Mixed Methods Designs

Table 18 presents an assessment of three existing visualizations (and classifications) of mixed methods designs: a) the visualization available in Onwuegbuzie et al. (2007), b) the visualization available in Leech and Onwuegbuzie (2009, p. 273), and c) the visualization presented in Creswell (2016). The assessment is done based on Eppler et al. (2011)'s criteria for assessing the quality of qualitative classifications. I have selected the three existing visualizations as the only ones, to the best of my knowledge that represent all basic mixed methods designs. I have decided not to include Ivankova et al.'s (2006, p. 16) visualization, because it represents one single mixed methods design (the sequential explanatory design). I have decided not to include Fetters et al.'s (2013, p. 2136) table, because it is not in a visual format.

Table 18. Evaluation Summary of Three Existing Visualizations of Mixed Methods Designs, based on Eppler et al. (2011)'s Criteria

Relevance	Rigor
VISUALIZATIONS 1 & 2 **Simplicity** (Score – moderate) ● Contain a multitude of boxes and circles and provide a level of detail that may be hard to comprehend by mixed methods beginners. VISUALIZATION 3	VISUALIZATIONS 1 & 2 Explicit classification principle (Score – moderate) ● The categorization criteria of the visualizations are not very clear. VISUALIZATION 3

Simplicity (Score – high) ● Is relatively simple to comprehend by mixed methods beginners.	Explicit classification principle (Score – high) ● The categorization criteria of the visualization are clear.
VISUALIZATIONS 1 & 2 ***Visual clarity*** *(Score – moderate)* ● The visualizations are overloaded and provide a multitude of boxed and circles. VISUALIZATION 3 ***Visual clarity*** *(Score – high)* ● The visualization is visually clear.	VISUALIZATIONS 1 & 2 **Difference** (Score – moderate) ● The categories (depicted in the boxes and circles) are not mutually exclusive. VISUALIZATION 3 **Difference** (Score – high) ● The categories (depicted in the boxes and circles) are mutually exclusive
VISUALIZATIONS 1 & 2 **Usefulness** (Score – moderate) ● The visualizations provide detail on three dimensions: mixing dimension, time dimension and emphasis dimension. It is questionable whether these dimensions are useful for researchers. VISUALIZATION 3 **Usefulness** (Score – high) ● The visualization offers useful benefits such as overview and dimensions.	VISUALIZATIONS 1 & 2 **Defined scope** (Score – moderate) ● The level of granularity is very high. VISUALIZATION 3 **Defined scope** (Score – high) ● The level of granularity is adequate.
VISUALIZATIONS 1 & 2 **Typicality** (Score – moderate) ● The categories use untypical attributes of the items. VISUALIZATION 3 **Typicality** (Score – high) ● The categories use typical attributes of the items that make it easier to understand distinctions.	VISUALIZATIONS 1 & 2 **Membership** (Score – moderate) ● Items can belong to more than one category. VISUALIZATION 3 **Membership** (Score – low): ● It is well defined which items belong to a certain category.
VISUALIZATIONS 1 & 2 Unique and unambiguous labels (Score – moderate)	VISUALIZATIONS 1 & 2 Clear group boundaries (Score – moderate)

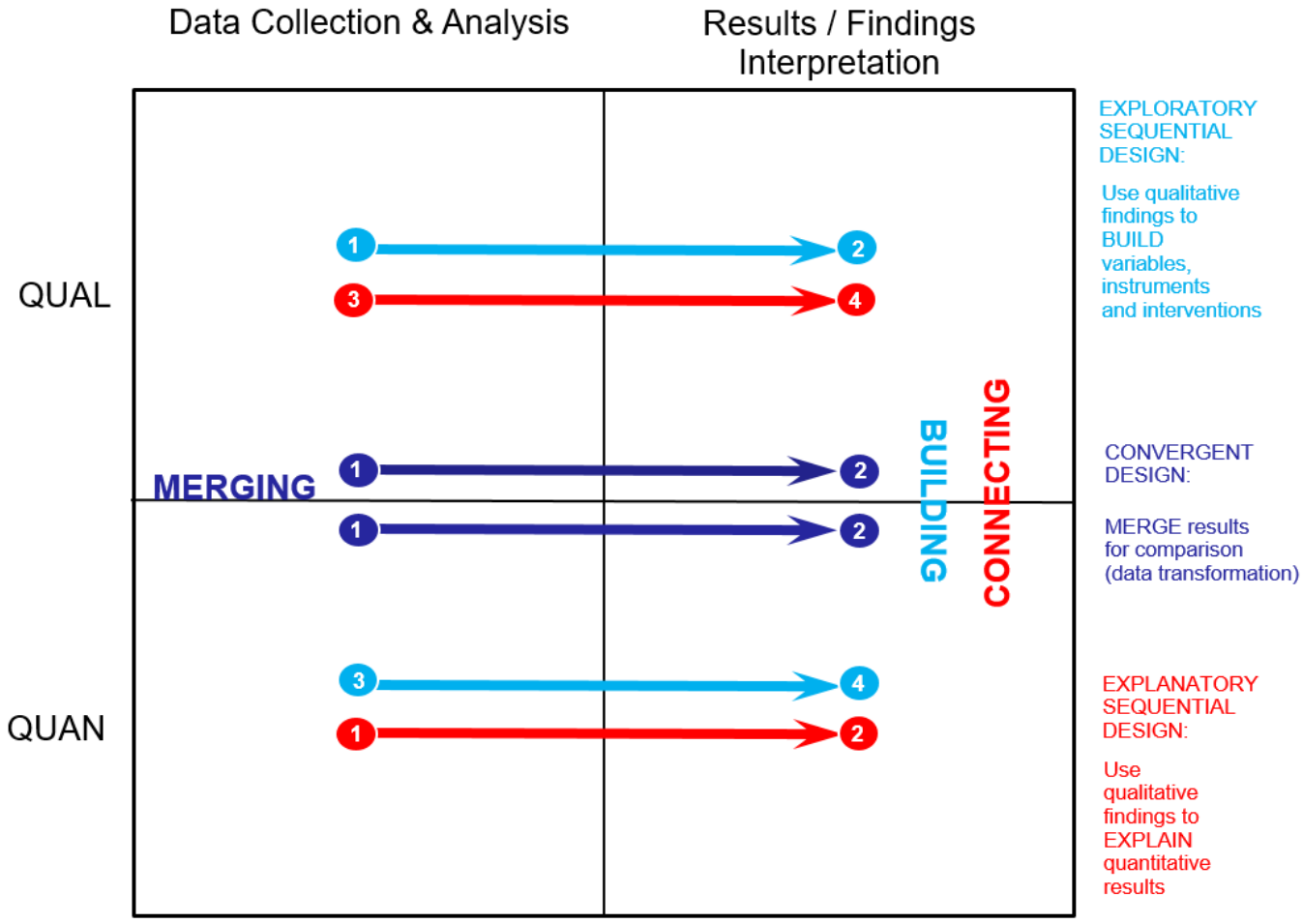
● The groups are not distinctly labelled. VISUALIZATION 3 Unique and unambiguous labels (Score – high) ● The groups are distinctly labelled.	● There are no clear inclusion and exclusion rules for items and their group membership. VISUALIZATION 3 Clear group boundaries (Score – high) ● There are clear inclusion and exclusion rules for items and their group membership.
LEGEND VISUALIZATION 1: Onwuegbuzie et al. (2007) VISUALIZATION 2: Leech and Onwuegbuzie (2009) VISUALIZATION 3: Creswell (2016)	

The assessment has revealed that Creswell (2016)'s visualization scores higher on all criteria compared to the other two visualizations. However, all three visualizations have a common disadvantage – all provide multiple boxes, circles and arrows, without the possibility (space) for adding textual content.

4. The Visualization

The visualization I introduce in this paper (Figure 10) represents three basic mixed methods designs – exploratory sequential, explanatory sequential, and convergent, and three basic mixed methods integration methods – building, connecting, and merging. The visualization utilizes a structure of a matrix, with the research steps being represented with numbers, in a process-like sequence. The numbers denote the sequence of research steps. The thickness of the arrows may be varied to denote the relative size of the qualitative or quantitative sample in a study.

Figure 10. A Visualization for Teaching Mixed Methods

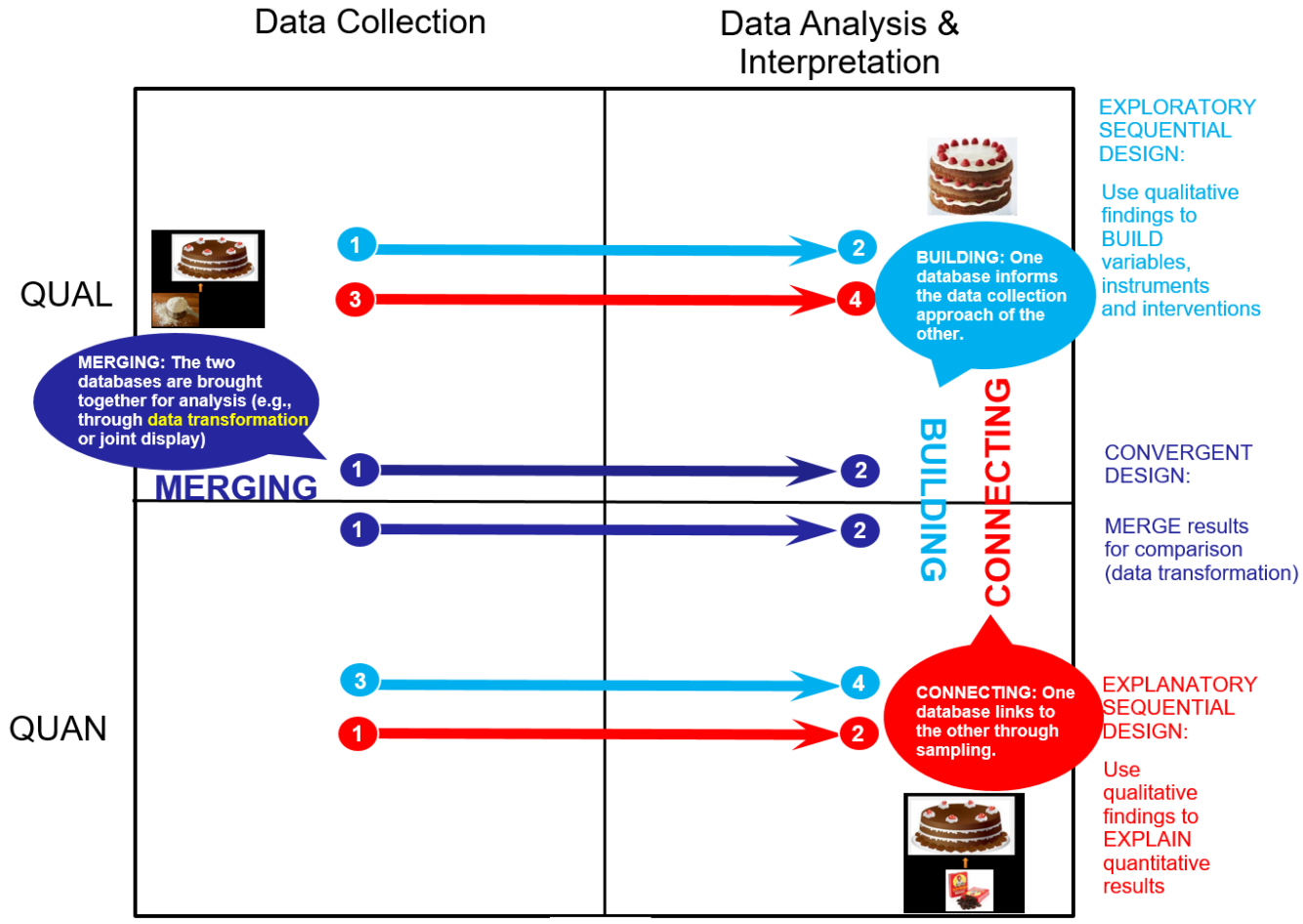


The simplified visualization in Figure 10 offers a matrix structure. Through this structure, the main steps of the mixed methods designs are easy to follow and comprehend. The visualization also provides an easy way to map any mixed methods study by adding textual contents to the quadrants of the matrix. The matrix structure of the visualization also enables easy switching through the quadrants, without the need to draw duplicates of boxes or circles. The dimensions of the matrix are as follows: a) QUAN (quantitative) and QUAL (qualitative) dimension mapped vertically and b) Data Collection & Analysis and Results/Findings Interpretation dimension mapped horizontally. Three different colors are used for the three mixed methods designs: blue color for the exploratory sequential design, red color for the explanatory sequential design, and violette color for the convergent design. The numbers denote the sequence of research steps. The exploratory sequential design (in blue color, Figure 10) has four steps, starting from QUAL and continuing with QUAN. The explanatory sequential design (in red color) has four steps, but goes in the opposite direction, starting from QUAN and continuing with QUAL. The convergent design has four steps that take place at the same time, pairwise. Three main mixed methods methods are mapped on the visualization, each of them belonging to one of the three basic designs:

- the method of building (in blue color, belonging to the exploratory sequential design);

- the method of connecting (in red, belonging to the explanatory sequential design), and
- the method of merging (in violette, belonging to the convergent design).

Figure 11. A Visualization for Teaching Mixed Methods – Extended



Notes: Source of the cake metaphor: Creswell (2016)

Figure 11 presents an extended version of the proposed visualization, with explanations of the three basic integration methods (building, connecting and merging), as follows:

- *building*: one database informs the data collection approach of the other;
- *connecting*: one database links to the other through sampling;
- *merging*: The two databases are brought together for analysis (e.g., through data transformation or joint display).

An extended version of the cake metaphor (initially to be found in Creswell 2016) is used in Figure 11 to explain the three methods. Building resembles building the layers of a cake. Connecting means connecting certain parts of the two databases, namely the parts related to the quantitative results that need to be explained. This resembles placing raisins between each two layers of a cake. The raisins play a connecting role, but stay intact. Merging resembles the way that flour melts completely within a cake. The quantitative data is

qualitized and the qualitative data is quantitized, so that the two databases melt into each other like the flour in a cake. Example of quantitizing is counting QUAL data (e.g., words, categories, themes) and converting to quantitative codes for statistical analysis. Examples of qualitizing are labeling factors/entities and developing categories and types from QUAN data.

5. Examples of Mixed Methods Studies Mapped on the Visualization

5.1. Selection of the Example Studies

I looked for example mixed methods articles across four highly ranked management studies journals over a ten-year span: Academy of Management Journal, Administrative Science Quarterly, Strategic Management Journal, and Journal of Management. I found the following 18 articles, each of which utilizes a mixed methods design: Graffin et al. (2011), Davies et al. (2010), Jonsson & Regnér (2009), Morse (2010), Ethiraj et al. (2012), Bunderson and Thompson (2009), Bernstein (2012), Battilana and Casciaro (2012), Aime et al. (2014), Grant et al. (2014), Yang et al. (2010), Almandoz (2012), Sonenshein et al. (2014), Vergne (2012), Raffaelli and Glynn (2014), Kistruck et al. (2013), Van Wijk et al. (2013), Detert and Edmondson (2011).

Table 19 describes four randomly selected examples studies from the management domain, each of which utilizes one of the basic mixed methods designs – exploratory, convergent, explanatory, and multi-phase design.

Table 19. Example Management Studies for Each Basic Mixed Methods Design

Exploratory Sequential Design: Example	Convergent Design: Example	Explanatory Sequential Design: Example	Multi-phase Design: Example
Bunderson and Thompson (2009) ***Topic Area:*** Meaningful Work ***Design:*** Exploratory Sequential ***Qualitative Sample/Analysis:*** Interviews with 23 zookeepers/ Grounded Theory	Raffaelli and Glynn (2014) ***Topic Area:*** Institutional Complexity and Practice Adoption ***Design:*** Convergent ***Qualitative Sample/Analysis:*** Unknown number of customer	Ethiraj et al. (2012) ***Topic Area:*** Innovation ***Design:*** Explanatory Sequential ***Qualitative Sample/Analysis:*** Interviews with 6 heads of marketing, sales, and product	Davies et al. (2010) ***Topic Area:*** Reputation and Firm Performance ***Design:*** Multi-phase (QUAL-QUAN-QUAL) ***Qualitative Sample/Analysis:*** Unknown number of customer interviews / Not Stated

Quantitative Sample/Analysis: Survey of 982 Zookeepers/ Descriptive statistics, CFA, and Regression Integration method: Building	interviews, Archival data ***Quantitative Sample/Analysis:*** Surveys of 161 firm participants/ Descriptive statistics, Correlations, and Regression Integration method: Merging	development/ Not Stated ***Quantitative Sample/Analysis:*** Analysis of 120 service requests/ Descriptive statistics, Correlations, and Bivariate probit Integration method: Connecting	***Quantitative Sample/Analysis:*** 4307 surveys (2575 from customers; 1732 employees)/ Descriptive statistics and Regression ***Integration method:*** Building, Connecting

5.2. The Examples Studies

In this section I present four examples of how studies (Table 19) can be mapped on the proposed visualization. Figure 12 visualizes the mixed methods design and method applied in (Bunderson & Thompson 2009). The topic area is "meaningful work" and the design is exploratory sequential. The qualitative sample includes interviews with 23 zookeepers and the analysis is based on grounded theory. The quantitative sample includes a survey of 982 Zookeepers. The analysis utilizes descriptive statistics, CFA, and regression. The integration method is "building", whereas qualitative findings from the interviews are used to build variables for the survey.

Figure 12. The Mixed Methods Design and Method in Bunderson and Thompson (2009)

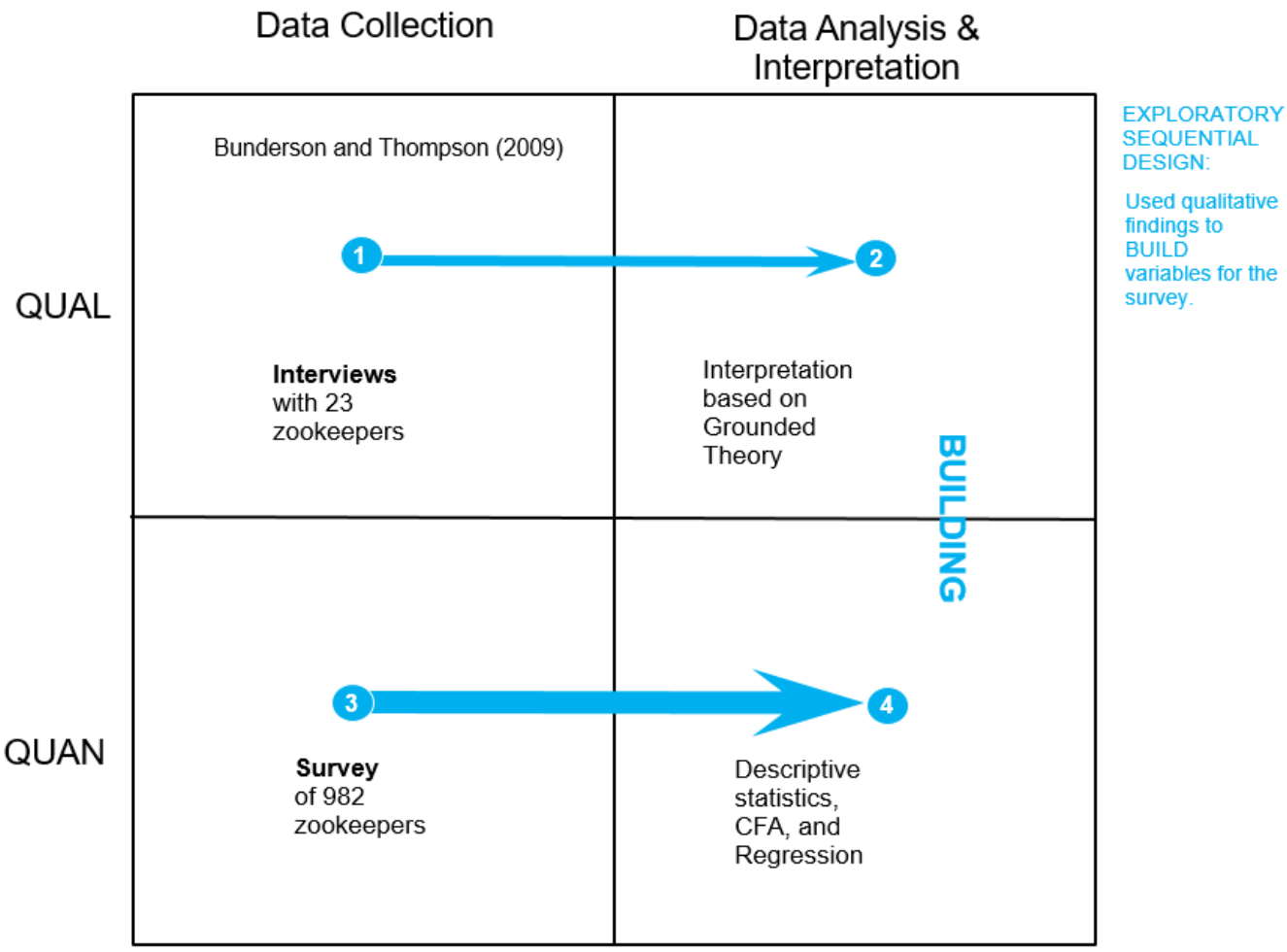


Figure 13 visualizes the mixed methods design and method applied in Ethiraj et al. (2012). The thickness of the arrows denotes the relative size of the qualitative or quantitative sample. The topic area is "innovation" and the study utilizes an explanatory sequential mixed methods design. The quantitative sample includes 120 service requests and the analysis is based on descriptive statistics, correlations, and bivariate probit. The qualitative sample includes interviews with 6 heads of marketing, sales, and product development. The integration method is connecting – the qualitative findings from the interviews are used to explain the quantitative results.

Figure 13. The Mixed Methods Design and Method in Ethiraj et al. (2012)

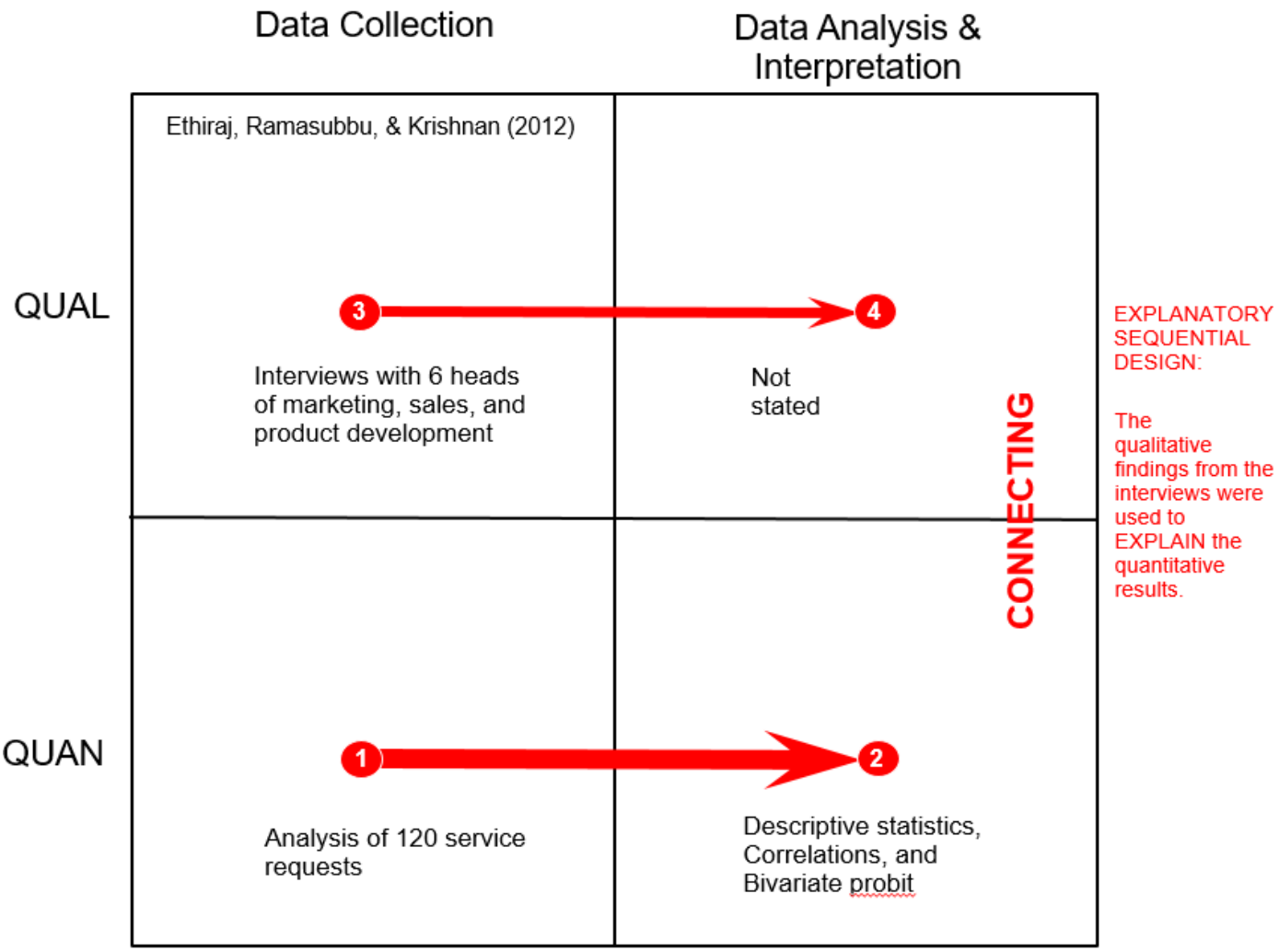


Figure 14 visualizes the mixed methods design and method applied in Raffaelli and Glynn (2014). The arrow in the quantitative part of the visualization is thicker, which denotes that the relative size of the quantitative sample in this study is bigger (compared to the qualitative sample). The topic area is "institutional complexity and practice adoption" and the study utilizes a convergent mixed methods design. The qualitative sample includes an unknown number of customer interviews and archival data. The quantitative sample includes surveys of 161 firm participants. The analysis is based on descriptive statistics, correlations, and regression. The results are merged for comparison.

Figure 14. The Mixed Methods Design and Method in Raffaelli and Glynn (2014)

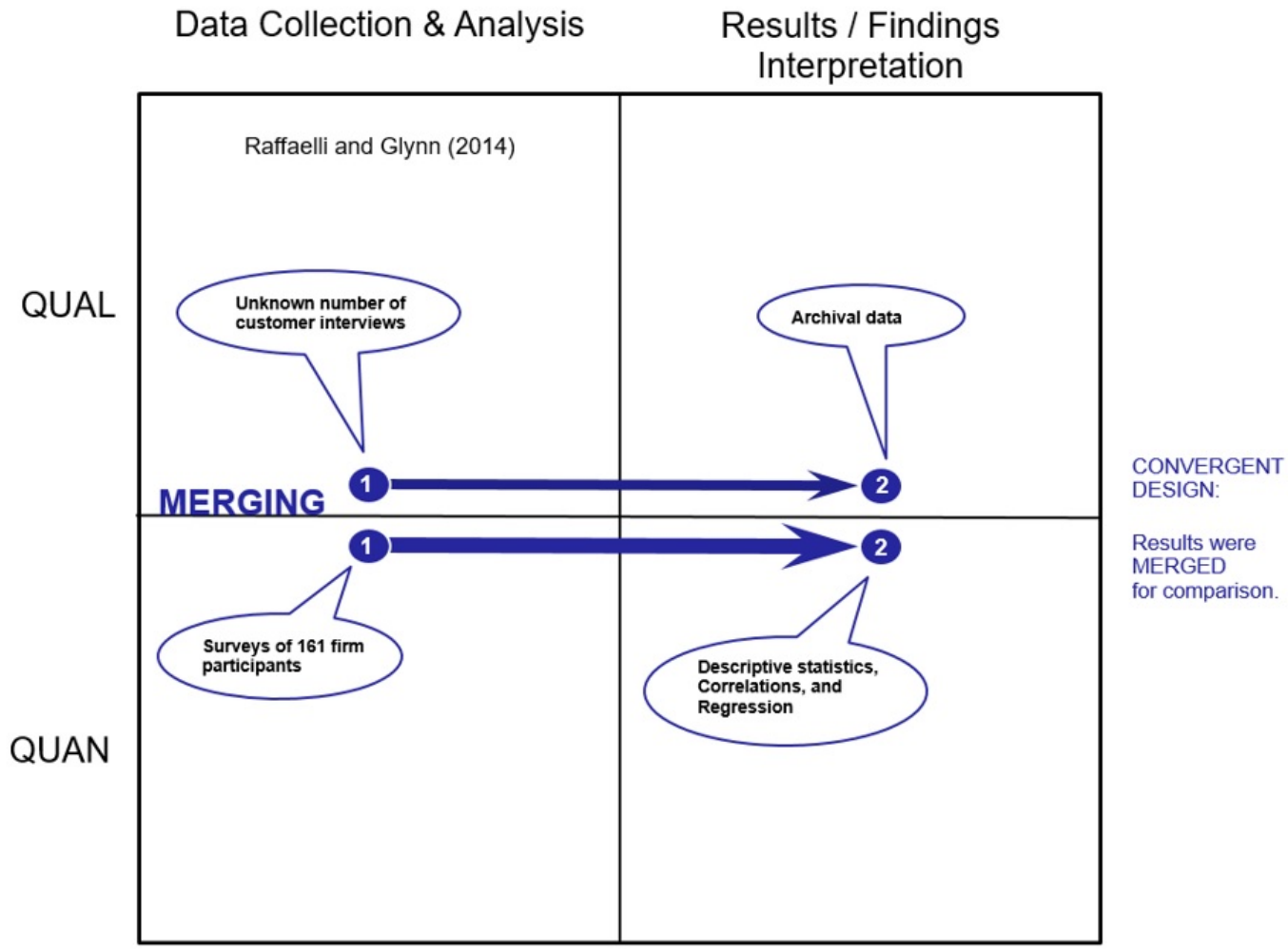
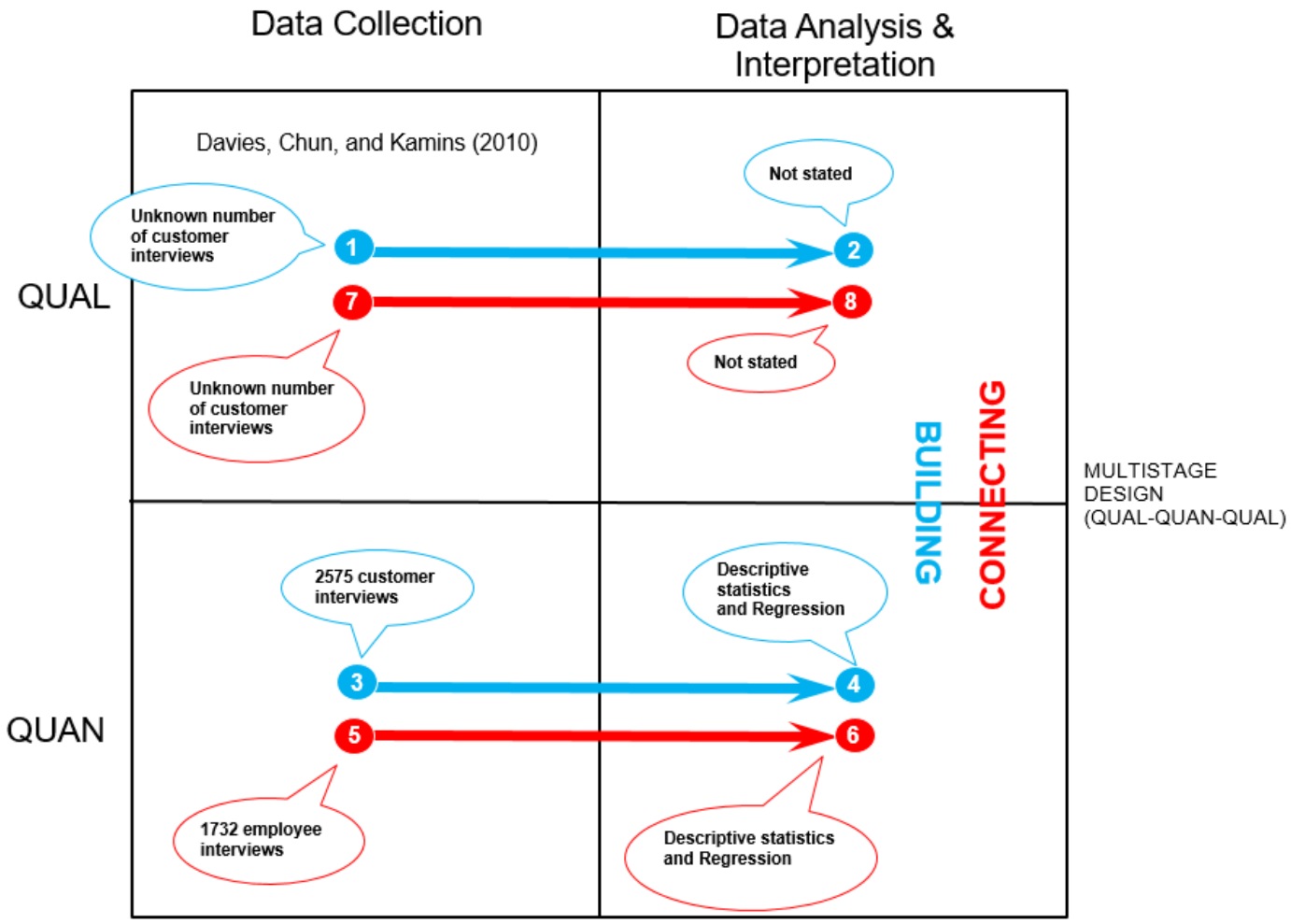


Figure 15 visualizes the mixed methods design and method applied in Davies et al. (2010). The topic area is "reputation and firm performance" and the study utilizes a multistage (QUAL-QUAN-QUAL) mixed methods design. The qualitative sample included an unknown number of customer interviews. The quantitative sample included 4307 surveys (2575 from customers and 1732 from employees) and the analysis is based on descriptive statistics and regression. The study utilizes two mixed methods methods – building and connecting.

Figure 15. The Mixed Methods Design and Methods in Davies et al. (2010)



6. Discussion

Motivated by the lacking simple visualization of basic mixed methods designs and methods and the pressing need to fill this gap, I have a) assessed three existing visualizations of basic mixed methods research designs and methods, b) developed a new visualization for teaching purposes, and c) provided example studies to illustrate how their mixed methods designs and methods can be mapped on the new visualization. The examination of exiting visualizations of mixed methods designs showed that two of them were overloaded and not easy to comprehend. These two scored moderately based on Eppler et al. (2011)'s criteria for assessing the quality of qualitative classifications. Although one existing visualization (Creswell 2016) scored high based on the same criteria, none of the existing visualizations provided the possibility (space) for adding textual content.

The visualization introduced in this paper (Figure 10) offers this possibility. The matrix structure of the visualization offers the benefit of easily switching from QUAN to QUAL or backwards through the quadrants, without the need to draw duplicates of boxes or circles. Unlike all existing visualizations, the new visualization outlines the basic mixed methods integration methods in relation to the corresponding mixed methods designs in which they are typically applied.

The proposed visualization is not without limitations, the biggest of which being the danger of reification because of its simplicity. While this is a valid limitation to be considered, it is moderated by the fact that this visualization is meant to be used for teaching, where simplicity is an advantage.

7. Conclusion and Future Research

The simple visualization introduced in this paper can potentially facilitate the process of teaching mixed methods, especially in the initial orientation phase for beginners. The visualization uses the advantages of the visual language to foster clarity and can potentially reduce the conceptual load necessary for comprehension. The latter is of practical and didactical value. The proposed visualization has been 'test-driven' in two mixed methods courses with PhD students. Formal testing will be undertaking in future steps. This type of testing will allow to formally assess the potential of the visualization to facilitate the process of teaching mixed methods.

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Passports	German, Bulgarian

EDUCATION	
Sept. 2004 – July 2009 **completed Ph.D. Study**	University of Koblenz-Landau, Germany, Faculty of Informatics Defence date: 13. July 2009 Degree: Doctor of Economic and Social Sciences PhD-Thesis title: "Authority-Based and Bottom-Up Diffusion of Collaboration Information Technologies: Constraints and Enablements"
Sept. 2001 – May 2003 MBA Diploma –with merit–	**Stuttgart Institute of Management and Technology**, Germany Degree: Master of Business Administration (MBA) Grade Point Average: B+ (3.41 out of maximum 4.00) Concentration: Management Information Systems
MBA Diploma Thesis –with excellence–	Thesis written for **SIEMENS AG**, ICN, Munich, Germany Thesis title: "Innovative Applications for Communication Networks" Grade: A (4.00 out of maximum 4.00)
Sept. 1995 – Sept. 2000 Graduate Economist Diploma	University of National and World Economy, Sofia, Bulgaria Degree: Graduate Economist Average grade from the course of education: very good 5.17 (out of maximum 6.00) Average grade from state exams: excellent 6.00 (out of maximum 6.00) Concentration: International Tourism Management

ACADEMIC EXPERIENCE (Switzerland, Bulgaria, Australia, Germany): Research and Teaching	
Feb. 2020 – now	Macromedia University of Applied Sciences, Freiburg, Germany

Professor of Media Management	
2019 Lecturer	University of St. Gallen, Switzerland Master course taught: Participatory Digital Media
Feb. 2017 – now Researcher (70%)	**University of St. Gallen, Switzerland** Institute for Media and Communications Management Project title: "Bridging the research-practice gap through information visualization – a mixed methods approach to involve research subjects in data interpretation" (Prof. Dr. Martin J. Eppler), **Swiss National Science Foundation (SNF)**
June 2015 – May 2016 Postdoctoral researcher (70%)	**University of St. Gallen, Switzerland** Institute for Media and Communications Management *Project title: "Bridging the Theory-Practice Divide through Information and Knowledge Visualization"* (Prof. Dr. Martin J. Eppler), **Basic Research Fund (GFF – Grundlagenforschungsfond), University of St. Gallen**
Jan. 2013 – May 2015 Postdoctoral researcher (80%)	**University of St. Gallen, Switzerland** Institute for Media and Communications Management Project title: "Understanding the Impact of Interactive Visual Representations on Group Communication – an Assessment in the Experience Sharing Context" (Prof. Dr. Martin J. Eppler), **Swiss National Science Foundation (SNF)**
July. 2010 – Sept. 2012 Assistant Professor	**American University in Bulgaria** Courses taught: Management Information Systems (bachelor), Decision science (bachelor, executive MBA) Responsibilities: bachelor- and MBA-level teaching, supervising and grading student assignments and exam papers, course administration, university service, research
May 2007 – Nov. 2007 Course Manager & Teaching Assistant (university master course)	University of South Australia, Adelaide, Australia Course Manager for 'Fundamentals of Information Systems M' (FISM) Responsibilities: master-level teaching, online teaching – giving online seminars via the course website, supervising and grading student assignments and exam papers, course administration
Oct. 2003 – May 2004 Research Assistant	University of Hohenheim, Department of Informatics, Stuttgart, Germany Research in the field of Requirements Engineering

AWARDS
2020 – EMMA conference: best paper award nomination
2015 – Academy of Management Meeting 2015: best paper proceedings
2006 – 19th Bled eConference eValues: best paper award nomination

PUBLICATIONS (née Shumarova)
Study Handbooks
Hilgers-Yilmaz U., **Alexander E.**, Studienskript „Grundlagen Online Medien“, Hochschule Macromedia, Stuttgart, Deutschland
Homscheid T., **Alexander E.**, Studienskript „Internationalisierung“, Hochschule Macromedia, Stuttgart, Deutschland
Homscheid T., **Alexander E.**, Study Handbook „Internationalisation“, Macromedia University of Applied Sciences, Stuttgart, Germany
Peer-reviewed Journal Articles
Alexander, E., Eppler, M. J., Comi, A., (2020). “Data Integration: A Real-Time, Participant-Driven, and Visually Supported Method”, ***Journal of Mixed Methods Research***, online first, DOI: 10.1177/1558689820902294, p. 1–27.
Alexander, E., Eppler, M. J., Bresciani, S., (2019). “Visual Replay Methodology: A Mixed Methods Approach for Group Discussion Analysis”, ***Journal of Mixed Methods Research***, Vol. 13(1), DOI: 10.1177/1558689816664479, p.33–51.
Alexander, E., Bresciani, S., Eppler, M. J. (2015). “Understanding the Impact of Visual Representation Restrictiveness on Experience Sharing: an Experimental Assessment”, ***Journal of Visual Languages and Computing***, Volume 31, pp. 30-46
Alexander, E., Bresciani, S., & Eppler, M. J. (2015). Knowledge scaffolding visualizations: A guiding framework. ***Knowledge Management & E-Learning***, Volume 7, Issue 2, pp. 179–198.
Alexander E. (2014), “Essentielle Experimente: Hilfreiche Forschungsergebnisse für Change-Prozesse”, ***OrganisationsEntwicklung***, Handelsblatt Fachmedien GmbH, 03/2014 , pp. 38–44.
Loubeau P. R., Jantzen R., **Alexander E.** (2014), “Profiles and Preferences of On-line Millennial Shoppers in Bulgaria”, ***Economic Review – Journal of Economics and Business***, Volume XII, Issue 1, pp. 63–79.
Loubeau P. R., **Alexander E.**, Kalchev G. (2011), “Profiles and Preferences of Online Millennial Shoppers in Bulgaria and Croatia”, ***Journal of Euromarketing***, Volume 20, Number 1 & 2, 2011, pp.85–102.
Shumarova E. and Swatman P. A. (2007), “eValue and Value-driven User Responses to Information Technology”, ***Electronic Markets,*** Volume 17, Issue 1 February 2007, pp. 5–19.

Peer-reviewed Conference Papers

Alexander, E., Eppler, M. J. & Comi, A. (2018). "Building on Disagreement Visually: The System and the Method". *Proceedings of the European Conference of Information Systems (ECIS 2018)*, Portsmouth, UK.

Alexander, E. & Eppler, M. J. (2018). "Visualizing Disagreement in Survey Responses to Revise Correlational Models: a Mixed Methods Approach". *European Academy of Management Conference (EURAM 2018)*, Reykjavik, Iceland.

Alexander, E., Eppler, M. J. & Comi, A. (2018). "Interaction Patterns: A Visual Approach to Mixed Methods Research". *Proceedings of the European Conference on Research Methodology for Business and Management Studies (ECRM 2018)*, Rome, Italy.

Alexander, E. (2018). "Mixed Methods Research" Basic Designs and Methods: a Visualization for Teaching Purposes". *Third Global Conference of the Mixed Methods International Research Association*
(MMIRA International Conference 2018), Vienna, Austria.

Alexander, E., Bresciani, S. & Eppler, M. J. (2017). "Innovating team communication through interactive visualization: visual restrictiveness or visual freedom". *Annual Conference of the SACM SGKM*, Switzerland.

Alexander, E., Comi, A. & Eppler, M. J. (2016). "Integrating Quantitative and Qualitative Data through Visualization: A Mixed Methods Approach". *76th Annual Meeting of the Academy of Management,* Anaheim, California.

Alexander, E., Comi, A. & Eppler, M. J. (2016). "Displaying Minority Opinions Visually: Focusing on Disagreement in Group Discussion". *British Academy of Management Conference*, Newcastle, UK.

Alexander, E., Bresciani, S. & Eppler, M. J. (2015). "The Effect of System-embedded Visual Restrictiveness on Experience Sharing". In John Humphreys (Ed.), ***BEST PAPER PROCEEDINGS*** *of the 75th Annual Meeting of the Academy of Management*, Vancouver, Canada. Online ISSN: 2151-6561

Alexander, E., Eppler, M. J., Bresciani, S. (2015). "A Visual Re-Play Methodology for Group Discussion Analysis", *75th Annual Meeting of the Academy of Management,* Vancouver, Canada

Alexander, E., Eppler, M. J., Bresciani, S. (2015). "A Re-Play Analysis Methodology for Small-Group Communication Research: Unique Characteristics, Potential Benefits and Application Guide", *Proceedings of the 65th Annual Conference of the International Communication Association (ICA),* San Juan, Puerto Rico.

Alexander, E., Eppler, M. J., Bresciani, S. (2014). "Introducing a Re-Play Analysis Methodology for Small-Group Communication Research: A Coding Scheme and Application", King, D. et al. (Eds), *Proceedings of the Intellectbase International Consortium Conference*, vol. 36, Fall 2014, Atlanta, pp. 158–176.

Alexander, E., Bresciani, S. & Eppler, M. J. (2014). "How Visual Restrictiveness Affects Group Communication Effectiveness: Experimental Evidence". *Proceedings of the International Conference on Communication, Media, Technology and Design (ICCMTD)*, Istanbul, Turkey.

Alexander, E., Eppler, M. J., & Bresciani, S. (2013). "Knowledge Scaffolding: A Classification of Visual Structures for Knowledge Communication in Teams", *Proceedings of the 13th International Conference on Knowledge Management and Knowledge Technologies – i-Know '13,* Graz, Austria, ACM Press, pp. 8:1–8:8.

Loubeau P. R., **Alexander E.** (2013), "Online Apparel and Accessories: Most Purchased Category Among Bulgarian and Croatian Millennials", *Proceedings of the 12th International Business and Economy Conference,* Caen, France, 2013.

Loubeau P. R., **Alexander E.**, Kalchev G. (2012), "Online Shopping Behavior of Millennials in Bulgaria and Croatia", *Proceedings of the International Conference on Global Business Environment,* Bangkok, Thailand, 2012.

Shumarova E. and Swatman P. A. (2008), "Informal eCollaboration Channels: Shedding Light on Shadow CIT", *Proceedings of the 21st Bled eConference eCollaboration,* 2008, Bled, Slovenia, pp. 371–394.

Shumarova E. and Swatman P. A. (2006), "The New Economy, eValue and the Impact on User Acceptance of Pervasive IT', *Proceedings of the 19th Bled eConference eValues,* 2006, Bled, Slovenia. ***BEST PAPER AWARD NOMINATION***

Shumarova E. and Swatman P. A. (2006), "Diffusion of Socially Pervasive IT Innovation through the Lens of Cognitive Elaboration and Perceived Behavioural Control", *Proceedings of the CollECTeR Europe Conference – Collaborative Business,* June 09–10, 2006, Basel, Switzerland, pp. 207–223.

Shumarova E. and Swatman P. A. (2006), "The Dynamics of Innovation in Electronic Networks – a System Dynamics Perspective on IT Innovation Diffusion", *Proceedings of the 24th International Conference of the System Dynamics Society*, 2006, Nijmegen, the Netherlands, pp. 2–25.

Doctoral Dissertation

Shumarova E. (2009), "Authority-Based and Bottom-Up Diffusion of Collaboration Information Technologies: Constraints and Enablements", **German National Library**, University of Koblenz-Landau, Germany, Faculty of Informatics, permanently available http://d-nb.info/997757205 , pp. 1–436.

Newspaper Article

Shumarova E. (2010), "Mirikle", *Drom-domendar*, sponsored by the ***America for Bulgaria Foundation***, November 2010, XVI, issue 13–14.

UNIVERSITY TEACHING EXPERIENCE (Bulgaria, Australia, Switzerland)

Courses taught (teaching evaluations available upon request)

Course	Semester	University	Type	Enroll-ment
Strategy and Practice of Corporate Communications	Summer 2020	Macromedia University of Applied Sciences	bachelor	17
Empirical Research and Statistics	Summer 2020	Macromedia University of Applied Sciences	bachelor	22
Online Media	Summer 2020	Macromedia University of Applied Sciences	bachelor	33
Internationalization	Summer 2020	Macromedia University of Applied Sciences	bachelor	10
Media Economics and Media Policy	Summer 2020	Macromedia University of Applied Sciences	bachelor	5
Scientific Work	Sommer 2020	Macromedia University of Applied Sciences	bachelor	130
Participatory Digital Media	Spring 2019	University of St. Gallen	master	31
Decision Science	Summer 2013	American University in Bulgaria	executive MBA	22
Decision Science	Summer 2012	American University in Bulgaria	executive MBA	21
Decision Science	Spring 2012	American University in Bulgaria	bachelor	12
Management Information Systems	Spring 2012	American University in Bulgaria	bachelor	81
Management Information Systems	Fall 2011	American University in Bulgaria	bachelor	50
Management Information Systems	Spring 2011	American University in Bulgaria	bachelor	77
Management Information Systems	Fall 2010	American University in Bulgaria	bachelor	65
Fundamentals of Information Systems	Winter 2007	University of South Australia	master	38
Fundamentals of Information Systems (online course)	Winter 2007	University of South Australia	master	10

TALKS GIVEN AT INTERNATIONAL CONFERENCES

	Juni 2018, UK
	August 2018, Österreich
September 2016, UK	*Annual Meeting of the British Academy of Management, Newcastle* Short talk presenting paper entitled "Displaying Minority Opinions Visually: Focusing on Disagreement in Group Discussion"
August 2015, Canada	*Annual Meeting of the Academy of Management, Vancouver* Short talk presenting **BEST PAPER PROCEEDINGS PAPER** entitled "The Effect of System-embedded Visual Restrictiveness on Experience Sharing"
August 2015, Canada	*Annual Meeting of the Academy of Management, Vancouver* Short talk presenting paper entitled "A Visual Re-Play Methodology for Group Discussion Analysis"

February 2012, Thailand	*International Conference on Global Business Environment, Bangkok* Short talk presenting paper entitled "Online Shopping Behavior of Millennials in Bulgaria and Croatia"
June 2008, Slovenia	21st Bled eConference eCollaboration, Bled Short talk presenting paper entitled "Informal eCollaboration Channels: Shedding Light on Shadow CIT"
July 2006, Holland	*24th International Conference of the System Dynamics Society, Nijmegen* Short talk presenting paper entitled "The Dynamics of Innovation in Electronic Networks – a System Dynamics Perspective on IT Innovation Diffusion"
June 2006, Slovenia	*19th Bled eConference eValues, Bled* Short talk presenting paper entitled "eValue and Value-driven User Responses to Information Technology"
June 2006, Switzerland	*CollECTeR Europe Conference – Collaborative Business, Basel* Short talk presenting paper entitled "Diffusion of Socially Pervasive IT Innovation through the Lens of Cognitive Elaboration and Perceived Behavioural Control"

OTHER RELEVANT PROFESSIONAL EXPERIENCE

Jan. 2008 – Dec. 2008 **Web Designer**	**University of Stuttgart**, Germany Symposium co-organisation: 4th International Symposium 'Networks for Mobility 2008', Sept. 25-26, 2008, Stuttgart, web design (www.uni-stuttgart.de/fovus, www.vwi-stuttgart.de)
June 2004 – April 2007 Responsible for Internet Marketing	**altenda GmbH**, Stuttgart, Germany (one of the biggest eBusiness projects in Germany at that time) Internet Marketing: pay per click advertising, banner ads, e-mail marketing, affiliate marketing, interactive advertising, search engine optimisation Trade Fair Lecture: CAT.PRO International Trade Fair for Innovative Product Development, Data and Process Management, Oct. 04–07, 2005, Stuttgart, *Lecture in German on the topic of "Project and Process Management through Electronic Networks"*
May 2002 – Sept. 2002 MBA Internship	**Robert BOSCH GmbH**, Schwieberdingen, Germany Project responsibility for creating the intranet web site, representing the company's project management system. Work included structuring the web site's information content, as well as technical creation of the HTML pages.

PROFESSIONAL TRAINING

Dec. 2016 – Feb. 2017 Certified JAVA Programmer –90 out of 100 points–	**Alfatraining**, Mönchengladbach, Germany Educational course 'JAVA – SE 8 Programming' 8 weeks full time
Oct. 2009 – Nov. 2009 **Certified SAP User** –with excellence–	date up education GmbH, Stuttgart, Germany SAP Education Partner Educational course 'SAP®-Software user certification, modularly with SAP® ERP (SAP R13®)', Module: Supply Chain Management Materials Management/ Sales and Distribution/ Production Control

COMPUTER SKILLS

Programming	Object oriented programming in **JAVA,** Regression Analysis in **R**, Google Script
Operating Systems	Microsoft Windows, Apple OS X, MS DOS
Standard Software	Word Processing, Spreadsheet Processing, Presentation, Project Management
Special Solutions	***Data Analysis***: Statistical Package for Social Sciences (SPSS), MAXQDA (Mixed Methods Research), MS Excel, StatTools 5.7 for Excel, PROCESS for SPSS (Mediation/Moderation) ***Bibliography***: ResearchSoft, EndNote, ProCite; ***Content Management***: Plone, Leximancer; ***Graphic Design***: Adobe Photoshop, Adobe Illustrator, Corel Draw, Jasc Paint Shop Pro, MS Visio, MS Paint, MS Publisher; ***Internet Marketing***: Internet Business Promoter, Arelis, MartTracker, eXTReMe Tracker; ***Group Work***: IBM Lotus Notes Collaboration Tools, GroupSystems ThinkTank; Supply Chain Management: SAP® ERP
Web Design	HTML, XML
Database	MS Access, MS SQL, MySQL

LANGUAGES

Bulgarian	mother tongue
English	fluent (spoken and written)
German	fluent (spoken and written)
Russian	fluent (spoken and written)

PROFESSIONAL MEMBERSHIP

Academy of Management, British Academy of Management, Association for Information Systems

PROFESSIONAL ACTIVITIES

Reviewer	Journal of Visual Languages and Computing Journal of Mixed Methods Research Academy of Management British Academy of Management Hawaii International Conference on System Sciences

UNIVERSITY SERVICE

2020 – now	University Committee for Knowledge Transfer, Macromedia University of Applied Sciences
2011 – 2012 University Committee Chair	University Library Committee Chair, American University in Bulgaria
2016 – 2018 Steering Committee Member	British Academy of Management Research Methodology Special Interest Group

DE-Klettgau, 27.07.2020