The Benefits of Sketching for Management.
Literature Review and Experimental Evaluation

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The President:

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Executive Summary

Despite the fact that flipcharts have been present in meeting rooms for many years, and blackboards shaped our schooling for decades, these media have been living an increasingly dire existence since the introduction of the presentation tool PowerPoint. The aim of this thesis is to provide hard evidence that collaborative sketching is still able to provide real added value to discussions, sales meetings and problem-solving tasks in management.

Based on a literature review and two experiments conducted during the compilation of this thesis, the effect of sketches is investigated. The literature gives answers to the question of the advantages of sketches in the field of knowledge management. It shows how sketches can support the knowledge management's functions of creating knowledge, sharing knowledge and documenting knowledge.

The second article deals with seller-buyer interactions and investigates the influence a sales presentation can have on a customer's attitude towards the salesperson and his or her intention to buy.

The third article examines the joint annotation of quantitative charts in a typical project meeting. Apart from examining the question of whether groups able to jointly annotate their charts found the correct solution more often; the article also pursues the matter of whether annotations can support groups in being less distracted by anecdotal evidence.

Overall, this discussion is able to show that sketching has certain advantages and should thus be part of every manager's toolbox. Although acknowledging the strengths of PowerPoint presentations, sketches still do have a right to exist.

Kurzdarstellung

Obwohl Flipcharts seit Jahren in den allermeisten Sitzungszimmern stehen und Wandtafeln den Schulunterricht während Jahrzehnten geprägt haben, fristen diese Medien seit der Einführung der Präsentationssoftware PowerPoint eher ein Schattendasein. Das Ziel dieser Dissertation ist es, einen Beitrag dazu zu leisten, wie das gemeinsame Skizzieren auch heute noch einen echten Mehrwert zu Diskussionen, Verkaufsgesprächen und Problemlösungsaufgaben im Management zu verrichten vermag.

Basierend auf einer Literaturrecherche und zwei Experimenten wird in dieser Dissertation die Wirkung von Skizzen untersucht. Die Literaturrecherche befasst sich mit der Fragestellung, welche Vorteile Skizzen im Bereich des Wissensmanagements haben. Es wird aufgezeigt, wie Skizzen die Funktionen Erzeugen von Wissen, gemeinsames Nutzen von Wissen und Dokumentieren von Wissen massgeblich unterstützen können.

Der zweite Beitrag befasst sich mit der Verkäufer-Käufer-Interaktion und untersucht, welchen Einfluss die Verkaufspräsentation auf die Einstellung des Kunden in Bezug auf seine Haltung gegenüber dem Käufer, als auch auf seine Kaufabsichten haben kann.

Der dritte Artikel untersucht das gemeinsame Annotieren von quantitativen Diagrammen durch Mitglieder eines Teams in einer typischen Projektsitzung. Neben der Frage, ob Gruppen, die auf ihren Darstellungen gemeinsam skizzieren können, öfter die richtige Lösung finden, wird auch der Frage nachgegangen, ob Annotieren dazu beiträgt, dass sich die Gruppen weniger stark von Einzelfallberichten ablenken lassen.

Insgesamt vermag diese Diskussion zu zeigen, dass die Technik des Skizzierens durchaus Vorteile hat, die zum Werkzeugkasten eines jeden Managers gehören sollte und als nützliche Ergänzung zu PowerPoint Präsentationen nach wie vor ihre Existenzberechtigung hat.

Introduction

We live in times of polished presentations, flashy flyers, glossy brochures, and refined workshop methodologies. Yet many of us feel that this way of rigid rituals and dictatorial slide presentations is not always conducive to communication, information sharing, consensus building or creativity. Nor does it create the kind of energy and commitment that most managers would like to generate in their communication. The presentation software PowerPoint is ubiquitous in corporate, pedagogical, governmental and non-governmental settings, or, to make a long story short—everywhere (Yates and Orlikowski, 2007). Microsoft estimates that there are more than 30 million PowerPoint presentations made every day (Parker, 2001). The advent of PowerPoint vanquished traditional techniques and blackboards, and became the normal channel of business communication (Tufte, 2003). Interesting in this context is, that the effect of this kind of communication is unclear (Stoner, 2007).

It is therefore not surprising that for some time now a counter trend has been emerging in business collaboration and communication: the practice of personally-engaging live sketching is replacing polished, but often boring and unproductive slide presentations. There are numerous, documented benefits of live sketching for management and knowledge management in particular. These benefits have been discussed and demonstrated in various research projects on the topic of sketching, primarily in the areas of psychology, engineering, design, education, and computer science (Buxton, 2007; Eppler and Pfister, 2012; Mayer, 2007; McGown *et al.*, 1998).

Sketching in general, according to design guru Bill Buxton, can be considered a tool of thought that enables the mind to capture things which are in flux and iteratively refine them (Buxton, 2005). This tool of thought has been used by many great minds to develop their ideas and understanding. Leonardo da Vinci, for example, was an avid sketcher. In his diary he notes that sketches often let him discover things he did not know he knew or detect newly emerging

patterns which led to new ideas. Charles Darwin used conceptual sketches to develop his theory of evolution. His sketch of an evolutionary tree of life is documented in his sketchbook and diaries. Sigmund Freud relied upon sketches to refine his theories on psychoanalysis and psychopathology. The philosopher Ludwig Wittgenstein used sketching as a way to refine, illustrate or clarify his thoughts. Also Albert Einstein, one of the most influential physicists, used to sketch. The quote "My pencil is smarter than I am" is accredited to him. In this beautifully simple phrase, he expressed a very profound truth. Namely, what he meant is that when we sketch and thus test out our theories and inner thought processes in the outer, objective world, we can get results that we did not see or expect in the beginning.

It is not surprising that architects, engineers and designers sketch in the early stages of their work, as the simple hand drawing increases their creative and conceptual skills. Sketching is fundamental to disciplines such as industrial design, graphic design and architecture (Tohidi *et al.*, 2006). But sketching is not only useful when working individually. Quite the contrary actually, as sketches have the ability to achieve a common focus. In meetings for example, participants comment on each other's sketches and remarks. Thereby, they start to converge in their interpretation processes, clarify basic assumptions, stimulate different perspectives and extrapolate trends into the future. Through their playful, collaborative, and informal mode, sketches contribute to a truly open dialog that is characterized by the suspension of one's own beliefs and assumptions and an active engagement with the viewpoints of others.

This study investigates the usage of sketches in daily management applications from a theoretical and practical perspective. This thesis is based on an extensive literature review and two experiments, which allow testing of the theoretical findings with both students and real-life managers.

Research Objectives

Although the benefits of conceptual sketching and visual annotations have been discussed in the research fields mentioned above, the topic has not been discussed extensively in management literature. Dan Roam's bestseller on the topic is a notable exception (Roam, 2009). This popular management book primarily relies, however, on anecdotal evidence. Other books go in the same direction (cf. Rhode, 2012; Gray *et al.*, 2010). The research objective of this thesis thus aims to examine the usage of hand-drawn sketches in management. The term sketching in this contribution is used in the sense of the dictionary's definition of "A rough drawing representing the chief features of an object or scene, often made as a preliminary study" (Merriam-Webster, 2008) and sketching is defined as hand-drawn, simple drawings on a poster, flipchart, piece of paper or via a digital pen on a tablet PC or an interactive electronic whiteboard. As later elaborated upon, the sketching technique is widely used both to clarify ideas and develop new ones by architects and designers (Fish and Scrivener, 1990), as well as in other collaborative contexts, as sketching markedly improves communication by allowing team members to simultaneously share ideas verbally and visually (Clemmensen *et al.*, 2006).

As sketching in this thesis is examined solely in management situations, the term is hence more narrowly subsumed than in general definitions. Managerial sketching is therefore defined as analytical sketches done either by managers, for managers or more generally, in a managerial context. A more specific form of sketches are the so-called sketchmarks, which are defined as follows in this context: "A sketchmark is a hand-drawn, simple, and ad hoc annotation, modification, or addition to one or several elements of a quantitative or qualitative diagram on a poster, flipchart, piece of paper, or via a digital pen on a tablet PC or interactive whiteboard. A sketchmark is drawn during a conversation, usually in front of colleagues involved in a joint decision or discussion process." (Eppler and Pfister, 2010, p. 369).

The thesis presents a systematic literature review to provide an overview of the current state of knowledge in this field as well as two experiments to analyze the effects of joint sketching in two different contexts. The intention behind the conducting of experiments is to generate hard facts with strong practical relevance to the benefits of sketching in a managerial context in order to legitimatize them for practice. The results of this thesis are ultimately intended to provide answers to the questions of if the often described benefits of live annotation and sketching have the same benefits in a management context as in the domains previously examined; and if they can become hardened in three important aspects of day-to-day management—namely convincing, deciding and managing knowledge.

The motivation for the chosen approach can be found in the following rationale: The state-of-the-art literature review is conducted as it is inalienable to get an overview of the current state of knowledge in this field. This desk-based research allows for a thorough overview and prevents the conduct of research in aspects of this field, where a lot of knowledge is already available and, in the worst case, the research question has already been discussed by other scientists. The literature review then leads to the second method, the scientific experiment. A gap in current research in the field of sketching was identified, that is to say, hardly any research has been done on the usage of sketches in management and secondly, there were no experiments conducted in this circumstance of practice. This means, that hard facts on the benefits of managerial sketching are not yet available. But for all that, having hard facts only allows legitimizing for practice, and doing research with practical relevance is eminent in the field of management.

A survey, a different but less performative method which could have been chosen in science, is not adequate in this specific context—as people's opinion was not of interest, but the effects thereof. Where the survey would tell a reader about how managers think and feel about sketches, the experiments will deliver measurable results in the sense that in the first experiment, the quality of the

customer-sales representative relationship is expected to be higher and in the second experiment, the result of the team's decision is expected to be better.

In order to conduct high quality research, the quality of the data used needs to be ensured based on methodological rigor, which relates to the overall planning and implementation of the research design and is concerned with whether the study has been carried out in a logical, systematic way. Rigor is described as the striving for excellence in research through the use of discipline, scrupulous adherence to detail and strict accuracy (Tobin and Begley, 2004) and consists of reliability and validity. According to social researcher Punch, data quality is the degree to which the collected data, as results of measurement or observation, meet the standards of quality considered to be valid and reliable (Punch, 2005).

The thesis commences with a literature review on publications on the benefits of sketching for knowledge management. The company's function of knowledge management was chosen, firstly as "managing knowledge as a corporate resource has been looked to as one of the few foundational weapons that promise to deliver sustainable distinctive competencies in the future" (Janz and Prasarnphanich, 2003, p. 352) and secondly because it requires a particularly high degree of sharing and dissemination (i.e. collaboration) of personal and organization experience (Gold *et al.*, 2001). The review is done at the intersection of the three research fields - design, computer science and psychology. "A substantive, thorough, sophisticated literature review is a precondition for doing substantive, thorough, sophisticated research" (Boote and Beile, 2005, p. 3) The importance of an in-depth literature review was also highlighted by Webster and Watson (2002) who emphasized that a review of prior, relevant literature is an essential feature of any academic project which facilitates uncovering areas, where research is needed. According to Randolph (2009), an effective method of beginning to plan the literature review is to consider where the proposed review fits into Cooper's Taxonomy of Literature Reviews (Cooper, 1988). Corresponding to the aforementioned classification, the literature review conducted in this thesis will focus on research outcomes with an exhaus-

tive coverage utilizing selective citation. The literature review thus provides answers to the following question:

> ***Benefits of sketching:*** *Which benefits of sketching for knowledge management can be derived from a literature review in different research streams?*

The first experiment evaluates different presentation formats in face-to-face sales encounters. As a consequence of the wealth of product and sales information they receive, prospective customers are often overwhelmed. Especially in the financial industry, the amplitude of information makes it difficult for customers to make a decision. The same applies to face-to-face sessions, where advisors overwhelm a prospect with slides, flyers, and reports. Hence, customers frequently rely on visual cues which allow them to concentrate on essential information. Two different approaches are used in sales to address this preference: Firstly, the so-called 'pencil-selling technique'—a visual communication approach where a salesperson visualizes his or her ideas on a piece of paper whilst talking; and secondly the usage of digital devices such as tablet PCs. The sales presentation can be seen as the core of the selling process (Johnston and Marshall, 2003) and influences several critical factors for successful sales. An extensive literature review on those factors crystallized a selection of aspects which would serve as dependent variables in the study. The experimental arrangement consisted of a single interaction between the salesperson and the prospect, and consequently relationships for longer periods had to be factored out. Additionally, the chosen factors had to allow for the forming of an opinion in a very short time. At the same time, it was crucial that the treatment in the experiment would show short-run effects. As a result, the study focuses on the factors of salesperson competence, empathy, customer orientation, trust and loyalty.

The experiment thus allows the investigation of the following research questions:

> ***Attitude towards the salesperson:*** *How does a collaborative, paper-based sales presentation influence the customer's attitude towards the salesperson?*
>
> ***Intention to buy:*** *Can a customer's intention to buy be influenced through the chosen format and degree of collaboration?*

In the second experiment sketching is used in the application of so-called sketchmarks on quantitative charts to cover the aspect of deciding. The fact that decision making has a particularly significant role in management has already been maintained by Drucker (1993) who affirmed, that more than 90 percent of a manager's activities involve decision making. Quantitative charts such as portfolio diagrams, bar, line or pie charts often form the basis for management decisions—for example in the context of strategy or project reviews. Such quantitative charts are often discussed in management teams based on a prior slideshow presentation or a printed report. In the ensuing discussions, however, managers may detach themselves from the presented or reported data and revert to their own experience or prior opinions instead of focusing on the presented data and their meaning and implications. Another frequent challenge of such meetings consists of creating a collaborative atmosphere and coming to a truly shared understanding of a strategy or a project portfolio. Many managers also struggle to fully capture their deliberations and argumentations for subsequent meetings or follow-up decisions. An alternative, often more effective way to support such decision and communication processes consists of giving managers the opportunity to jointly annotate the presented charts, either on a poster or flipchart (or through a multi-touch large screen or an interactive whiteboard), thus literally working with the chart and using it as an inscription device (Henderson, 1991) to capture their collective interpretations of the represented data and make the data's implications visible to everyone. Managers can make use of such simple sketchmarks to augment the quality of their group communication. Positively or negatively valued informa-

tion (e.g. anecdotal evidence) can influence the formation of judgments. The experiment is designed to compare the decision and communication performance of management groups in regard to their usage of live annotation and sketching activities; and to provide evidence that unrelated, anecdotal evidence has a much lower impact and thus has less influence on the decision when the team members process information by using the sketching technique. Hence, the second concept introduced is the notion of sketchmarks or mark-ups on diagrams using hand-drawn sketches.

> ***Make the right decision:*** *How does joint annotation of charts support teams in coming to a correct decision?*
>
> ***Avoid distraction:*** *Does joint annotation of charts lead to a greater focus on facts and thus less distraction via anecdotal evidence?*

Outline of the Thesis

To address the research questions above in a structured way, the thesis is organized into three chapters. Each chapter represents a peer-reviewed manuscript that is either published in (Chapter 1), submitted to (Chapter 3), or in preparation for submission to a scientific journal (Chapter 2).

Chapter 1 is based on a manuscript published in the *Journal of Knowledge Management* and presented in a slightly different form at the 11th International Conference of Knowledge Management (i-KNOW '11). This manuscript reviews the benefits of sketching or ad hoc, collaborative hand drawings for knowledge creation, knowledge sharing, and knowledge documentation and thus highlights the often overlooked role of informal drawings in team knowledge management and may encourage scholars to examine this important visual practice. A comprehensive literature review has been conducted in the fields of design, psychology, and computer science; this documents the multiple advantages of sketch-based approaches for managing knowledge in organizations, especially at team level. The evaluation recommends a complementary use of this 'low-

tech knowledge management' approach with existing digital infrastructure and tools. The manuscript concludes with a set of propositions for practitioners regarding the use of sketching in different knowledge management contexts and implications for future research in this area.

Chapter 2 contains a manuscript in preparation for submission to the *European Journal of Marketing* and is an adapted version of a manuscript presented at the 16th International Conference on Information Visualization (IV12); which discusses the benefits of using a variety of interactive, collaborative presentation formats in face-to-face sales encounters. How important the sales presentation is within the selling process has been stressed by both academics and practitioners alike. While the presentation's language, content and the visuals used has been the object of many dissertations, the aspect of collaboration and medium has been neglected. The manuscript reports on the results of the first experiment of this thesis. Financial sales meetings between prospective customers and a banking advisor where simulated to examine the impact of collaborative sales sessions. The findings suggest that a collaborative sales presentation has the power to significantly increase the positive attitude towards the salesperson, and in turn to significantly increase the intention to buy. The choice of a paper-based medium on the other hand, although some effects could have been demonstrated, does not have significant effects compared to computer-based media.

Chapter 3 is based on a manuscript under review by *Management Decision* and is an (through empirical validation) extended version of a manuscript presented at the 14th International Conference on Information Visualization (IV10); which deals with the question of how jointly annotating quantitative charts leads to higher decision accuracy. Nowadays, management teams frequently make important decisions based upon the graphic representation of quantitative evidence or projections (i.e. bar, area, or line charts). The extensive use of such charts creates a dual challenge: creating a collaborative atmosphere to make sense of the evidence, while still staying close to the actual data. A man-

ner by which to support such decision and communication processes consists of giving managers the opportunity to jointly annotate the presented charts. The manuscript reports on the second experiment of this thesis which required participants to solve a simple case study. Whereas one group solved the case by jointly annotating the charts, the other group had no possibility to alter the graphical representation of the relevant financial figures. The results suggest that such annotation dramatically improves the decision accuracy of managers.

Through this combined approach of literature review and experiments in two different settings, we were able to see which benefits of sketching can be derived from the literature (particularly in the area of knowledge management) and which ones can be confirmed empirically in day-to-day management settings such as decision making or persuasion.

Chapter 1

The Benefits of Sketching for Knowledge Management

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Keywords – Knowledge management, knowledge transfer, knowledge creation, knowledge documentation, sketching, hand drawings

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1.1 Abstract

Purpose – In this paper, the authors aim to review the benefits of sketching or ad hoc, collaborative hand drawings for knowledge creation, knowledge sharing, and knowledge documentation.

Design/methodology/approach – The authors conducted a comprehensive literature review in the fields of design, psychology, and computer science that documents the multiple advantages of sketch-based approaches for managing knowledge in organizations, especially at team-level. The authors argue for the complementary use of this 'low-tech knowledge management' approach with existing digital infrastructures and tools. The literature survey is based on a search for the title term 'sketching' on the ISI Web of Knowledge online database. After topic filtering and eliminating all articles where sketching was used in the sense of a project proposal or a theoretical sketch, there were only 48 articles left related to the keyword 'sketching'. Based on the authors' awareness of important contributions in the field of sketching, which did not appear in the database search, they extended their inclusion criteria to include grey or conference literature and examined the reference sections of highly cited articles. The article concludes with a set of propositions for practitioners regarding the use of sketching in different knowledge management contexts and with implications for future research in this area.

Findings – Knowledge creation contexts, such as innovation management or problem solving sessions, provide participants with the opportunity to jointly devise large scale sketches in order to integrate their views and experiences on joint frameworks. In knowledge sharing situations, such as team briefings, or debriefings, hand-over processes, or strategic alliances, the equipping of all participants with pen and paper napkins for augmentation of their knowledge dialogues via visible means which facilitate interaction and turn-taking increases vividness and memorability, and allows for an authentic and personal follow-up documentation.

Research limitations/implications – An implication for research is the value of studying sketching in knowledge management through interdisciplinary research efforts. This could be done by paying attention to the way that digital and hand-drawn sketches differently affect interactions among professionals and the way that they share, defend, and integrate their knowledge. Specifically researchers with a background in organizational psychology could work jointly with human computer interaction specialists to study differences among analog and digital sketching activities. In this way one can learn about the respective risks and advantages of hand-drawn versus computer-supported sketching for knowledge-intensive group collaboration tasks.

Originality/value – The literature review resulted in an extended list of benefits which support three relevant tasks in knowledge management, namely knowledge creation, knowledge sharing and knowledge documentation. This compilation shows simple and effective ways in which the use of hand drawings can enhance existing knowledge management practices.

1.2 The Relevance of Sketching for Knowledge Management

Knowledge management (KM) can be considered to have at least partially grown out of the understanding that the mere reliance on information management infrastructures is probably not sufficient to enable organizations to utilize their intellectual capital effectively. While modern knowledge management applications (such as context-aware applications or collaborative filtering systems) are an important element for the solving of many knowledge management challenges (such as the on-demand retrieval of experiences codified in documents), it is not a panacea for all knowledge-related problems that companies face today. Many genuine KM problems—such as enabling teams to use all of their members' expertise when solving a problem—cannot solely rely on IT-based solutions, as these may be too demanding in terms of the required infrastructure or budget, or simply require too much training effort to unleash their full potential. At times, IT-based knowledge management technology may even distract knowledge workers from the tasks that they should focus on. A Gartner (2006) study found for example that those companies that had put knowledge management systems into place also had employees that reported higher perceived information overload than those organizations that had not implemented specific knowledge management technologies.

Based on these insights, there seems to be room for complementary, 'low-tech' or hybrid (low- and high-tech combination) approaches that can help to foster knowledge creation, sharing, and documentation. In this paper, such an approach is proposed for knowledge management, namely the use of collaborative, live hand drawings or *conceptual sketches*. The authors systematically review the documented benefits of this visual knowledge sharing practice (in such domains as computer science, psychology, and design) and derive action implications and recommendations for knowledge management practitioners and scholars. In doing so, the authors hope to highlight simple and effective ways in which the use of hand drawings can enhance existing knowledge man-

agement practices. In this context, the authors will also show how simple 'analog' hand drawings can be combined and integrated with more sophisticated digital knowledge management technology. The paper concludes with an outlook on future research in this area. First, however, the authors will define and delineate the realm of sketching in Section 1.3, before presenting the literature review on its benefits in Section 1.4 and the implications for knowledge management in Section 1.5.

1.3 The Realm of Sketching

Sketching in general can be considered as a tool of thought that enables the mind to capture things which are in flux and iteratively refine them (Buxton, 2007). This tool of thought has been used by many great minds to create and convey breakthrough knowledge: Leonardo da Vinci, for example, was an avid sketcher. In his diary he notes that sketches often let him discover things he did not know he knew or detect emerging patterns that lead to new insights. Charles Darwin used conceptual sketches to develop his theory of evolution (as documented in his sketchbook and diaries), as did Sigmund Freud who relied on sketches to refine his theories on psychoanalysis and psychopathology. Another luminary who used sketching as a way to refine or clarify his thoughts and surface his implicit knowledge was Ludwig Wittgenstein. Even KM's überguru Michael Polanyi mentions sketching in his treaty on personal knowledge, as a way to make tacit knowledge explicit by holding a visual dialogue with oneself (Polanyi, 2003).

In this article, sketching is defined as hand-drawn, simple drawings on a poster, flipchart, piece of paper or via a digital pen on a tablet PC or an interactive electronic whiteboard. As elaborated upon below, the sketching technique is widely used to both to clarify ideas and develop new ones by architects and designers (Fish and Scrivener, 1990), as well as in other collaboration contexts, as sketching improves communication by allowing team members to simultaneously share ideas verbally and visually (Clemmensen *et al.*, 2006).

The following figure provides a simple example of this approach. Figure 1.1 represents the completed analysis conducted during a meeting by a management team regarding its service quality problem. Starting with the tip of the iceberg the team uncovers the participants' implicit knowledge about the problem by asking a series of why questions, and sketching the resulting answers in the metaphoric doodle.

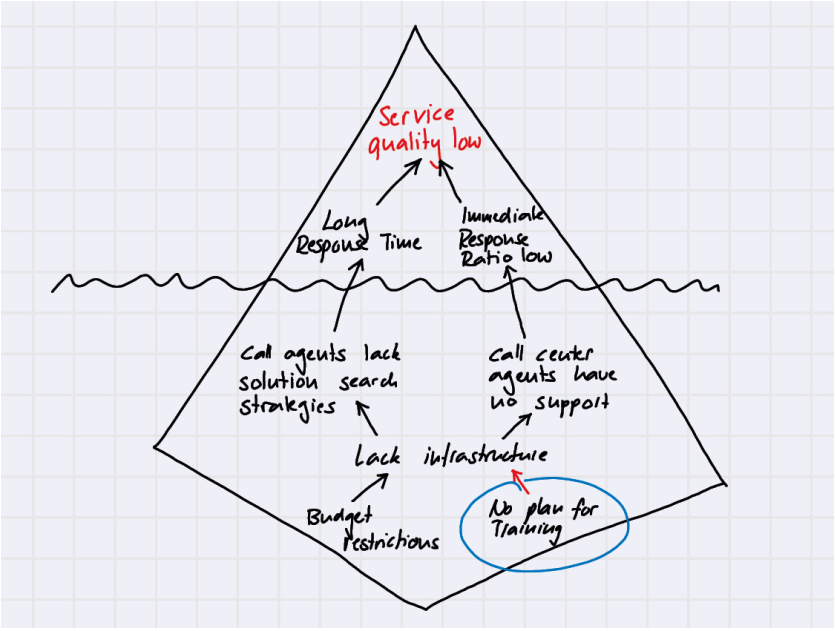

Figure 1.1 Completed analysis based on the Root Cause Iceberg (lessons learned gathering)

The goal of sketching in this context is to optimize the knowledge sharing among the participants of a meeting. The challenge teams very often face is how to create an environment which helps to clarify issues, to surface hidden knowledge, to support guidance of discussions or simply to communicate one's own knowledge in a more engaging and memorable way.

Imagine a regular meeting setting: All team members are gathered around a u-shaped table. The meetings starts as usual, with the only difference being that instead of kicking the meeting off by distributing printed hand-outs, the project manager sticks a large piece of brown paper to the wall. Instead of projecting slides onto the screen, the team is going to develop the visuals during the meeting and sketch them on paper. The facilitator therefore holds a pencil in his hand instead of a remote control. To tackle the meeting goal, he is making use of the metaphor-based template called Root Cause Iceberg (one of 35 sketching templates described in (Eppler and Pfister, 2011)).

The image of an iceberg is a very strong and well-known metaphor because of its clear characteristics. Only the tip of the iceberg sticks out of the water; the bulk of the volume is hidden below and invisible. Seeing only the effects of a problem, but leaving the causes and root causes in the dark is very similar to this. To initiate discovery of the underlying causes of a problem, the meeting's host starts sketching. In the top third of the page he draws a wavy line representing the water line. He continues by drawing a triangle, representing the iceberg itself. Two thirds of the iceberg are below the waterline to signal that most aspects of the problem are still hidden. The problem, summed up in a single word or a simple phrase is positioned above the waterline. Now it is time for the rest of the team to jump in.

The participants then identify the problem's causes and root causes and use arrows to connect them to the problem. This meeting setting, where all participants are standing in front of a large sheet of brown paper involves and mobilizes everybody to share his or her knowledge with the team. Using visual language allows more creativity and out-of-the-box thinking and motivates all participants to play a part in the discussion. As a result, it makes them more confident about the outcome, but they also feel more committed to their final decision, as it was reached in a collaborative and engaged manner.

The image in Figure 1.1 is a typical sketch used for knowledge sharing in the sense that by using the visual metaphor of the iceberg the image helps to ab-

stract or generalize from the concrete situation; and by drawing it during the meeting, without the support of any IT system, it signals a work-in-progress and invites everybody to modify the image or add extensions to it. By drawing while talking, it also indicates the process of how, and how fast to discuss the problem analysis, namely from overview to detail and no faster than the meeting host can sketch. In this way it is conducive to knowledge elicitation and sharing.

But beyond such anecdotal evidence, what are the specific, researched and documented benefits of this way of sketching for knowledge creation, sharing and documentation? To answer this question, the authors review seminal studies on sketching in the next section.

1.4 Literature Review

Having described the goal and rationale of reviewing the realm of sketching related to knowledge management, the authors now proceed to a concise literature review on sketching benefits that are relevant for knowledge management.

Sketching is fundamental to disciplines such as industrial design, graphic design and architecture (Tohidi *et al.*, 2006a). In this paper, all articles within this domain were subsumed under the term 'Design'. As those disciplines have been transformed dramatically through the emergence of the computer, together with its associated technology, as a medium of considerable promise for the manipulation and storage of visual imagery, it is not astonishing that there is a lot of interest in sketching within computer science (Murugappan and Ramani, 2009). There has also been a lot of attention in psychology when it comes to understanding how people think with the help of sketches (Tversky, 2002). The authors were therefore interested in literature from the domains of design, psychology and computer science, and limited their search to those three domains for a first review of sketching benefits documented.

The literature survey is based on a search for the title term 'sketching' on the

ISI Web of Knowledge online database, from which 406 articles were found on March 21, 2011. After topic filtering and eliminating all articles where sketching was used in the sense of a project proposal or a theoretical sketch, there were only 48 articles left related to the keyword 'sketching'. Based on the awareness of important contributions in the field of sketching, which did not appear in their database search, the inclusion criteria was extended to include grey or conference literature and the reference sections of highly cited articles were examined. Figure 1.2 represents a classification of the articles included in this literature review, displayed in a Venn diagram.

Most of the articles belong to the domain of design, followed by computer science and psychology. The figure also illustrates that there are several articles located at the intersections of psychology, design or computer science, but no

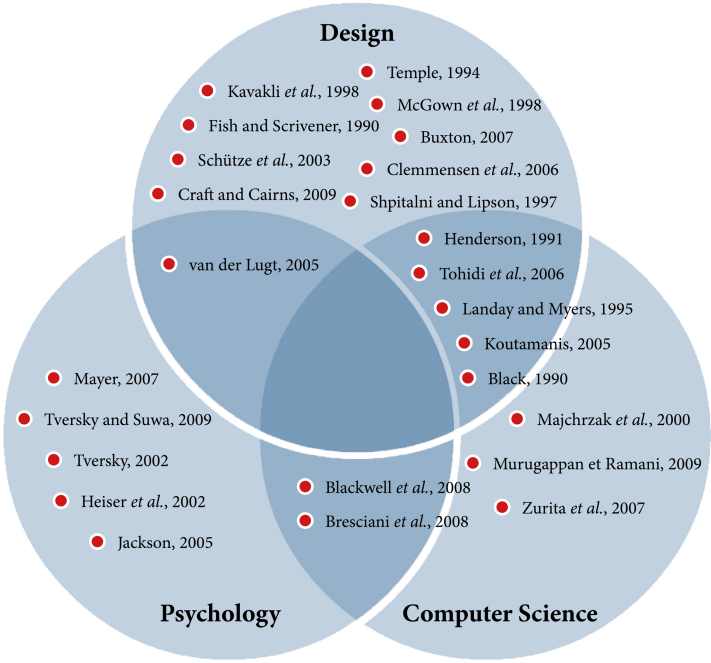

Figure 1.2 A classification of the reviewed articles

single article manages to provide an overview on sketching taking into account all three disciplines at once. The three domains and their respective studies will now be examined.

Stanford psychologist and sketching expert Barbara Tversky views sketching mainly from the perspective of cognitive *psychology* or thinking and therefore conceives of sketches as thinking tools (not just for individuals, but also for groups). According to Tversky, sketches facilitate the communication of ideas to others and collaborating with others (Tversky, 2009). She and her colleagues elaborate that in collaboration, sketches represent the idea of a group and not just of an individual which leads to the commitment of all group members. Sketches are useful because of their ability to externalize ideas, they encourage coherence and completeness and allow for an expression of the vague as well as the specific, map large space to small, extract the crucial, enrich by annotation, make the abstract concrete, relieve limited working memory, facilitate information processing, encourage inference and discovery, and generally promote collaboration (Heiser *et al.*, 2004).

In an experiment where pairs of students had to find the most efficient route to rescue a certain number of injured people, Tversky and her colleagues Heiser and Silverman were able to derive five important co-ordination benefits of sketching: In a conversation facilitated through sketching, collaborators can easily point to its relevant part and in doing so establish a joint focus among conversers. The shared external representation of the sketch thus serves as a shared focus of attention and makes the collaboration a continuous, on-going process and thereby promotes interactivity and involvement. Heiser, Tversky and Silverman (2004) were further able to show that sketches foster efficient and enjoyable collaboration which influences the time taken to reach a solution. Gesturing in relation to the sketches is conducive to creating shared meanings and finally leads to better listening and better recollection of the issues discussed. All of these are important benefits for knowledge creation and sharing in teams.

A comprehensive introduction to sketching in psychodynamic psychotherapy has been written by Mayer (2007). He describes the benefits of sketches as conversation and analysis catalysts among psychotherapists and their patients. According to Mayer, hand-drawn conceptual sketches generally provide many different advantages, mainly because they become a potentially unfiltered access point to the feelings and thoughts of a patient and let the therapist and patient explore important themes or issues together during a session, and also over time, by using older sketches in subsequent sessions. Sketches are thus also an important documentation device. Sketching in therapy becomes a reflection enabler that gives the patient and the analyst access to previously unarticulated hopes, fears, or experiences. In a knowledge management context, the authors would say that they make implicit knowledge explicit. They also engage people and keep them focused and concentrated, as well as helping to abstract or generalize from a concrete phenomenon or situation in order to crystallize experiences into explicit knowledge. Sketching, or the production of untidy images signals a work-in-progress and subjective perspectives and thus consequently invites modifications or extensions.

As seen earlier, sketches invite the drawer to explore a change in perspective and view things differently (which is instrumental for knowledge creation), and they also help to articulate previously implicit notions or beliefs. In the end, they become instant documentation for subsequent reference and later analysis and comparison (Mayer, 2007). This is, as a side note, exactly why the Swiss bank Credit Suisse uses sketches as a knowledge transfer and debriefing tool in its corporate knowledge management program.

In the domain of *design*, van der Lugt identified various functions of sketching in group activities (van der Lugt, 2005). Of the three identified functions, two of them are of particular interest for knowledge management: The stimulation of a re-interpretive cycle in the idea generation process and the stimulation of the use of earlier ideas by enhancing their accessibility. According to van der Lugt, sketching plays a positive role in the re-interpretation process which

provides new knowledge, which leads to further re-interpretation. By building a collective graphic memory, sketching also facilitates archiving and retrieval of information and fosters the group's creative process by providing an easily accessible database of design ideas, which stimulates building on earlier design ideas.

In their theoretical perspectives, the scientists and artists Fish and Scrivener stress the fact that sketching is conducted to both clarify existing ideas and to develop new ones; and that the necessity to sketch arises from the need to foresee the results of the synthesis or manipulation of objects without actually executing such operations (Fish and Scrivener, 1990). The benefit they have identified is that sketching facilitates the transition from general descriptive knowledge to specific depiction. According to Fish and Scrivener, sketches have a unique set of attributes that help the human mind in translating descriptive propositional information into depictive information. In knowledge management the authors would say that they help to transform conceptual knowledge into operational knowledge, a key for knowledge utilization or application.

Martina Schütze and her colleagues Sachse and Römer report the results of a study that showed that sketching during design activities produces significant benefits (Schütze *et al.*, 2003). In an experiment they have demonstrated that groups which were supported by sketching achieved a significantly higher solution quality compared to those without sketching. In this regard, sketching served as an aid for analysis, short-term memory, communication and documentation. In addition, it proved to be helpful for the development and testing of solutions as well as for the identification of errors.

As mentioned earlier, sketching has traditionally been central to the *design*-oriented disciplines of architecture, engineering and visual communication. In this context, Craft and Cairns (2009) elaborate that sketching is a particularly successful method for creativity and acts as an aid to memory during problem solving. Drawing upon the work of Landay and Myers (1995) they emphasize that sketching aids evaluation of design ideas by preventing individuals and

teams from focusing on unimportant low-level details and allowing them to concentrate on the larger conceptual issues at hand. This supports Black's finding, that "the finished appearance of screen-produced drafts shifts attention from fundamental structural issues" (Black, 1990, p. 284).

That sketching also serves another purpose, which was not discussed earlier, was identified by Henderson (1991) in her studies on technological design and production. She provides evidence that sketching helps to better understand the parameters of a given project. She illustrates that sketches can be used as an individual thinking tool, as well as a collective 'conscription device' (a melting pot for knowledge from different people). According to her studies, sketches serve as boundary objects, assist communication to refine ideas further and capture pertinent knowledge from many sources on the interactive level, such as multiple designers.

The third domain which examines the practice of sketching is *computer science*. Most of the articles found during the literature review containing the term 'sketching' in the title were from this domain. The reason for this circumstance is most likely the following fact: While the potential advantages of freehand sketches as being an efficient and natural way for users to visually communicate ideas have been widely recognized and exploited, it is still a major challenge to transform those informal and ambiguous freehand inputs into more formalized and structured digital representations (Murugappan and Ramani, 2009). The same explanation for the interest in sketching in the realm of user interface approaches for computer systems, and CAD systems in particular, can be found in Shpitalni and Lipsons work: "Sketching appears to be a natural communication language, enabling faster conveyance of qualitative information while not burdening the creativity of the user or disrupting the flow of ideas" (Shpitalni and Lipson, 1997, p. 131). Similar findings were also made by Jackson who elucidates that the usage of metaphors and analogies, as well as employment of sketching designs and visual analogies could increase the productivity of knowledge work and knowledge workers (Jackson, 2005).

In Koutamanis' research on transferring sketches to computer, he stresses the fact that sketching is a natural, unobtrusive way of focusing collaborative activities on common tasks and mirroring the discussions in a group (Koutamanis, 2005). The findings of Crafts and Cairns (2006) also go in this direction. They have documented a case study on using sketching to aid the collaborative design of an information visualization software application. Their key findings were that sketching was able to improve communication because it allowed the team members to simultaneously share ideas visually which helped them to clear up misunderstandings and build up simple ideas into complex ones. Their work also indicated that sketching allows the recording of an activity for later reference and helps team members to overcome so-called 'mental blocks'.

Especially the recording function of a sketch, which is of particular interest in the context of knowledge documentation, has perhaps been overlooked in favor of its spontaneity (McGown *et al.*, 1998), even though Temple already mentioned that "the sketch may possess the potential to act as both facilitator and recorder of creative acts" (Temple, 1994, p. 16).

Blackwell *et al.* (2008) provide an overview of the ways that sketches function as informal representation tools, especially when used in (software-) design contexts. In their project, they have investigated design experiences across a wide range of domains and were able to identify different functions of sketches. The project found "that sketches are used as depictions of potential objects in idea generation, but also as thinking aids for reasoning about abstract concepts" (Blackwell *et al.*, 2008, p. 12). According to them, sketching is especially supportive when applied in domains where there is no pictorial description of a product, such as in software design.

The value of sketching in the idea generation context was also underlined by Bresciani *et al.* (2008), who introduced the generic usability dimension of 'Perceived Finishedness' which means that users get encouraged to offer feedback on designs or ideas that are sketched—and thus signal their being work-in-progress.

Zurita, Baloian and Baytelman looked into the question of how a system which enables face-to-face collaborative design based on sketches using hand-held devices could support designers in spontaneously exchanging ideas and knowledge. Drawing upon the work of van der Lugt (van der Lugt, 2005), they emphasize that sketching facilitates the creator's idea generation process and simulates both communication of ideas as well as the early use of ideas; and therefore improves the participation and creativity of a group (Zurita *et al.*, 2008).

The fact that sketching supports the cognitive processes involved in idea generation and discovery was also discussed in Kavakli *et al.* (1998) in their work on the relationship between creative discovery, cognition and computer-supported design.

Tohidi and her colleagues Buxton, Baecker and Sellen pursued the question of whether sketching could help to elicit more reflective user feedback (Tohidi *et al.*, 2006b). In the process of developing a new design, in this case a user interface, usability testing is well-known and commonly used to involve prospective users. The commonly used techniques such as questionnaires, interviews and the observation of behavior during task performance fall short, according to the authors, in facilitating the reflection which is required to generate design ideas and alternative solutions. In their study they were able to show that sketching helps to better organize thoughts and that people who sketch come up with unexpected ideas, reflect on and refine previously stated ideas, and communicate their ideas to the experimenters more pro-actively. They furthermore discovered that sketches allow for deeper interpretation and analysis. In a study on computer-mediated interorganizational knowledge sharing, Majchrzak and her colleagues stressed the fact that sketching is mainly used for ambiguous tasks (Majchrzak *et al.*, 2000). Of interest in their study is the finding that the sketching technique was not only used in interpersonal media (such as face-to-face), but also with the aid of collaboration tools.

The compiled benefits of sketching not only differ with regard to their disciplinary background, but first and foremost with regard to how they support the relevant tasks in knowledge management such as knowledge creation, knowledge sharing and knowledge documentation.

In the following table, the benefits from the articles discussed are summarized and how they can support knowledge management is described. Given the fact that those benefits come from radically different disciplines, it is interesting to conclude that many of the benefits were found in more than just a single discipline.

The benefit most frequently mentioned across disciplines is by far that of the ability of sketches to facilitate information processing and support communication, which predominantly supports knowledge sharing, but equally knowledge creation.

Support derived	Benefits	Originators
Knowledge Creation	Represents ideas of a group and not just of individuals and thus increases commitment of all group members to process	(Tversky, 2009)
	Enhances coherence, completeness and creativity	(Tversky, 2009), (Zurita *et al.*, 2008), (Kavakli *et al.*, 1998)
	Allows expression of the vague, the specific and extraction of the crucial and relevant	(Tversky, 2009), (Heiser *et al.*, 2004), (Landay and Myers, 1995), (Black, 1990), (Clemmensen *et al.*, 2006)
	Makes implicit knowledge explicit	(Mayer, 2007)
	Helps to abstract or generalize from a concrete phenomena or situation	(Mayer, 2007), (Fish and Scrivener, 1990), (Blackwell *et al.*, 2008)
	Signals work in progress and invites modifications	(Mayer, 2007), (Black, 1990), (Bresciani *et al.*, 2008)
	Helps to explore changes in perspective and overcome mental blocks	(Mayer, 2007), (Clemmensen *et al.*, 2006)
	Supports clarification of existing ideas and developing/testing new ones	(Fish and Scrivener, 1990), (Schütze *et al.*, 2003),
	Aids memory during problem solving	(Schütze *et al.*, 2003), (Craft and Cairns, 2009), (Blackwell *et al.*, 2008)
	Helps to organize thoughts	(Tohidi *et al.*, 2006)

Table 1.1 The benefits of sketching for knowledge management

Support derived	Benefits	Originators
Knowledge Sharing	Externalization of ideas and shared meanings	(Tversky, 2009), (Heiser *et al.*, 2004), (Mayer, 2007)
	Relieves limited working memory	(Tversky, 2009)
	Facilitates information processing and communication	(Tversky, 2009), (Henderson, 1991), (Schütze *et al.*, 2003), (Koutamanis, 2005), (Murugappan and Ramani, 2009), (Zurita *et al.*, 2008), (Tohidi *et al.*, 2006), (Shpitalni and Lipson, 1997)
	Promotes efficient and enjoyable collaboration and establishes a joint focus	(Tversky, 2009), (Heiser *et al.*, 2004), (Mayer, 2007), (Jackson, 2005)
	Leads to better listening and engagement of the team members	(Heiser *et al.*, 2004), (Mayer, 2007)
	Enhances accessibility of ideas and building on earlier ideas	(van der Lugt, 2005), (Majchrzak *et al.*, 2000)
Knowledge Documentation	Becomes instant documentation for subsequent reference or later analysis	(Mayer, 2007), (Schütze *et al.*, 2003), (Clemmensen *et al.*, 2006), (McGown *et al.*, 1998), (Temple, 1994)
	Builds a collective graphic memory which facilitates archiving and retrieval of information	(van der Lugt, 2005), (Henderson, 1991)

Table 1.1 (continued) The benefits of sketching for knowledge management

1.5 Conclusion and Implications

In this paper, the authors have made an attempt to extract the benefits of the visual collaboration practice of sketching for knowledge management. They have done so based on a systematic review of literature in the domains of computer science, psychology and design. This has resulted in an extended list of benefits which support three relevant tasks in knowledge management, namely knowledge creation, knowledge sharing and knowledge documentation. This compilation shows simple and effective ways in which the use of hand drawings can enhance existing knowledge management practices.

Specifically, the following propositions for *practitioners* can be derived from this paper as practical implications:

In *knowledge creation* contexts, such as innovation management or problem solving sessions provide participants with the opportunity to jointly devise large scale sketches in order to integrate their views and experiences on joint frameworks. Teams can start with simple, open and revisable sketching templates, such as those documented in Eppler and Pfister (2011).

In *knowledge sharing* situations, such as in team briefings or debriefings, in hand-over processes, or in strategic alliances, equip all participants with pens and paper napkins to augment their knowledge dialogs with visible means that facilitate interaction and turn-taking, increase vividness and memorability, and allow for authentic and personal follow-up documentation.

The usage of sketching is limited when it comes to meetings with remote teams as hand drawings are not immediately available electronically and always need to either be scanned or re-drawn with a digitizer. The authors therefore suggest using digital cameras, interactive whiteboards and similar technology to transform analog sketches into digital ones that can be further annotated, electronically stored, shared and retrieved and thus professionally *documented*. You can also use sketching software in the process that not only captures the final images, but also records the drawing process step-by-step, a useful documenta-

tion feature to reconstruct the sense making process of groups at later points in time. Inexpensive or free software that allows teams to record their tablet, whiteboard, touch screen, or projector-based sketches are www.lets-focus.com, Drawez!, or www.pencil-animation.org.

In terms of implications for *theory*, the authors would like to highlight the often overlooked role of informal drawings in team knowledge management and encourage scholars to examine this important visual practice for knowledge creation and sharing, for example by adopting the theoretical perspective of the boundary object literature that has already been applied to knowledge management.

An implication for *research* is to study sketching in knowledge management through interdisciplinary research efforts. This could be done by paying attention to the way that digital and hand-drawn sketches differently affect interactions among professionals and the way that they share, defend, and integrate their knowledge. Specifically researchers with a background in organizational psychology could work jointly with human computer interaction specialists to study differences among analog and digital sketching activities. In this way one can learn about the respective advantages and risks of hand-drawn versus computer-supported sketching for knowledge-intensive group collaboration tasks.

The study also has implications for software designers in the area of knowledge management. KM software designers should think about integrating sketch-based annotation features to their collaboration tools so that experts can also express their views, intuitions, and analyses in this intuitive and natural way, for example by graphically annotating engineering or business charts, slides, or text documents.

In their future research the authors are preparing an experimental study to systematically evaluate the benefits and risks of this visual knowledge management practice. This series of experiments should reveal, under which circumstances and for which settings the use of hand drawings can enhance knowledge sharing in teams.

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Chapter 2

Engaging the Customer. An Experiment on Interaction Modes in Sales Sessions

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Keywords – Sketching, visual sales, visualization, sense making, communication quality, collaboration

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2.1 Abstract

Purpose – Both academics and practitioners have stressed the importance of sales presentations in the selling process. While the presentation's language, content and visuals have been the object of many studies, the aspect of collaboration and medium has been neglected so far in this context. In this paper, the author reports on the results of an experiment simulating financial sales meetings between prospective customers and a banking advisor. In this context, the impact of collaborative sales sessions on the prospective client is analyzed.

Design/methodology/approach – The study involves 112 subjects and examines the effects of interactive visual sales communication on the quality of a sales encounter. We have simulated informative sales meetings where a financial sales expert explains the functioning of a mutual fund to a potential client. We have used a 2-by-2 experimental design, varying the degree of interaction (with or without customer involvement) and the medium (paper versus computer) used in the sales meeting.

Findings – The results of this study provide evidence that a collaborative sales presentation has the power to significantly increase the positive attitude towards the salesperson, and in turn to significantly increase the intention to buy.

Practical implications – The findings of this study encourage sales professionals to use interactive, collaborative presentation formats in face-to-face sale encounters. Instead of showing a handout or delivering a ready-made PowerPoint presentation, they should gather around a sheet of paper or a device with interactive software and jointly sketch the product or problem in order to increase the customer's perceived customer orientation, empathy and loyalty towards the sales person.

Originality/value – The originality of this research can be found in the fact that it is the first study to demonstrate the impact of collaborative sales sessions on the customer's purchasing intention. Its value consists of giving sales professionals guidance on which media to use to enhance collaboration. The experiment also provides an informative testing ground for non-numeric, qualitative visualization that so far has not been the object of rigorous evaluation in business studies.

2.2 Introduction

Both practitioners and academicians have recognized for quite some time that personal selling effectiveness has become vital to the success of banking institutions (Berry and Kantak, 1990; Bernstel, 2001). For a variety of reasons, the sales presentation has been termed "the core of the selling process" (Johnston and Marshall, 2003, p. 55). In general, eighty percent of the information that people absorb is absorbed visually (Jensen, 2000). With leaflets and brochures, websites, booklets, catalogs and DVDs, prospective customers in today's world are often overwhelmed by product and sales information. All those media present the final result, peppered with myriad additional information. The effect of this sensory overload is that the prospective customer becomes blind to the relevant (Lurie and Mason, 2007). Hence, customers frequently rely on visual cues, which allow them to concentrate on essential information (Ha and Lennon, 2010).

Two different approaches are used in sales to address this preference. The first is the so-called 'pencil-selling technique', a visual communication approach where a salesperson visualizes his or her ideas on a piece of paper while talking. The salesperson either starts a drawing from scratch on a blank sheet of paper, or edits and highlights information on printed material. In this regard, it is immaterial whether the seller can actually draw or if he has beautiful handwriting. By using lines, circles, boxes or curves, many complex problems and relations can be sketched. In particular, characteristics of rather intangible products, such as financial services, which are non-spatial and therefore invisible, can be conveyed more effectively if displayed visually. The fact that instructors and teachers are often better able to explain thoughts when sketching has already been shown by Lanir and Booth (2007) and subsequently applied to business. While printed information appears uniform and standardized, sketching with the customer suggests an individual consultation. The prospective customer gets the feeling that the salesperson is fully focused on him and is addressing his individual needs. Giving the customer the feeling of receiving an individual

consultation is consistent with the adaptive selling approach, which suggests that salespeople should customize their presentations to a customer's needs (Spiro and Weitz, 1990; Jaramillo and Marshall, 2004). Finally, the jointly developed sketch is much more memorable than just spoken words, and as Bell and Eisingerich (2007) emphasize, customer participation is increasingly viewed as a source of value creation. However, since the advent of PowerPoint, hand-drawn sketches have often been replaced by computer presentations, and as Tufte (2003) notes, the normal, direct channel of business communication has become the projected slide. Still, the benefits of sketching have been widely recognized and researched.

The second approach uses digital devices such as tablet PCs to engage customers. According to a study conducted by Oracle, Generation Y is very tech savvy and has grown into a key group of customers in retail banking (Efma and Oracle, 2011). To sell actively to these prospective customers, they need to be approached with a technology they use themselves with great enthusiasm. Successful salespeople not only present the outcome, but also visualize the way to the result, enabling the customer to fully understand the benefits and risks of a solution much better than through just reading an attractive brochure. A customer sitting in front of a brochure first needs to cumbrously filter the relevant facts from the bulk of information, which is a time-consuming process, as he first needs to absorb the irrelevant information or minor details as well. By providing visual support, a salesperson can guide the customer step by step through the important arguments, enabling them to penetrate deeper into the customer's awareness and finally have a greater impact on his decision. In this regard, Dwyer *et al.* (1987) identified twelve variables that differentiate salespeople into top and bottom performers and found that top sellers used non-manipulative and customer-oriented practices and were able to adapt their presentations to meet the specific needs of each prospective customer.

In this study, we aimed to understand how the sales presentation may affects a customer's attitude and intention to buy, by testing four different presentation

formats which differ in terms of the degree of collaboration and medium used. This study is structured as follows: In the theoretical section, we examine the critical factors for success in sales and take a closer look at sketching and the pencil selling technique. In the empirical part, we present the findings of our experimental study. In the concluding section, we acknowledge the limitations of our study, and pinpoint avenues for future research on the visual collaboration practice of sketching applied in sales.

2.3 Theoretical Background

2.3.1 Critical factors for success in sales

The strong impact of the sales presentation on sales and in equal measure on the development of the relationship between a customer and a salesperson has already been demonstrated by many researchers (Haas, 2009; Dubinsky, 1980; Dwyer *et al.*, 1987). Interaction in sales is of a dyadic nature (Crosby *et al.*, 1990). Although there is a mutual understanding in the marketing community about the importance of collaboration in sales presentations, there is no research on the effect of involving the customer in information brokerage. Collaborative in this context designates the act of asking the customer questions about his or her preferences and changing the sales presentation, or more specifically, the visualization accordingly in real-time. The fact that salespersons' asking questions is a significant indicator of success in sales has already been analyzed and confirmed by Olshavsky (1973). The collaborative presentation formats (pencil selling and interactive software) mainly differ in terms of how they are perceived as finished or, as Jolson (1975) calls them, canned presentations. In his repeatedly discussed article, he states that presentations prepared in advance lack persuasiveness in comparison to those that are developed by the salesperson.

A multitude of research streams in marketing explore the critical factors for successful sales. Having conducted extensive literature research on those factors, we had to make a selection of aspects that would serve as dependent

variables in the present study. As the experimental arrangement consisted of a single interaction between the salesperson and the prospective customer, and relationships for longer periods had to be factored out, the chosen factors had to allow for the formation of an opinion in a very short time. At the same time, it was crucial that the treatment in the experiment would show short-run effects. Furthermore, we intentionally uncoupled the product from a company or a brand. Therefore, factors such as company attributes, characteristics of the relationship (especially those with a time component) and effects from habitualization were not taken into consideration. We thus focus on the following aspects: salesperson competence, empathy, customer orientation, trust and loyalty. All aspects have to be understood from the customer's perspective and are therefore measured as perceived by the customer. Short definitions of all five aspects will be provided below.

Salesperson competence is defined by Parasuraman *et al.* (1998) as the presence of knowledge and the ability to fulfill a task, whereas competence includes both the knowledge of the company's products and/or services and procedural knowledge (Stock and Hoyer, 2005). According to Stock and Hoyer, salespeople with a high level of competence distinguish themselves as competent in problem solving, operating in complex domains and having greater knowledge of the company's offer and the needs of their customers.

Empathy is defined as the ability to understand and react to another person's perspective (Davis, 1983). Stock and Hoyer (2005) emphasize in this context that this definition implies two broad classes of response: an intellectual reaction that refers to the ability to understand another person's thoughts, feelings and intentions and an emotional reaction toward the other person.

According to Saxe and Weitz (1982), *customer orientation* is defined as the ability of salespeople to help their customers by engaging in behaviors that increase customer satisfaction. They state that "highly customer-oriented salespeople avoid actions which sacrifice customer interest to increase the probability of making an immediate sale" (Saxe and Weitz, 1982, p. 344). Examples include

behaviors such as trying to help to achieve the customer's goals, discussing the customer's needs and trying to influence the customer with information rather than by pressure.

Doney and Cannon's work on *trust* in the salesperson has received a lot of attention. They state that the salesperson plays a key role in interfacing with customers. Whereas salespeople once persuaded customers to purchase their firm's products, they nowadays perform an important function in facilitating and developing customer trust (Doney and Cannon, 1997). Ultimately, trust is a necessary requirement and a determinant of sound business relationships (Håkansson *et al.*, 2004).

The last aspect examined is the construct of *loyalty* as elaborated by Palmatier (2007). Citing Zeithaml, Berry, and Parasuraman (1996), Palmatier affirms that cultivating loyal customers can lead to increased sales and customer share. The interconnection of customer participation and loyalty has already been demonstrated in an exploratory study by Ennew and Binks (1999).

2.3.2 Sketching and pencil selling

Stanford psychologist and sketching expert Barbara Tversky views sketches as thinking tools, not just for individuals but for groups as well. In her numerous articles on the topic, she emphasizes three benefits that are particularly relevant for sales conversations supported with sketches: the speed of sketching, its provisional nature before definitive commitments and its simplicity (Tversky, 2002). In collaboration contexts, she and her colleagues Heiser and Silverman (2004) stress that sketching establishes a joint focus among conversers, promotes interactivity and involvement, fosters efficient and enjoyable collaboration, is conducive to the creation of shared meanings and finally leads to better listening and better recollection of the issues discussed.

In their studies, Tversky and her colleagues provide experimental and observational evidence for these benefits. Similarly, McGown, Green and Rodgers (1998) stress the following collaborative advantages of hand-drawn

sketches: they are fast and seamless, easy to (re-)do, have an immediate effect, can trigger a high quality response, and they are highly expressive, only constrained by the drawer's imagination.

A more praxis-oriented view was gained through conducting interviews with several salespersons working for a major Swiss insurance company. They primarily pointed out the fact that during sales negotiations where Pencil Selling is used, the salesperson is able to catch the prospective customer's attention from the very moment when he removes the cap from his pen and starts drawing. This technique furthermore supports salespersons in fostering a good atmosphere, which helps in making the presentation interesting and diverting. For the salespersons interviewed, the use of Pencil Selling provides an opportunity to differentiate themselves from other consultants. But sketching a solution or a product not only offers a variety of benefits during the presentation itself: many salespersons also mentioned that most clients want to keep the drawings sketched during the presentation at the end in order to have a reminder. Having such a reminder means that they are likely to remember not only the product, but also the consultant, and will eventually ask for advice from the same consultant again.

Hence, we were interested in understanding the impact of the sales presentation on sales effectiveness and, if the stipulated benefits of sketching can get confirmed in a sales context as well.

2.4 Research Model and Hypothesis

Our research model is derived from this theoretical background and is shown in Figure 2.1. We hypothesize that the customer's attitude mediates the impact of the presentation format—collaborative or non-collaborative—on buying intention. We further propose that the medium is a relevant moderator: thus, different visual presentations should have different effects when presented using computer and non-computer supported media. We propose a mediated moderation (Morgan-Lopez and MacKinnon, 2006), meaning that the path

from the presentation modality to the attitude of the customer depends on the medium used, whereas the effect of attitude on buying intention is constant. With this approach, we aim to extend theories on attitude and intention to collaborative sales sessions. Second, we aim to test whether there occurs a change in attitude, if the salesperson uses a paper-based approach such as pencil selling or showing a handout, or if he presents by means of PowerPoint or interactive software. We conduct an experiment to compare four different presentation formats, hypothesizing that the paper-based collaborative approaches lead to increased buying intentions.

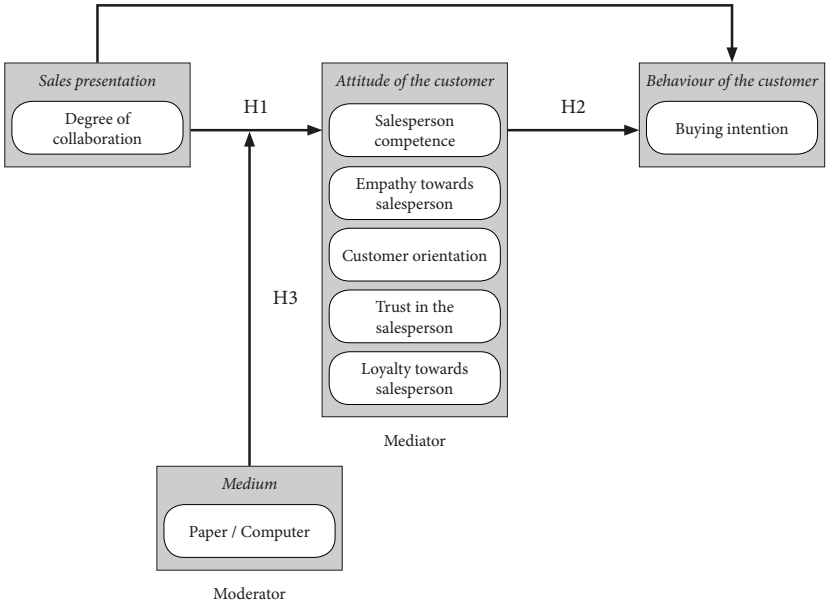

Figure 2.1 Research model

In our research model, the independent variable is the presentation modality of the product with four conditions: two collaborative and two non-collaborative sales conversations. The mediating variable is attitude and the dependent variable is buying intention. The moderating variable is the medium: paper-based (pencil selling and handout) and computer-based (PowerPoint and

interactive software). Based on the research model, we postulate the following hypotheses:

Hypothesis 1: *Giving a collaborative sales presentation, compared to a non-collaborative presentation, strengthens the positive attitude associated with the salesperson.*

Hypothesis 2: *Giving a collaborative sales presentation, compared to a non-collaborative presentation, increases the customer's buying intention, mediated by attitude.*

Hypothesis 3: *The impact of the sales presentation modality on buying intention is mediated by attitude and moderated by the medium (mediated moderation). A collaborative, paper-based sales presentation is the most effective sales presentation.*

The experiment-based research approach applied to test these hypotheses is described in the following section.

2.5 Method

2.5.1 Experimental procedure

Most experiments in research on visualization compares the effects of different visualization techniques and formats on outcome variables, such as performance or satisfaction. Evidence that the chosen visualization has a significant impact on attention, agreement, comprehension and retention has been provided, for example, by Eppler and Kernbach (2010). In the experiment we have conducted and which we will describe in this article, we do not focus on the visual representation itself, but on the aspect of collaboration and on the medium in which visualization is used. While the visualization on the whole stayed the same, the associated degree of collaboration changed.

In particular, we conducted a controlled experiment with four different conditions. Prospective clients were given an introduction to how mutual

fund products work. They either received a paper-based, non-interactive presentation, where the salesperson used a handout (1), or a paper-based, collaborative presentation where the salesperson used the pencil selling technique (2), or a computer-based, non-collaborative presentation using a PowerPoint slide (3), or finally a computer-based, collaborative sales talk where the salesperson led the client through the talk using Let's Focus, a collaborative visualization software environment (4). The image used during these sales sessions was based on a real template from the Swiss Universal Bank UBS's 'Hand Drawing Library' (UBS, 2007) and was identical in all four presentations. These images are shown in Figures 2.2 and 2.3. The pencil selling and software presentation are considered to be the collaborative presentations, whereas the handout and the PowerPoint presentation are the non-collaborative sales presentations. The mediating variable is attitude and the dependent variable is intention. The moderating variable is the medium (paper- or computer-based). Subjects were randomly assigned to one of the four conditions. Randomization of subjects is a requirement of experimental settings in order to ensure a non-biased distribution of group characteristics (Campbell and Stanley, 1966).

		Technology of the presentation	
		Paper	Computer
Collaborative presentation	Yes	The salesperson used the **pencil selling** technique.	The salesperson lead the client through the talk using **let's focus, a collaborative visualization software** environment.
	No	The salesperson explained the function of a mutual fund using a **simple handout**.	The salesperson showed the client a **PowerPoint slide**.

Table 2.1 The four experimental conditions

The context for the experiment is financial services, as this context consists of selling a service that is invisible, intangible and characterized by credence attributes and thus requires visualization (unlike selling tangible products that can be tried out, such as furniture or cars). Additionally, intangible and thus often highly complex products are "intrinsically difficult for customers to evaluate" (Bell and Eisingerich, 2007, p. 437). Because of the abovementioned characteristics, most customers have difficulties in fully understanding those products or services. On the other hand, salespersons find it too difficult to pinpoint their product's future benefits (Román and Ruiz, 2005). This might be the reason why retail divisions of major banks like UBS and HSBC, but also telecommunications service providers like Vodafone, employ visualization and pencil selling: the salesperson, who for most services organizations is the most visible representative of the company (Crosby *et al.*, 1990), sketches a picture

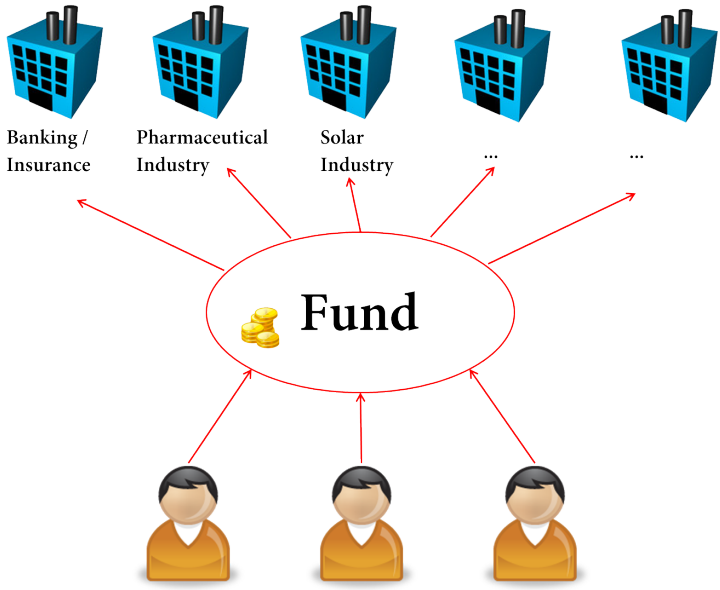

Figure 2.2 Experimental treatment: slide used for handout (1), PowerPoint slide (3) and interactive software (4)

of the product and thus makes it more tangible. According to Blackwell and his colleagues, sketching is especially supportive when applied in domains where there is no pictorial description of a product, such as financial products (Blackwell *et al.*, 2008). As pencil selling is quite commonly used in the financial services sector and as there is no research on its effectiveness, our experiment has been conducted in this field. The experiment also provides an informative testing ground for non-numeric, qualitative visualization that so far has not been the object of rigorous evaluation in business studies.

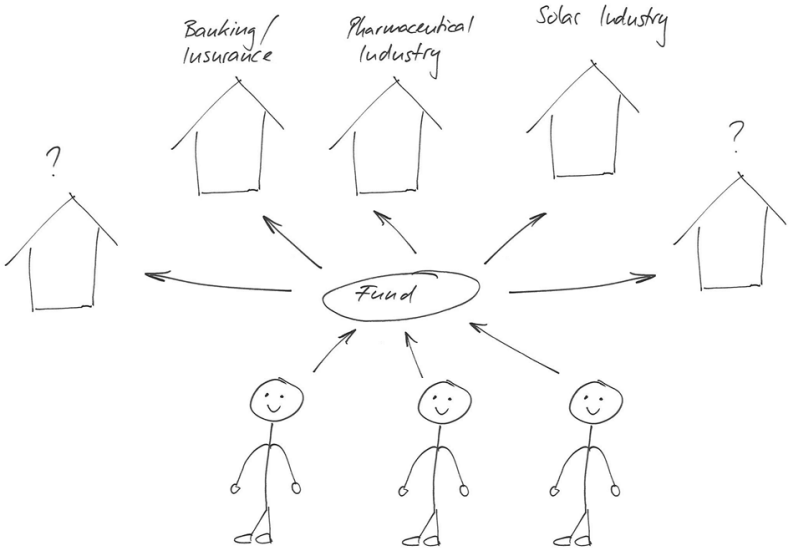

Figure 2.3 Experimental treatment: sketch used for the pencil selling condition (2)

2.5.2 Treatment

The experimental manipulation consists of exposing the subjects to one of the four conditions. The task given to each subject was to attend a sales session in order to obtain an understanding of the mechanism and functionality of an open investment fund. At the end, the participants had to configure a mutual

fund product that suited their individual needs (or industry preferences) and reflected their attitude. The setting can be considered fairly realistic, as various retail banks use visualization techniques in one form or another to explain something 'invisible' like financial products. Some banks use the pencil selling approach, while others conduct standard slide presentations on a screen. All subjects were students from diverse cultural groups and with varying degrees of experience in financial products.

The physical setting remained constant for the different experimental conditions. The following variables were held unchanged as well: the salesperson (identical person, dress, presentation style, intonation, body language, etc.), environment (consistent lighting and screen size; placement of laptop, handout and sheet of paper), and the presentation duration (approximately five minutes). The duration of the presentation was chosen because it is realistic for this segment of a sales presentation and allowed the salesperson to explain terms and functions and give illustrative examples. This was the same for each of the four conditions. As the salesperson used to work for a Swiss universal banking institute, he had sufficient knowledge about mutual fund products. The salesperson and the subject were sitting around a table's corner so that the salesperson was able to either draw a picture or operate a laptop in front of the prospective client.

2.5.3 Measurements

The outcomes of the experiment were measured by asking the subjects to fill out two questionnaires: one before and another one after the experiment. For the subjects, the experiment began with a survey where we measured nine elements. We first asked them if they had ever received professional advice on financial products or if they had bought financial products before. Attitude towards fund products and customer orientation of financial consultants were validated following appropriate scales through seven-level multi-item – measures, as suggested by many researchers in this field (cf. Donavan *et al.*, 2004; Lee and Dubinsky, 2003; Saxe and Weitz, 1982; van Dolen *et al.*, 2002). In addition, demographic data were also collected.

The survey after the sales presentation measured six outcomes based on the previously presented research question: intention (would the subject arrange another meeting with the salesperson?), perceived competence and empathy of the salesperson, satisfaction with the advice, attitude towards the product and purchase intention, customer orientation as well as confidence and loyalty towards the salesperson. The explorative dependent variables—perceived salesperson competence, customer orientation, trust and empathy—were all measured based on four semantic differential items and loyalty based on three semantic differential items. The dependent variable buying intention was measured using a dichotomous variable that we collected through asking each subject whether he or she would like to arrange a follow-up meeting with the consultant by simply stating 'yes' or 'no'.

2.5.4 Intervention

In this section, the procedure followed in the experiment will be described, as well as the task given to the subjects. As briefly stated above, the participants were asked to attend a one-on-one sales session with a financial consultant/salesperson. It is very common in the financial industry that prospective clients are invited to individual meetings, as decisions about financial security and portfolio strategy are often tailored to the particular client and financial products often cannot be sold by just handing out an advertising folder. Those sale sessions were intentionally kept short and only one aspect of the portfolio strategy was discussed with the subject, namely the functioning of one particular product, a mutual fund. Each session lasted approximately five minutes.

To avoid distortion of the experiment, the customer service representative was the same person for all 112 sales sessions. A between-subjects design was chosen. This type of design is often called an independent measures design because every participant is only subjected to a single treatment. This lowers the chances of participants suffering boredom after a long series of tests or, alternatively, becoming more accomplished through practice and experience, skewing the results (Shuttleworth, 2009).

The prevailing view in the literature suggests measuring the behavior of the customer from his own perspective (cf. Brady and Cronin, 2001; Michaels and Day, 1985). We therefore collected data using a research design that consisted of two surveys[1].

First, each participant completed a pre-experiment survey. In this survey, they were asked to answer questions to capture personal characteristics (e.g. is the subject more an emotional or rational kind of customer, how much does he or she know about financial products and fund products in specific, what is his or her affinity to technology and what is his or her perception of financial consultants?), as well as some demographic data. This allowed us to measure both prior knowledge and attitude towards financial products and sales professionals for each person participating in the experiment.

Having completed the questionnaire, subjects entered the room where the salesperson was waiting. The subjects were randomly assigned to one of the four conditions. The salesperson started the sales session by stating the goal of this five-minute talk, namely providing an overview of mutual funds[2]. Subjects were told that they could interrupt the consultant whenever they had any questions. The salesperson then walked them through his presentation and explained what a fund was. He pointed out the advantages of such a financial product compared to buying regular stocks and also mentioned the possible risks. The range of financial products available today is manifold. It might therefore be quite challenging to find the fund product that objectively suited the client's needs the most. The subjects were given the possibility to add and/or remove sectors and industries that they wanted to invest in and thereby configure a fund that suited their individual needs or reflected their investment attitude. Having done so, subjects were asked if they could imagine investing in a mutual fund like the one they had just configured and if they had any additional questions.

1 The two questionnaires are provided in Appendix I
2 The script is provided in Appendix II

The last task consisted of another questionnaire to measure whether subjects' general attitude towards financial products and sales professionals had changed, how they perceived the salesperson's competence and how satisfied they were with the meeting.

In total, we held thirty-three interviews supported by a paper handout, twenty-seven interviews using the pencil selling technique on an initially blank piece of paper and another twenty-seven interviews showing a PowerPoint slide. Finally, twenty-five meetings were facilitated by using the Let's Focus visualization software package (Eppler, 2004). Compared to PowerPoint, this software package allows the user to alter parts of the slide (e.g. move and delete objects or add labels) during the presentation and thus enables him to actively involve the client by handing over the mouse and letting him make the changes himself.

2.6 Results

In this section, we describe the results by offering a description of the sample characteristics, followed by an analysis of the scales employed with principal component analysis and reliability analyses. Having ensured that the scales work properly, we proceed with testing our model, beginning by first analyzing the main effects for the treatment model of the mediation of attitude for the full sample (N=112) and performing MANOVA for all six aspects of the attitude and to test the mediation for the intention to buy. We then proceed to test the moderation effect of the medium on the treatment, using GLM MANOVA to test the interaction of the medium and the treatment on intention to buy mediated by attitude. In our analysis, we closely followed the procedure suggested by Muller and his colleagues (2005).

2.6.1 Sample description

The participants in this experiment were 112 undergraduate and graduate students from three universities in Switzerland. Their knowledge about financial products and especially fund products varied but was, in general,

quite limited. Their average age was 24 years; 43 percent were male and 57 percent were female. The descriptive statistics of the sample for each condition show that age differs within a range of roughly one year from the total mean.

The sales session of the experiment was held fifty-eight times in German and fifty-four times in English. 36 percent of the subjects had already received professional advice on financial products and 21 percent had bought an investment fund in the past. Their average familiarity with the topic of financial products was 2.8 on a 7-point scale. None of the subjects refused to take part in the experiment.

2.6.2 Scales

To check the validity of the various scales, consisting of only four or, respectively, three items, we conducted a factor analysis that resulted in very acceptable, high factor loadings. Reliability was measured using the Cronbach alpha measure. As displayed in Table 2.2, all values for the factor loadings were above the threshold of .80, which is considered as a critical value for internal consistency (Bryman, 2008); the total scores for all five variables were used rather than each item separately.

	Items	Coefficient alpha
Perceived salesperson competence	4	.90
Empathy towards the salesperson	4	.83
Customer orientation	4	.88
Trust in the salesperson	4	.81
Loyalty towards the salesperson	3	.94

Table 2.2 The scales coefficient alpha

Perceived salesperson competence: A reduced scale of salesperson expertise developed by Doney and Cannon (1997) was used to capture perceived salesperson competence. The final scale, which had very high reliability (α=.90), consisted of four items.

Empathy: The four items used to measure this variable covered aspects such as the ability to understand customer needs and adopt a customer perspective and have already been used by Stock and Hoyer (2005). The reliability of the scale reached the necessary value (α=.83).

Customer orientation: Customer-oriented attitude was measured as the strength of a salesperson's effect for or against customers. This measure is based on the scale for measuring affective customer orientation developed by Peccei and Rosenthal (2001) and discussed by Stock and Hoyer (2005). The scale, which had high reliability (α=.88), consisted of four items that captured issues such as enjoying interaction with customers and the conviction that customer interaction contributes to their own personal development.

Trust: The items used to measure trust were selected from seven items that were used to measure the nature of trust in buyer-seller relationships, as developed by Doney and Cannon (1997). The four-item salesperson trust scale exhibits sufficiently high reliability (α=.81). Trust was measured because this construct is particularly important where uncertainty and risk are inherent and contracts and warranties are often absent (Crosby *et al.*, 1990), which is definitely the case for financial products in general.

Loyalty: For this construct, we used a cut-down version of Palmatier and his colleagues' buyer-reported measure, which they developed to measure salesperson-owned loyalty (Palmatier *et al.*, 2007). The scale, with very high reliability (α=.93), consisted of three items that captured questions such as "would you recommend this salesperson?" or "I will consider this salesperson as my first choice."

2.6.3 Mediation

First, we tested the impact of the sales presentation on the intention to buy, mediated by attitude. For the analysis in this section, we considered the total sample (N=112). In section 2.6.4, we also accounted for the moderation of the medium used (paper-based vs. computer-based).

Condition	Handout			Sketch			PowerPoint			Software		
	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N	Mean	S.D.	N
Competence	5.35	1.13	24	5.61	0.77	24	5.40	1.23	25	5.74	0.90	22
Empathy	3.93	1.22	30	4.66	1.22	28	4.20	1.43	26	4.67	0.91	22
Customer Orientation	4.24	1.31	35	5.00	1.20	30	4.44	1.54	30	4.97	1.17	25
Trust	5.10	1.25	32	5.26	0.99	28	5.32	5.32	23	5.42	1.11	23
Loyalty	4.35	1.31	28	5.32	1.00	28	4.17	1.75	26	4.57	1.21	24
Intention	1.56	0.56	32	1.36	0.49	28	1.59	0.50	29	1.42	0.50	26

Table 2.3 Means and standard deviations

The aggregated results of the experiment are shown in Table 2.3, which reports on the mean and standard deviation of the outcomes for each condition.

Adjacent, we performed a MANOVA to analyze the five aspects of attitude and the intention to buy, and report the results in Table 2.4.

	F	df	Sig.
Competence			
Collaboration vs. Non-collaboration	2.001	1	.161
Empathy			
Collaboration vs. Non-collaboration	6.379	1	**.013***
Customer Orientation			
Collaboration vs. Non-collaboration	6.855	1	**.010***
Trust			
Collaboration vs. Non-collaboration	.307	1	.580
Loyalty			
Collaboration vs. Non-collaboration	9.281	1	**.003***
Intention			
Collaboration vs. Non-collaboration	4.480	1	**.036***

Table 2.4 Analysis of Variance[3]

Hypothesis 1 is only partially supported by the data: the MANOVA revealed a significant effect ($p \leq .05$) of collaboration on customer orientation, empathy and loyalty and thus can be confirmed for those aspects. However, no significant effect could be established for competence and trust. Hence, we needed to reject those two aspects of our hypothesis.

We tested hypothesis 2, which posits a positive impact of a collaborative sales presentation on the intention to buy mediated by the customer's attitude towards the salesperson. As we had to partially reject hypothesis 1, we did not include competence and trust in any further analysis.

	Model Summary				Coefficients			
	R Square	Adj. R Square	df	Sig.	B	Std. Error	t	Sig.
Empathy	.153	.144	1	**.000****	.969	.224	4.325	**.000****
Customer Orientation	.081	.074	1	**.002***	.740	.229	3.235	**.002***
Loyalty	.212	.205	1	**.000****	1.364	.247	5.516	**.000***

Table 2.5 Regression of attitude on intention[4]

3,4 Note: * indicates results significant at <.05 and ** indicates results significant at <.01 level.

We started testing hypothesis 2 by conducting an ANOVA and we found confirmation in our data that a collaborative sales presentation had a positive impact on the intention to buy a fund product (p=.036). Second, we conducted the same analysis controlling for the mediating variables of attitude. When accounting for the three aspects of the attitude measure, the effect of the treatment on intention became non-significant (empathy: p=.380; customer orientation: p=.255; loyalty: p=.530). Thereby evidence is provided that attitude is mediating the relationship; in fact, the impact of the treatment on behavior intention disappears when attitude is controlled for. However, some scholars (Baron and Kenny, 1986) take a more restrictive view on the mediation test. They argue for the necessity to also have a significant impact of the mediator on the outcome. Hence, we also report the result of this further test in Table 2.5. The results provide evidence that attitude significantly and positively predicts intention (p<.001; $_{Adj}R^2$: .415).

Hypothesis 2 is supported by our data, providing evidence of a significant full mediation of attitude in terms of empathy, customer orientation and loyalty on the impact of a sales presentation on a customer's intention to buy.

2.6.4 Moderation

Having tested the main effects and found partial confirmation for the hypothesized mediation, we tested the full model, including the moderating effect of the medium, thus resulting in a mediated moderation. The aim was to find out whether, in the moderation of attitude on intention, the path between the treatment (collaborative vs. non-collaborative presentation) and the mediator (attitude) is moderated by the medium used in the sales presentation. The model thus presumes that subjects have a more positive attitude toward the salesperson when the presentation given is paper-based.

We tested the mediated moderating effect of the medium by adding an interaction term of the experimental treatment and medium on attitude. The results of the interaction effect of the medium are provided in Table 2.6, reporting no significant interaction between the sales presentation and the

medium. Although no significant interaction was established, we can observe, by visually inspecting the graphs of the interaction effects (Figure 2.4), that joint drawing scores slightly higher than using interactive software but substantially higher than non-collaborative forms of sales presentation. In the evaluation, an intention to arrange an additional meeting with the sales consultant was coded as 1, whereas no interest in another meeting was coded as 2. Therefore, the lower the marginal means, the higher the intention to arrange another meeting and subsequently the intention to buy.

	F	df	Sig.
Empathy			
Collaboration	6.379	1	**.013***
Medium	.361	1	.549
Collaboration x Medium	.314	1	.576
Customer Orientation			
Collaboration	6.855	1	**.010***
Medium	.146	1	.703
Collaboration x Medium	.192	1	.662
Loyalty			
Collaboration	9.281	1	**.003***
Medium	2.386	1	.125
Collaboration x Medium	1.688	1	.197

Table 2.6 Interaction of experimental condition and medium[5]

5 Note: * indicates results significant at <.05 and ** indicates results significant at <.01 level.

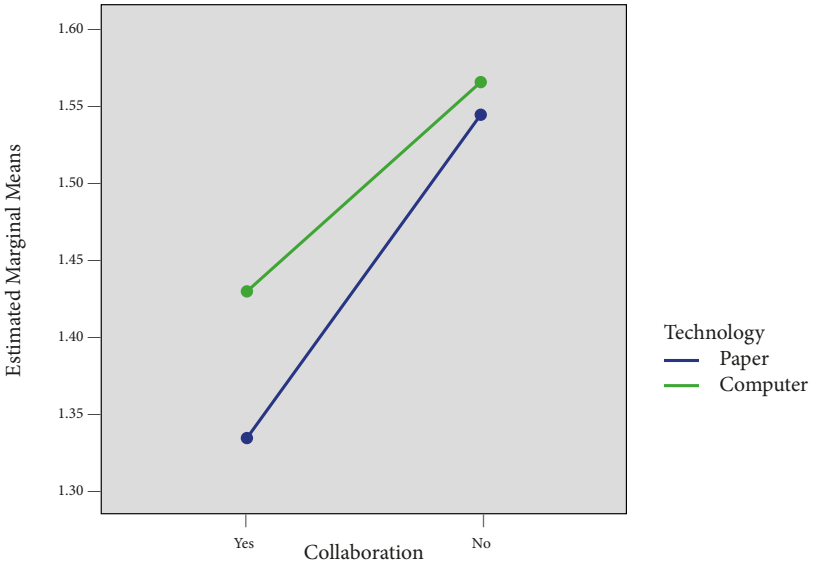

Figure 2.4 Interaction effect of collaboration and medium on the intention to buy

Hypothesis 3 is thus not supported by the results. We did not find confirmation of a mediated moderation where the impact of a sales presentation on buying intention is mediated by attitude and the medium is a significant moderator of the impact of the representation on attitude. Therefore, paper-based collaborative sales presentations do not enhance the intention to buy compared to computer-based collaborative sales presentations, or stated positively, a low-tech approach such as selling with pencil and paper leads to the same results as a high-tech approach with collaborative software.

We tested whether our results were robust across different contexts by including control variables in our model. The significance of the coefficients did not change when potential confounding variables were included, which indicates that our results are stable. To conclude, our model finds confirmation

of a significant mediation by attitude on intention, but not for a significant mediated moderation of the medium on intention mediated by attitude.

2.6.5 Manipulation check

Finally, we also conducted a reality check, as we wanted to bring to light whether the subjects assessed the sales interview as being realistic or artificial. This item was evaluated through two questions in the feedback questionnaire. Of all subjects, 66 percent held the view that the session could have taken place in reality, and only 27.5 percent assessed the meeting as not being realistic. Interesting in this regard was the fact that the analysis of variance (ANOVA) of all four conditions revealed that only the handout showed significant results (p=.013), indicating that subjects whose presentation was supported by a handout rated the session as the most realistic. The explanation might be that subjects are mostly familiar with paper-based, non-collaborative sales presentations and the other forms, especially the computer-supported presentations, are less common. Literature moreover suggests that customers process emotional information depending on the authenticity of the seller (Doney and Cannon, 1997). Accordingly, the result could be due to the fact that in the present study, the surveyed subjects perceived the salesperson's effort as artificial or implausible (Haas, 2009).

2.7 Discussion

2.7.1 Findings

The results of the conducted experiment partially confirm the predicted model. We were able to provide evidence that a collaborative sales presentation has the power to increase the positive attitude significantly in terms of empathy, customer orientation and loyalty towards the salesperson (H1), and in turn substantially increase the intention to buy (H2). At odds with our expectation, our third hypothesis (H3), suggesting the medium to be a moderator of the mediator, had to be rejected. Although prospects, who were given a counseling interview by means of the collaborative, paper-based practice of pencil selling,

more often expressed the wish to arrange another meeting with this very consultant, and thus some effects have been demonstrated, choosing a paper-based medium does not have significant effects compared to computer-based media.

2.7.2 Implications

In this study we aimed to identify the effects of a collaborative sales session in the financial services industry on the perceived salesperson's competence and customer orientation, and the customer's empathy, trust and loyalty towards the salesperson. Over one hundred prospective clients attended sales sessions and completed two questionnaires about their perceptions of the quality of the session and the salesperson. The supporting material used in the sales session was varied by the salesperson into four different presentations: two collaborative and two non-collaborative formats.

The findings reported above lead to important implications for both practitioners and scholars in the fields of visualization and sales management. As a theoretical implication, the results of this study show that collaboration has a positive impact on customer orientation, contradictory to Jolson's prediction that "in many sales situations the prospect does not want to express many points of view and is quite satisfied with a one-way flow of information" (Jolson, 1976, p. 69). According to Saxe and Weitz (1982), the probability of prospective purchase decisions can be positively influenced through a salesperson's customer orientation. The two collaborative sales presentations also had a positive impact on participant's ratings of the salesperson's empathy and the customer's loyalty towards the salesperson. The Study thus adds a significant piece of evidence to those sales theories that claim that collaboration and interaction with the customer can increase sales effectiveness (e.g. Crosby *et al.*, 1990; Saxe and Weitz, 1982; Kelley *et al.*, 1990). This finding is consistent with notions of client education (Bell and Eisingerich, 2007) or relationship selling (Weitz and Bradford, 1999).

From a practical perspective, these findings could help marketing and sales managers to more effectively support their sales representatives by providing interactive sales materials and educating them on how to better involve the customer and increase collaboration in their sales talks. The aspect of education initiatives particularly stands out, as the behavior of customer contact personal, and the information and explanations they provide, will be especially important for customers' understanding of the product (Ennew and Binks, 1999). Sales personnel thus should be provided the autonomy within their jobs to assess the presentation format which works best for them.

2.7.3 Limitations and future research

Our study is subject to several shortcomings that limit interpretation of the results. The first limitation of the study is the selection of the subjects. As they all were students, most of them did not have extra money to invest and therefore were not really considering the idea of investing in a financial product such as a mutual fund. In addition, the study was conducted during the year 2010, in the midst of the turmoil in the financial market. Those events had somewhat shaken people's confidence in financial institutions. Another limitation may also be caused by the selection of the visual representation, which was based on an existing template to explain the function of mutual fund products. Additionally, we also factored out the so-called customer effect as described by Cronin: "Some customers are relatively easy to sell to, regardless of the salesperson, and even consistently poor-performing salespeople will do well with them" (Cronin, 1994, p. 72).

The methodological approach taken in this paper leaves room for further research, as we measured the behavior of both the salesperson and the customer on the same person. Although relevant literature considers different approaches as being problematic, and that view is additionally supported by recent findings which show a different assessment of the customer's own behavior by the salesperson (see Stock and Hoyer, 2005), the possibility of a so-called common-method bias cannot be neglected (Podsakoff *et al.*, 2003). In

this respect, future analysis could complement the chosen methodology with an observation of the behavior of the salesperson. As we only measured buying intention, a further research dimension could be to investigate the actual 'closure' effectiveness. Stafford and Greer (1965) surmised that there might be a different effect of the closing-related behavior of the customer in those cases where the product risk at the end of a sales conversation is higher, compared to, for example, consumer goods. Then it would be possible that a slight pulse—such as the medium or format of the presentation—would not be sufficient to influence the prospective customer's decision (Stafford and Greer, 1965).

In future research, we would like to evaluate in more depth whether the effects of collaborative presentation formats differ when facing analytical or emotional potential clients. After the first evaluation of the collected data, it is still unclear whether the perception of competence or customer orientation differs from analytical to more emotional customers and if there is a difference for people with more or less computer affinity in terms of judging paper- and computer-based presentation formats. Furthermore, it would be interesting to examine whether the results can be generalized or if they are only valid for western cultures.

2.8 Conclusion

Although the question of using paper-based vs. computer-based presentation formats remains far from settled, we believe this study takes a modest step in providing some preliminary insight into the use of interactive, collaborative presentation formats in face-to-face sale encounters. It can help to better assess the crucial role of visual support media and their levels of collaboration.

The results of this study are important for salespeople and for the banking industry in particular in the context of the phenomenon that banking customers are alienating themselves from their banking institute. As it is becoming increasingly difficult to distinguish financial products from each other, the challenge banks face is to create new and unique sales presentations in order

to increase the customer experience, with the ultimate goal being to retain their customers. Hence, bank managers may develop training programs for their sales force to enhance the impact of their sales presentations as a means for improving long-term sales. In this regard, however, our conclusions are tentative, given that no significant effect size was obtained from the medium manipulations.

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Chapter 3

Increasing Decision Accuracy through Joint Annotation: Experimental Evidence

Martin J. Eppler, Roland A. Pfister

Keywords – Decision making, visualization, communication, problem solving, project teams

This chapter is based on:
Eppler, M.J. and Pfister, R.A. (submitted), "Increasing Decision Accuracy through Joint Graphic Annotation: Experimental Evidence for the Benefits of Sketching in Dyadic Decision Making", *Journal of Behavioral Decision Making.*

An extract of this chapter has appeared as:
Eppler, M.J. and Pfister, R.A. (2010), "Drawing conclusions: Supporting decision making through collaborative graphic annotations", *Information Visualization*, Proceedings of the 14th International Conference on Information Visualization, IV10, London, July 26-29, 2010, IEEE Computer Society, Los Alamitos, CA, pp. 369-74.

3.1 Abstract

Purpose – Management teams frequently make important decisions based on the graphic representation of quantitative evidence or projections (i.e., bar, area, or line charts). The extensive use of such charts creates a dual challenge: establishing a collaborative atmosphere to make sense of the evidence, while still staying close to the actual data. One way to support such decision and communication processes is to give decision makers the opportunity to jointly annotate the presented charts. The purpose of this paper is to show—based on experiments with experienced management students and real-life managers—that such annotation dramatically improves decision accuracy.

Design/methodology/approach – To assess the impact of sketched graphic annotations on the decision accuracy of dyadic groups, we have conducted a case-based experimental study with 264 subjects. The participants were divided into two groups, working either with or without sketching (working in teams of two). Each pair of participants had to resolve a cost reduction project prioritization task based on quantitative evidence and projections.

Findings – The results clearly indicate that joint sketching and annotating quantitative charts graphically significantly increases the accuracy of decisions made in dyadic while not prolonging decision making time (compared to simply taking notes or writing down calculations).

Practical implications – We argue that these positive effects can be explained theoretically through the cognitive and coordinative mechanisms proposed by activity theory and by the theory of visuospatial reasoning. Specifically, we argue that these effects come about by the greater focus, synchronization and scrutiny afforded by joint, sketch-based chart annotation.

Originality/value – The originality of this research lies in the fact that it is the first study to show that annotating charts significantly improves the accuracy of decisions made in dyadic groups. Its value consists of giving managers a simple way to improve evidence-based, joint decision-making.

3.2 Introduction

Quantitative Charts such as portfolio diagrams and bar, line or pie charts often form the basis for management decisions—for example, in the context of strategy or project reviews. Such quantitative charts are frequently discussed in management teams based on a prior slideshow presentation or a printed report. Many researchers have emphasized the importance of visual representations to support decision-making (Lohse *et al.*, 1994; Tufte, 1990; Platts and Tan, 2004). Very few of them, however, have looked at the actual benefits of such charts, and no one has addressed their actual impact on decision accuracy in an experimental setting. Chart-based decision-making may be fraught with several challenges. In a chart-based discussion, managers may detach themselves from the presented or reported data and revert to their own experiences or prior opinions instead of focusing on the presented data, their meaning and implications. Another frequent challenge of such meetings is to create a truly collaborative atmosphere and come to a common understanding of a strategy or a project portfolio. Many managers also struggle to fully capture their deliberations and arguments for subsequent meetings or follow-up decisions.

An alternative way to support such decision and communication processes consists of giving managers the opportunity to jointly annotate the presented charts, either on a poster or on flipcharts (or through a multi-touch large screen, or an interactive whiteboard), thus literally working with the chart and using it as an inscription device (Henderson, 1991) to capture the collective interpretations of the represented data and make the data's implications visible to all participants. In his insightful study, Mutch (1996) emphasized in a similar context that handling data effectively is a vital and often underestimated discipline.

In this article we consequently examine the impact of such visual annotation practices on decision accuracy through an experiment with real-life managers and students. Our goal is to provide solid evidence that management groups that annotate their charts while solving a business problem achieve a higher ra-

tio of accurate solutions and are less distracted by irrelevant information that is not based on evidence (such as anecdotes, out-of-context quotes or stories (see Pfeffer and Sutton (2006b)). In contrast to other studies on decision-making in groups or dyads, we do not focus on team composition or team dynamics, but rather on the communicative support given to a team that needs to make a decision.

The rest of the paper is organized as follows: In section 3.3, we discuss sketching and sketch-based annotation and their relation to decision-making in groups. Based on these insights we develop and present the hypotheses of our study in section 3.4. In section 3.5 we describe the experimental design, followed by the detailed results in section 3.6. These results are discussed in terms of their implications for theory and for managerial practice in section 3.7. Finally, in section 3.8 we point out limitations of the study and we present an outlook on open questions and future research needs in the area of quantitative decision-making through annotation.

3.3 Sketching and Sketch-Based Chart Annotation

Although conceptual sketching and visual annotations have received attention in various research fields, such as psychology, engineering, design, education, and computer science (Mayer, 2007; McGown *et al.*, 1998; Buxton, 2007), the topic has not been discussed extensively in management literature. Dan Roam's bestseller on the topic is a notable exception (Roam, 2009). However, this popular management book relies primarily on anecdotal evidence and does not discuss sketching for chart annotation.

For the purposes of this article, we define a sketchmark as a simple hand-drawn ad hoc annotation, modification, or addition to one or several elements of a quantitative or qualitative diagram on a poster, flipchart, or piece of paper, or via a digital pen on a tablet PC or interactive whiteboard. A sketchmark is drawn during a conversation, usually in front of colleagues involved in a joint decision or discussion process (Eppler and Pfister, 2010).

To illustrate the use of such sketchmarks in managerial decision-making, imagine the following scenario: A strategy review board meets to assess the financial situation of a large-scale strategic initiative to reduce costs. After having presented various slides with performance charts and figures, the initiative's project manager displays a bar chart that shows the development of the total costs. He starts by highlighting and emphasizing certain values, months, or upper limits to draw the participants' focus to those specific data points. Then, an expert from the controlling department sketches on the chart to highlight the increase of the cost base in order to emphasize abrupt rises or to relate two different months to each other. By dividing and cross-hatching the columns, the participants gain an understanding of how the total costs add up and which cost categories are responsible for rising costs. By extending the bars of the months after the cost saving measures were carried out, the managers realize where they would stand today without those cost savings. In this way, all participants have been brought to the same level of understanding. Next, the project manager identifies possible toeholds for cost savings by extrapolating the cost curve for both scenarios. Those possible scenarios are also represented by sketching on the initial bar chart. In their meeting, the participants use arrows to depict different possible future directions or the development of the costs, and circles to emphasize specific values. They also extend curves, divide or resize the bars by enlarging or cross-hatching them. At the end of the meeting, the participants feel that they really understand how their costs will develop and are confident that, based on the various discussed scenarios, they have agreed on the right decisions to bring the initiative to a successful end, at least from a financial point of view.

We believe that such joint discussions using sketchmarks will become a useful and pervasive management practice, as collaborative decision-making approaches and the corresponding technology mature. Sketches, however, have so far mainly been discussed as creativity catalysts (see Verstijnen *et al.* (1998); McGown *et al.* (1998); Anderson (1993); Goldschmidt (1992); and Duarte (2008)), and not necessarily as analytic, collaborative thinking tools (for exceptions see Heiser *et al.* (2004) and Ferguson (1994)).

Sketching in general, according to design theorist and practitioner Bill Buxton, can be considered a tool of thought that enables the mind to capture things which are in flux and iteratively refine them (Buxton, 2007). Stanford psychologist Barbara Tversky also views sketches as thinking tools, individually and in groups, as do Fish and Scrivener (1990). In her numerous articles on the topic (such as Tversky and Suwa (2009), Tversky *et al.* (2000) and Tversky (2002)), she emphasizes that the speed and the provisional nature of sketching (projected solutions do not have to be adhered to) enable an "expression of the vague" (2009, p. 76), and, together with its simplicity, are key benefits. In collaborative contexts, she and colleagues Heiser and Silverman (Heiser *et al.*, 2004) stress the following benefits of sketching: establishing a joint focus among conversers, promoting interactivity and involvement, fostering efficient and enjoyable collaboration, being conducive to creating shared meanings, and leading to better listening and better recall of the issues discussed. Tversky and her colleagues (2000) also provide experimental and observational evidence for these benefits (but not for managerial decision-making contexts). Similarly, McGown (1998) stresses the following (collaborative) advantages of hand-drawn sketches: they are fast and seamless, easy to (re-) do, have an immediate effect, and can trigger a high-quality response.

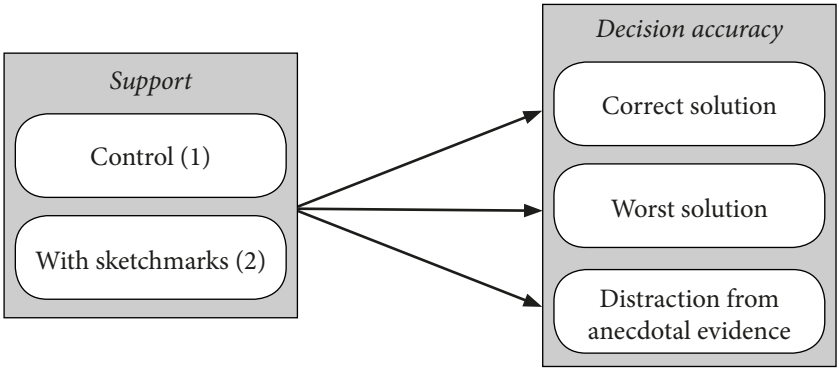
Annotating graphic charts thus seems to bring about numerous benefits that can ultimately lead to better communication and decision quality. As Tversky and Suwa point out: "Sketches serve as an easy referent for words and gestures, so deictic expressions like here and there and this part and that way simultaneously make communication easier and more precise" (2009, p. 76). This is what happens when managers add sketchmarks to charts: By sketching on and pointing at the chart and by adding symbols or by connecting elements, managers render the implications of data visible and help their colleagues see and understand the consequences of the presented numbers. But sketchmarks help to achieve much more than just a common focus. As meeting participants comment on each other's sketchmarks and remarks, they start to converge in their interpretation processes, clarify basic assumptions, stimulate different

perspectives, and extrapolate trends into the future. Collaborative and informal, sketches contribute to a truly open dialogue (Isaacs, 1999; Bohm, 2000) characterized by the suspension of one's own beliefs and assumptions and by an active engagement with the viewpoints of others. All of these stipulated benefits should, in theory, lead to more accurate decision-making. To put this rationale to the test, we will develop and test a simple model in the next section.

3.4 Research Model and Hypothesis

To test whether the aforementioned benefits of jointly adding sketchmarks to quantitative charts really do have an impact on decision accuracy, we have developed a focused measurement model to assess annotations in decision-making. Our independent variables in this model are the two support conditions given to the dyadic teams, namely a control condition without annotations and a condition that encourages participants to add annotations to a distributed (and previously presented) bar chart sheet. For the dependent variable we have operationalized decision accuracy as the ratio of teams achieving the fully correct solution, the ratio of teams opting for the worst solution, and the impact of distraction by anecdotes.

Figure 3.1 Research model



The model thus comprises three hypotheses, which can be articulated as follows:

Hypothesis 1: *Teams that are instructed to jointly annotate the cost bar cart achieve a higher ratio of finding the correct solution than teams that do not jointly sketch on the bar chart.*

Hypothesis 2: *Teams that are instructed to jointly annotate the cost bar chart achieve a lower ratio of the worst solution than the teams that do not jointly sketch on the bar chart.*

Hypothesis 3: *Teams that are instructed to jointly annotate the cost bar chart are less distracted by anecdotal evidence than those teams that do not jointly sketch on the bar chart.*

The rationale for these hypotheses can be found in two highly distinct (in terms of origins), yet thematically converging theories. The first school of thought that motivates these hypotheses is the so-called theory of visuospatial reasoning, as proposed by Tversky (2002) and briefly described above. This theory established (mostly through systematic observations and experiments in the context of design activities) the collaborative benefits of joint sketching. In our reading of the theory, these benefits – especially joint focus and shared meaning- can translate into improved decision making. The second body of literature, which also emphasizes the key role of joint activities and shared representations, is often referred to as activity theory. Activity theory is based on the seminal works of psychologists Lev Vygotsky and Alexei Leont'ev, and focuses on object-oriented, artifact-mediated collective activities (Engeström, 1999).

A central claim of activity theory is that our thinking, learning, decision-making and work in general can be improved if we augment our reasoning and deliberation with joint externalized thinking tools that lead to a close collaboration of the people who are interacting (Fjeld et al., 2002). This is exactly the effect that we envision by providing dyadic groups with the opportunity to jointly annotate a quantitative chart. In addition, activity theory claims that if

abstract work (such as adding and comparing costs in our case) is made concrete, let's say through jointly drawing missing cost information into a chart or drawing arrows between cost profile charts, then this transformation (or 'objectivation') will improve information processing and joint learning (Engeström, 1999). As Blackler (1995) has shown in his discussion of knowledge work in organizational contexts, activity theory can thus be fruitfully used to better understand knowledge-intensive deliberations in management. He stresses activity theory's focus on situated, joint but provisional activities—in our case such as jointly sketching on or annotating a chart.

Another argument why joint sketching may be beneficial to decision accuracy can be found in Niccolini, Mengis, and Swan's (2012) seminal discussion of activity theory. In their Organization Science paper they highlight the fact that activity theory stresses the propensity of shared objects to enable dispute, contradiction or verification loops (ibid., p. 614). This activity theory argument hence supports the positive impact of joint sketching on decision accuracy. Niccolini *et al.* (like many others in activity theory) also argue that the use of a joint object makes the conversers more goal-oriented and thus less likely to distract from their assigned task (ibid., p. 620). This again can be said to contribute to decision accuracy.

In the remainder of the paper we examine if the central claims of the two theories can be confirmed for the context of managerial decision-making.

3.5 Method: Simulating Collaborative Problem-Solving through a Realistic Experiment

To assess the impact of chart-based sketchmarks on a dyadic group's decision accuracy, we have designed and conducted an experimental study. We have selected an experimental methodology because we aim to isolate the effects of sketching on quantitative charts on decision accuracy.

Specifically, we have developed a between-subjects experimental design and

implemented two conditions: groups of two were assigned either to group (1) a visualization support with permission to make annotations on the chart sheet, or to group (2) a suboptimal visualization support where they were not permitted to sketch on the chart itself (they were allowed to sketch on pieces of paper next to it). In the second condition, management teams discussed financial figures based on quantitative charts on slides projected on a screen, while participants were only permitted to take individual notes or make individual annotations. As Tufte (2003) notes, the normal, direct channel of business communication has become the projected slide.

3.5.1 Sample description

Our sample is composed of 131 groups (N=264 individuals), distributed as evenly as possible across the two experimental conditions (66 sketchmark-supported and 65 control groups). This balanced distribution allows for results to be compared across the experimental conditions. Each team was comprised of two individuals (dyadic groups). In order to accommodate the uneven number of participating subjects, we had two teams of three out of the 131 teams (one in each condition).

The 264 participants of the experiment had prior experience in the field of management, and were recruited as students enrolled in either Master of Arts in Management classes (n=140), MBA (n=78), or Executive MBA (n=44) classes. Data was collected over the course of eight experiment runs, carried out between March and November 2012 at two universities in Switzerland (n=194) and one university in China (n=68). This sample population exhibits some degree of diversity as the experiment has been conducted in three different languages, namely in English (n=77), German (n=32) and French (n=22). The sample characteristics (prior knowledge and language) are fairly evenly distributed across the two experimental conditions.

A power analysis performed with G*Power 3 has revealed that the current sample is sufficiently large, assuming a moderate effect size of the independent variable. In the first analysis of our dataset we found support for two of our

three hypotheses. In the following sections, we therefore report the results of our data analysis, starting with the description of the experimental procedure and the measures.

3.5.2 Experimental procedure

In each of the eight experimental runs we followed the exact same experimental process and timing. Subjects were first randomly divided into pairs. We chose dyads for our experiment because, although pairs of collaborative workers do not fully represent everyday managerial decision-making, studying collaboration in dyads is nevertheless a common technique in research (see, for example, Heiser *et al.* (2004)). The dyadic grouping also simulates many important face-to-face decision-making contexts, for example among business unit heads and CEOs, or project heads and program or department heads. Each group was randomly assigned to one of the two different modalities of the independent variable. Randomization of subjects is a requirement of experimental settings (in contrast to quasi-experiments) in order to ensure a non-biased distribution of group characteristics (Campbell and Stanley, 1966). We then instructed the dyads to spread out around the room in order to avoid contamination (lateral communication or copying) between groups and across experimental conditions. The experimenters also made sure that all groups who were not permitted to sketch on their chart sat in the front rows (to prevent them from seeing the other groups sketching on their handouts). Before the groups started solving the case, they were given a five-minute presentation. With the exception of the experiment round in China, the presentation was always given by the same presenter and consisted of an introduction to the business situation and the participant's task, as well as a presentation of the four proposed cost-reduction projects. The business case consisted of an SME that needed to reduce its costs as their margins were slowly eroding. The participants' task was to rank the four proposed cost-reduction projects based on their net savings over four years. For this purpose, the groups were asked to calculate the estimated cost savings per project and subsequently come up with a prioritization of all four projects (1 being the project with the most savings, to 4 with the least savings). This is

a highly realistic and relevant management task, as many managerial decisions consist of prioritizing projects or initiatives. The solution of every team had to be documented on the exercise sheet. The two treatments were implemented by assigning different documentation and discussion means to the groups. Each subject participated in only one treatment.

We implemented the control condition by providing each group with a chart sheet in a clear-cut flush folder, simulating a projected slide. This prevented the groups from annotating the charts jointly on the same sheet. In the treatment

Figure 3.2 Case study projects overview

condition, the groups received an unprotected chart sheet which allowed them to directly annotate the charts and enhance them with additional information they had received during the presentation and in their hand-outs, such as hidden costs and additional costs to take into account (which were not represented in the charts) as well as quotes on these cost-reduction projects by managers

(see Figure 3.2). During the presentation of this information, the participants were instructed to base their decision only on the information that they received in both the presentation and the hand-outs, and not to make their decision based on their own assumptions.

To reduce the risk of experimenter's bias (Jung, 1971), and to ensure consistency in the team solutions, every dyad received a closed envelope containing written instructions for the experimental task. The instructions explicitly indicated the project ranking criterion to be used, namely the improvement of net costs (compared to the status quo) within the next four years. The four presented projects to be evaluated differed greatly with this regard. The project to 'optimize sourcing' (P1) had the biggest impact on cost savings, namely $15,000 USD over the next four years. A change of the current software landscape to Open Office (P4) would save less, but still reduce costs by $5,000 USD

Figure 3.3 Example of a distributed and subsequently annotated chart sheet

over the considered period of time. Introducing home office work (P3) is much less favorable and would, because of hidden costs, lead to a zero-sum game and not save any money at all. Lastly, the IT outsourcing project (P2) would actually increase net costs by $5,000 USD and can therefore be considered the worst solution. These total cost effects, however, were not visible to the teams, but had to be calculated by combining the information given on the slide in Figure 3.2 with the projected costs in Figure 3.3.

After the presentation, the subjects received an envelope containing four sheets: The overview sheet of the four projects (this sheet also served as the decision documentation sheet, Figure 3.2), a sheet with the four project charts (Figure 3.3, indicating the projected cost development of every project in the case it is implemented) and finally a sheet with instructions, where we asked the groups in condition 2 to jointly annotate their chart sheet.

Besides the financial information on the projects, the project overview sheet shown in Figure 3.3 also included some (misleading) anecdotal information, e.g., quotes by the head of marketing (who of course is usually not a specialist on sourcing) and the head of HR. The groups were then given exactly ten minutes to complete the calculation and ranking task and document their decisions on the overview sheet.

3.5.3 Measures

Before reporting the results of our experiment, we will briefly describe the operational definitions that we have used for measuring the dependent variable of our study.

Based on the hypotheses that we outlined in section 3.4, three major outcomes were measured: first, how many dyads came up with the correct prioritization of all four proposed projects?; second, how many groups prioritized the project with negative savings (increasing costs) as the highest?; and third, how many groups were distracted by anecdotal evidence and thus clearly favored the projects with positive (but irrelevant) endorsements?

Correct/best solution: To determine whether a team's solution is correct or not, we used a dichotomous variable (yes/no). The experimenters analyzed the outcome of the subject's solutions against the case study solution key. The solution was considered correct only when all four projects were put in the correct order.

Worst solution: As with the previous measure, we used a dichotomous variable (yes/no). We defined the worst solution as the one where groups assigned the highest priority to the least favorable project (where instead of saving costs, the result of implementing the project would lead to increased operational costs).

Distraction by anecdotal evidence: Two project descriptions included not only financial figures, but also managers' quotes, stressing the positive or negative effects of executing the respective project. The variable we used to measure if the group was distracted by this pseudo-evidence was again a dichotomous variable (yes/no). We defined those solutions as distracted by evidence, where groups assigned the highest priority to the project with the positive quote (home office) and a low priority (rank 3 or 4) to the project with the negative quote (restructuring sourcing).

This operationalization of our variables led to a straightforward and fair coding procedure for each team's answers. It allowed us to measure decision accuracy rigorously and in a way that will also be easily communicable to managers. In addition, it makes the experiment easily replicable.

3.5.4 Selection of the visualization

The visualization used to present the cost development of the four projects was a horizontally plotted, stacked bar chart, as suggested by Zelazny (2001) for financial figures with a time component. Few, a widely recognized expert in the field of quantitative data visualization, stresses the fact that bar graphs are usually chosen when we want to emphasize the individuality of values and compare their magnitudes (Few, 2009), which was the case in this scenario. The categorical data on the horizontal axes used for each chart were years and costs

on the vertical axis. The stacked bar chart represents the distinction between compensation (salary and bonus) and non-compensation costs. This distinction was not relevant for the prioritization task, but increased the cognitive load on the participants. The height of the resulting bar showed the combination of both categories—or, in other words, the total costs.

3.6 Results

3.6.1 Hypothesis testing

The results of our coding of all the teams' jointly documented project priority decisions and the subsequent statistical analyses clearly indicate that ad hoc sketching or annotating on charts, compared to a traditional setting, has a significant positive effect on decision accuracy. In particular, the sketchmarks significantly enhanced the probability of finding the right solution, while helping to avoid the worst solution. We can thus confirm, as reported below, hypotheses 1 and 2. We cannot, however, confirm hypothesis 3. Although groups using sketchmarks were less distracted by the two 'pseudo-evidence' remarks, this effect was not significant. Below we describe how we achieved these results.

To assess our hypotheses, we began by comparing the means of the experimental groups, as shown in Table 3.1 (Standard Deviation is in parentheses).

Measures	(1) Sketchmarks	(2) Control
Correct solution	.53 (.503)	.35 (.482)
Worst solution	.08 (.267)	.20 (.403)
Distraction from anecdotal evidence	.06 (.240)	.09 (.292)

Table 3.1 Mean comparison

The next step consisted of an independent t-test to indicate the relevance of the differences observed in the mean comparison shown above (Table 3.2). We compared the sketchmarks to the control condition and flagged all results significant at $p<.05$ level (two-tailed).

	Correct solution	p	Worst solution	p	Distraction	p
t-Test	F=5.309	**.023***	F=19.349	**.000****	F=1.868	.174
Sketchmarks vs. Control	t=-2.051	**.042***	t=2.077	**.040***	t=.679	.498

Table 3.2 t-test results[6]

Hypothesis 1 – *joint annotations or sketchmarks lead to a higher ratio of correct solutions* – is supported by the results. The t-test for equality of variances between the two conditions returned significant values (F=5.309, p=.042). In terms of values, 53 percent of all groups who used sketching worked out the correct solution, whereas only 35 percent of the groups not permitted to annotate solved the task correctly. Therefore, working with charts by using ad hoc annotations seems to increase the accuracy of a dyadic team's decisions.

Hypothesis 2 – *discussing quantitative charts by ad hoc annotating supports groups in avoiding the worst solution* – is supported by the data and is highly significant (F=19.349, p=.040). Out of the 18 groups in total (representing 13.7 percent) who came up with the worst solution, five groups belonged to the treatment condition (7.6 percent) and the remaining 13 groups to the control condition (20.0 percent). The meaning of this finding is that groups who were permitted to add sketchmarks more often avoided the worst solution than teams who did not sketch.

Hypothesis 3 – *discussing quantitative charts by ad hoc annotating leads to less distraction by anecdotal evidence* – was not supported in the statistical analysis. On average, groups were less distracted by anecdotal evidence in the treatment condition (M=.06, SE=.030) than in the control condition (M=.09, SE=.036). This difference, however, was not significant t(129)=.679, p>.05 and only represents a small effect of r=.06. At a descriptive level, four out of the ten groups in total who met the stipulation for this hypothesis belonged to the treatment

6 Note: * indicates results significant at <.05 and ** indicates results significant at <.01 level.

condition. Hence we did not find that sketching made teams immune to anecdotal evidence.

In conclusion, contrasting the treatment condition with the control condition, we found clear evidence that subjects who were given the opportunity to jointly annotate the presented charts did significantly better on finding the right solution and were more likely to avoid the worst solution in their joint decision-making.

3.6.2 Qualitative observations

Besides the quantitatively captured and analyzed data, we also observed the subjects' collaboration patterns during the experimental sessions. Interesting provisional and qualitative findings can be reported from these live observations. We noted systematically that teams that jointly sketched while talking were much more synchronized in their task; these individuals really seemed to have a common goal and were 'on the same page'. This was not always the case for teams working without visual annotation. We also observed less one-sided dominance in those groups working with visual annotation, which implies that those dyads worked more like a team of equal partners than those in the control condition, where often hierarchies or asymmetries among the two conversers were established (i.e. one person took the lead and set the pace). Whereas the team members in the control group worked on separate sheets (in the vast majority of cases), the treatment groups worked on the same sheet and thus aligned and synchronized their discussion and thinking. On the other hand, we observed no difference in time needed to solve the task. The visual support for the collaborative deliberation apparently had no impact on the speed, but only on the accuracy of the decision-making.

3.7 Implications for Theory and for Practice

The significant positive effects of engaging in joint sketching for decision accuracy cannot be simply attributed to the fact that previously distributed information was integrated on a single page. Groups that worked without sketching

were also able to connect, combine and compare the information given on the two slides, yet they were more likely to make errors in doing so. The question thus arises—why did the sketching groups outperform those that did not sketch? The answer to this question can be found in the explanations provided by the two reference theories introduced earlier, namely the theory of visuospatial reasoning and particularly activity theory. The fact that teams that used joint sketching outperformed those that did not do so most likely results from the increased joint focus on the provided data, the more synchronized way of working with the data, and from the concreteness of the drawing task (as opposed to the abstract calculation and comparison task). In this sense, the study confirms the benefits of artifact-mediated collaboration stipulated by these two theories for the realm of managerial decision-making in dyads. As such, it extends the application scope of the theory of visuospatial reasoning from design activities to quantitative decision-making. The main claim of visuospatial reasoning is that sketching can lead to greater quality in the collaboration of designers, especially when engaged in divergent tasks or in joint option generation. With this study, however, we can extend this claim and propose that collaboration quality can be positively influenced through joint sketching in convergent tasks as well, such as dyadic decision making. It is thus not only the concreteness that renders sketches valuable, but also their positive effects on turn-taking, joint deliberation, and concentration. Our study also adds to activity theory by illustrating that joint sketching can be considered a form of 'objectivation' and brings about the benefits stipulated by activity theory. These benefits include the contradiction and verification loops made possible by joint objects, as postulated by activity theory. These 'checking loops' seem to come about, we believe, because of the unpolished look of the graphic annotation (in contrast to software based annotations). A sketch signals a provisional analysis or decision point and consequently literally invites others to scrutinize it and to question its validity. This has proven useful for a more diligent decision making in the context of our examined dyads. Next to objectivation, we thus identify the effect of collaboration objects with low perceived finishedness (Eppler and

Bresciani, 2013) to provide decision making groups with the advantage of a 'decision suspension', ultimately leading to more accurate decision making. The annotation's sketchiness (signaling work-in-progress) provides decision makers with an unthreatening way to once more assess their opinions and options in light of the presented evidence. In doing so, decision makers have an additional opportunity to (visibly) compare their views with the presented evidence and jointly discuss this correspondence. Future research must, however, disentangle these different effects and benefits to identify how they individually contribute to higher decision accuracy.

In terms of practical implications, our study has direct relevance for the way that managers conduct decision-making meetings. In such meetings the mere presentation and subsequent verbal discussion of evidence does not assure accurate decision-making. A complementary way of discussing decision-relevant data thus consists of printing out key charts on large-scale posters and jointly annotating them to improve joint sense-making and deliberation. This is in fact a decision-making practice that several companies already use on a regular basis (including Procter & Gamble, based in the US, and Migros, based in Switzerland). In dyadic discussions, managers should use sketching whenever possible to make their deliberations more collaborative, focused, and concrete. In both contexts (small groups and dyads) the advent of new computer-based interfaces, such as mounted touch-screens or tablets, makes this visual practice even more seamless and powerful.

3.8 Limitations and Directions for Future Research

While providing interesting insights into the use of ad hoc annotations on quantitative charts, our experimental study is not without limitations. As noted above, we have established that sketching improves decision accuracy, but we cannot yet isolate the individual effects that contribute to these superior results. In addition, the entire data evaluation is based on the answer sheet completed by the experiment's subjects (i.e., their final decision). No questionnaire was

distributed to the participants, and we thus have neither detailed demographic data on the subjects, nor any information on the quality of the process of problem-solving as perceived by the participants. In this regard the only data available are the teams' solutions. No process data can be analyzed and reported in this study aside from the unsystematic qualitative observations reported in section 3.6.2.

In future research it would thus be particularly interesting to gather qualitative data to investigate this process perspective (particularly questions regarding the subjects' satisfaction with the process or the perceived collaborative quality). We did, however, conduct follow-up discussions with the participants (in joint debriefing sessions) after each experiment, and the sketching groups repeatedly indicated that sketching together gave them more focus and certainty in their deliberation than if they had just worked on separate sheets or simply talked about the data analysis.

Another limitation is the artificial nature of experimental research, which may constrain the extent to which our research findings can be generalized to real-life management decision-making tasks. While limitations in external validity are inherent in experimental research (Hoyle *et al.*, 2002), we have tried to reduce this shortcoming by simulating a simple but realistic 'cost-reduction initiatives selection' scenario. A further limitation is the fact that we have only examined the decision-making of dyads, even though many management teams consist of more than just two individuals. The rationale for this choice can be found in the feasibility of an easily controllable experimental setting (with minimal additional intervening variables) where the experimenters also needed a certain number of cases in order to be able to evaluate the collected data statistically. Still, as argued above, dyadic decision-making is not uncommon in management. Additionally, a setting where just two people are discussing financial figures on the basis of either a projected or printed bar chart slide is fairly realistic. If management teams exceed the size of two team members, a printed chart slide would no longer be the right medium for discussion, as the

size of a standard sheet is simply too small. To overcome this limitation, companies often enlarge those charts by printing or plotting them on larger sizes of paper and attaching them to flipcharts or walls.

A final limitation of our study can be found in the recruitment of the experiment's participants. All of them were enrolled in postgraduate university courses. Although almost all of them had practical management experience, they might have been biased, as they were students of a course focusing on management methods. The external validity of the study could therefore be enhanced by reproducing the same experiment with a more complex case in a real corporate setting. The same can be said with regard to the geographic background of the participants. We already have evidence that the benefits of using sketching go beyond cultural boundaries, as the Chinese participants who used sketching also outperformed the non-sketching groups in our experiment sessions in Beijing. Still, further experimental sessions in other cultural regions are necessary to confirm the universal value of visual chart annotation for decision accuracy. A final caveat regarding the participants concerns their graph literacy (see Okan *et al.*, 2012). We did not ask or control for their general ability to correctly interpret graphs and thus differing levels of graph literacy may influence their performance in this simulation. However, as all of the participants had academic degrees and were enrolled in executive or graduate training, we can assume a fairly good level of graph literacy.

There is another limitation of the experiment presented in this paper that should be noted—the almost exclusive focus on charts as a guide for decision-making. Management teams should of course not only base their decisions on quantitative charts or data in general, but also take into account their team members' experience, know-how, intuition and advice. It seems, however, that many management teams often suffer from too much focus on prior (anecdotal) evidence rather than too much focus on quantitative data (see Pfeffer and Sutton (2006a)).

Taking into account these limitations, we nonetheless believe that researchers and particularly practitioners should give this simple socio-visual practice a try and augment quantitative decision-making with annotative sketching. We thus invite others to experiment with sketching and see for themselves how effective this simple visual way of collaborating and decision-making can be. We conclude by paraphrasing Karl Weick's famous sense-making mantra: How can we understand what we know until we see what we think?

3.9 References

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Synthesis

Summary of the Main Findings

Conceptual sketching and visual annotations were discussed extensively in the research fields of psychology, engineering, design, education, and computer science. In spite of the diversity of these research fields, a great many benefits were identified and confirmed. Surprisingly, the topic has not previously been discussed extensively in management literature (Eppler and Pfister, 2010). In this thesis, I attempt to broaden the understanding of the effectiveness of sketching and applied it to the discipline of management.

A great number of findings can be derived from the results of this thesis: In each chapter I have addressed specific research questions, which aimed to construct an integrated understanding of the phenomenon under investigation. Going beyond the significance of each individual study, which was discussed at the end of the relative chapter, the intention of this last chapter is to combine the various pieces of the puzzle in order to finally see the bigger picture.

What do this thesis' findings mean for managerial communication tasks? The answer in short: it depends. Although existing literature unanimously agrees on and confirms the benefits of sketching, this visual collaboration practice was only partially able to stand favorable comparison in practice. Whereas experiments in sales did not produce clear cut results, the findings in the decision-making context were much clearer and promising. It thus depends: on the situation, on personal affection and on task.

Nevertheless, the overall results indicate that sketching can have a significant positive effect upon communication effectiveness. However, acknowledging that collaborative sketching can have positives does not mean that applying this technique necessarily or automatically provides benefits to knowledge management, problem solving, and decision or communication tasks.

My recommendation for practitioners should not be regarded as a call to throw established means of communication overboard and to solely use the sketching technique as of now. My intention is to disclose that sketching has its benefits and, although not nemine contradicente should become an element in the repertoire of managers. To sketch, one only needs a pen and paper: Tools, which are available everywhere and in every situation. This means of communication is always on hand when needed and its presence is thus—in my own estimation—something all managers should have up their sleeves.

To illustrate how findings on the effectiveness of hand-drawn sketches from various research streams can enhance management communication, Chapter 1 presented an extensive literature review which resulted in an extended list of benefits which support three relevant tasks in knowledge management namely: knowledge creation, knowledge sharing and knowledge documentation. Thus simple and effective ways in which the use of hand drawings can enhance existing knowledge management practices were shown. The experiments outlined in Chapters 2 and 3 are one of the first attempts to empirically measure the impact and effectiveness of hand-drawn sketches. The results of the two experiments and the literature review are summarized below; first in detail, which enables a discussion of the key findings and their validity; and then more broadly in order to present the limitations of the thesis, future avenues of research, and the main lessons for managers.

Theoretical Implications

At a theoretical level, the contributions are manifold. The literature review in Chapter 1 revealed that the current research on sketching is dominated by work done in the fields of psychology, engineering, design, education, and computer science. Although some work was done at the intersection of two different research domains, for example psychology and computer science (Blackwell *et al.*, 2008; Bresciani *et al.*, 2008), no work was found covering or integrating all relevant areas of research. In addition, a research gap was identified in the sense

that no research had been conducted on the application of sketching in an explicitly managerial context. The review of the benefits of sketching, or ad hoc collaborative hand drawings for knowledge creation, knowledge sharing and knowledge documentation first highlights the often overlooked role of informal drawings. It thus confirms findings within the framework of boundary object theory which posits the importance of sketches for distributing cognition through verbal and non-verbal means (Lawson, 2006). Whereas this theory is traditionally applied to design projects through the facilitation of interactions in teams (Ewenstein and Whyte, 2007), the manuscript confirms findings from Star and Griesener (1989) in the field of knowledge management and broadens the application context from knowledge development as elaborated upon by Whyte *et al.* (2008), to the two additional, equally vital aspects of knowledge sharing and knowledge documentation. The present research has thus drawn on a theoretical analysis of the literature in an initial phase and subsequently applied the identified benefits of sketching to the specific topic of managing knowledge.

The empirical work conducted and presented in Chapter 2 and 3 provides a theoretical contribution by demonstrating that ad hoc, hand-drawn visualizations can significantly enhance communication quality in the context of management. Previous studies of sketching in other research domains are largely confirmed and evidence of the potential positive effects of joint sketching on communication outcomes is thus provided.

The implications of the empirical findings from the first experiment (Chapter 2) are relevant at a theoretical level in that they show that collaboration in sales presentations is eminent and thus responds to the negative Jolson predication, that prospects prefer a one-way flow of information in counseling interviews (Jolson, 1976). The conducted experiment demonstrates that a collaborative sales presentation can positively affect a prospect's attitude in terms of perceived salesperson customer orientation (Saxe and Weitz, 1982), empathy (Stock and Hoyer, 2005) and loyalty (Palmatier, 2007) as well as behavioral intention to buy.

By providing application of the aspect of collaboration and interaction to marketing theories, or sales theories in specific, the study thus adds a significant piece of evidence to those theories that claim that collaboration and interaction with the customer can increase sales effectiveness (e.g. Crosby *et al.*, 1990; Saxe and Weitz, 1982; Kelley *et al.*, 1990). The finding is furthermore consistent with notions of client education (Bell and Eisingerich, 2007) or relationship selling (Weitz and Bradford, 1999).

The insights from the second experiment (as described in Chapter 3) offer a theoretical contribution by empirically demonstrating that joint sketching has the power to enhance problem solving capability in teams. The setting of the experiment combined two different kinds of graphical elements, namely the chart, which formed the basis for the decision, and the annotations in the form of hand-drawn sketches. The theory of visuospatial reasoning has already been used by Tversky (2005) to explain the widespread use of diagrams (such as statistical charts or mundane corporate charts in general) when it comes to the conveyance of abstract information. Whereas these diagrams are intended for clear, error-free communication and the precise display of quantitative information, sketches are "meant to be ambiguous" (Tversky, 2005, p. 231) and allow for reinterpretation and discovery. While the diagram—the basis for the discussion—had to be clear, annotations fostered the process to go beyond the data. The evident implications for the domain of psychology and cognitive sciences are thus that we were able to prove that the application context of the theory of visuospatial reasoning can be extended from design activities (where it was originally studied) to managerial decision-making. The other theory stream the manuscript is basing its hypothesis on is the activity theory. This theory has its roots in the Soviet cultural-historical school of psychology of Lev Vygotsky and Alexei Leont'ev that originally focused on child development and learning (Engeström and Kerosuo, 2007). When team members jointly sketch on an existing chart sheet, they make their individual insights, findings or beliefs visible through the resulting annotations. This process of turning mental activity into an object or objectification is what Leont'ev called exteriorization (Engeström,

1999). The results of this study illustrate that sketchmarks and annotations can take over the function of objects and thus bring about the benefits stipulated by activity theory. In this regard, especially the claim stressed by Fjeld *et al.* (2002) that decision-making can be improved by augmenting our reasoning and deliberation through the use of joint externalized thinking tools (sketchmarks in our case) can be verified.

In conclusion, this thesis makes a unique contribution to management studies, in particular to managerial communication by showing that collaborative sketching is an effective means of enhancing communication with customers, within teams and knowledge sharing in groups.

Practical Implications

This thesis provides several implications that may help practitioners to enhance their communication quality by using the visual collaboration practice of sketching. Here, I highlight the three most noteworthy findings.

Sketching for knowledge management

The main finding relevant for practitioners is that all three of the tasks relevant to knowledge management can be supported through joint annotation. In knowledge creation contexts, jointly devising sketches provides participants with a means by which to integrate their views and experiences by dint of joint frameworks, sketching can augment knowledge dialogues with visible means that facilitate interaction and turn-taking in all situations where the sharing of knowledge is the goal. Finally sketches may increase vividness and memorability, thus allowing for authentic and personal follow-up documentation. A caveat in this regard: Sketches quickly reach their limits when it comes to the increasingly common setting of meetings taking place amongst remote teams. Due to fact that hand drawings are not immediately available electronically, they first need to be digitized and may thus lose some presence.

Sketching in personal selling situations

The findings of this study encourage sales professionals to use interactive, collaborative presentation formats in face-to-face sales encounters. Instead of showing a handout or delivering a ready-made PowerPoint presentation, the results of the experiment confirm that sales professionals should gather around a sheet of paper, or a device with interactive software, and jointly sketch in order to increase the customer's perceived customer orientation, empathy and loyalty towards the sales person. Those implications are valuable for salespeople selling intangible goods such as services, and especially for the banking industry within context of the phenomenon that banking customers are currently alienating themselves from their banking institute. As it is becoming increasingly difficult to distinguish financial products from each other, the challenge banks face is to create new and unique sales presentations in order to enhance the customer experience, with the ultimate goal being to retain their customers. Hence, bank managers may want to consider developing training programs for their sales force to enhance the impact of their sales presentations as a means for improving long-term sales.

In this regard, however, the conclusions of this study are tentative, given that no significant effect size was obtained from the medium manipulations. We nevertheless may argue, that this study provides evidence that the aspect of collaboration is much more influential in sales than the medium itself; or put differently—it does not matter whether a sales person uses a high-tech device such a tablet PC or an iPad, or if he or she resorts to the sometimes dubbed as ill-reputed, old-fashioned pencil and paper.

Joint annotation of quantitative charts

Through this experiment, we offer strong evidence, that joint sketching and annotating quantitative charts significantly increases the accuracy of decisions made in dyadic discussions. This finding may encourage managers to take advantage of the visual collaboration practice of sketching and use it to avoid deliberations based upon one-way presentations only. We suggest managers

discuss quantitative content by means of large-scale data posters and jointly annotate them to clarify the interpretations and consequences of the evidence presented. Whenever the basis for a discussion is exact quantitative data, the discussion and subsequently the decision accuracy can be increased by printing or plotting the charts on posters and using these media instead of a projected slide.

Managers have a persistent and widespread belief in their inability to sketch or draw. As a few basic rules of visual representations are already sufficient to start sketching comprehensible visual elements, we expect that by actually applying this technique, a fast and continuous improvement in the users' satisfaction and perception of the increased communication quality, along with an increase in the likelihood of adoption, takes place. Before discussing the approach for future research on the visual collaboration practice of sketching in greater detail, I elaborate on the methodological implications and limitations of the study in the following section.

Limitations, Methodological Implications and Directions for Future Research

While this thesis contributes to the understanding of the benefits of sketching in management, the experimental studies in particular are not without limitations. Although limitations in external validity are inherent to experimental research (Hoyle *et al.*, 2002), we have tried to reduce this shortcoming as much as possible by simulating two realistic scenarios: A sales situation, where the aspect of convincing was put in the foreground, and a managerial decision-making situation.

In the first experiment where we pursued the question of whether or not the degree of collaboration and the medium used has an influence on a salesperson's ability to convince prospective customers, we set the stage for a comprehensive assessment of different presentation formats in face-to-face sales encounters. As discussed in the respective chapter, we used self-reported measures in the form

of two questionnaires and a final statement to capture if the prospect would like to arrange another meeting with the consultant in question. The chosen approach enabled us to capture subjective measures (perceived customer orientation, empathy and loyalty towards the salesperson) as well as the result (the customer wanting to arrange another meeting)—which can be considered to be the objective measure of salespersons engaging their customers. We selected the simple task salespeople are faced with when explaining a non-spatial product to a prospect (in our case, a mutual fund product).

The approach we followed in the second experiment (Chapter 3) was similar to the previous one. We wanted to clarify how decision accuracy can be improved by letting groups annotate the quantitative charts serving as a basis for their discussion. The selected task consisted of discussing a project portfolio based upon quantitative bar charts to ultimately come to a decision. The basic experimental design allowed for a rather heterogeneous collection of a population which met the requirements in terms of sample size (Kenny, 1987). While the data evaluation is solely based upon the submitted solution, we only collected objective measures, namely how many groups came up with the correct solution, how many groups were in favor of the objectively worst solution, and finally if the groups let themselves be distracted by anecdotal evidence.

As the context differed in the experiments conducted, the experimental manipulations and thus the generalizable findings were different as well. In the first experiment, the manipulation consisted of a different degree of interaction with the customer and a different medium (paper vs. computer based). The chosen aspect of the sales talk was the very beginning, where salespeople explain the basic functioning of such a financial product. By only simulating the first step of a typical counseling interview, we disregarded the following steps where it is likely that more interaction between the sales representative and the prospective customer takes place as more of the customer's requirements, such as financial goals or current spending and budget—to name but a few—have to be taken into consideration for the proposal of the optimal financial strategy.

Therefore, for this experiment our research findings should be generalizable for all sales tasks where a prospect receives a product explanation in order to consider, whether to do further business with this particular advisor, or not. Nevertheless, future research should replicate our experiment's design in the other stages of a counseling interview as well as with different kinds of products, in order to strengthen confidence in our research findings.

In the second experiment, we manipulated the way in which pairs discussed quantitative data. Whereas the control groups did not have the possibility to annotate their chart sheet and thus simulate a projected slide, the treatment groups jointly annotated their chart. As discussions on the basis of quantitative charts are quite common in management, and the prioritizing of projects is a relevant task, our findings should be generalizable to managerial tasks in which teams have to decide on the basis of facts and figures. Our focus was on answering the question of whether or not the treatment groups would achieve higher decision accuracy—rather than on questions such as why or how this was achieved. More grounded and qualitative methodologies could have been applied for analyzing how annotating changes the processes and the dynamics of the discussion. Future work could specifically focus upon the process in order to understand the mechanisms through which joint annotations improve, for example, group productivity.

Having the results of the experiment at hand, together with the theory of visuospatial reasoning and the action theory supporting them, it still remains unclear how the crystallized benefits contribute individually to the higher decision accuracy demonstrated. One has to assume that confound effects played a crucial role and significantly influenced the outcomes of the study. Further studies therefore need to disentangle the various elements, isolate them and subsequently focus upon examining the single variables.

This thesis' experimental studies only allowed for the measurement of a limited number of outcome variables which might be affected through means of the presentation. Our results assume that sketching can potentially have an effect

on a number of other outcomes, which can include emotions and engagement (Huff, 1990) for instance. Whereas emotions could play a key role in a sales talk, increased engagement might be the driver for the higher decision accuracy observed in the experiment in Chapter 3.

Future studies could also focus on understanding the effects of the interface and input devices in sales talks. Since the realization of the experiment, touch-screen tablets such as the iPad have penetrated our daily life, but we were only partially able to simulate interaction on a PC. Collaborative work on a PC is made much easier by just touching the screen, rather than by handing over the computer mouse. Furthermore, people are much more used to such devices and might react differently when asked to change certain elements on the screen. The impact of, using a multi-touch screen on visualization effectiveness has already been proved by Burkhard *et al.* (2009).

Finally, a limitation arises from the choice of methodology. With the aim of conducting rigorous studies, we have selected controlled experiments. It was our declared aim to generate hard facts with strong practical relevance of the benefits of sketching in a managerial context in order to legitimatize our findings for practice. Controlled experiments are considered the most suitable and rigorous methodology to test a causal model (in our case to test if a collaborative, paper-supported sales talk increases propensity to buy, and if joint annotation increases decision accuracy) and to draw an inference on the results. While attempting to design realistic tasks, we acknowledge the limits of laboratory experiments. We have favored internal validity at the expense of external validity; at this point it would be relevant if future research could provide evidence of the experiment's external validity by applying them in real life management situations. Field studies and action research as suggested by Argyris and Schon (1991) would be appropriate methods. Limitations for both experiments can be found in the recruitment of the experiment's participants. All of them were students: In the first experiment, the majority of the prospects were undergraduate and graduate students, and for the most

part graduate and MBA students participated in the study's second experiment. As all the students were all taking either marketing, management methods or visual problem solving courses, they might have been biased. In the second experiment, we observed that graduate and undergraduate students generally achieved higher results. A possible explanation for this could be that they are more familiar with the solving of case studies than real managers or MBA students. In addition, in the first experiment most of the students did not have extra money to invest and were therefore not seriously considering the idea of investing in a financial product such as a mutual fund. Financial products, which are normally considered to be high involvement products (Bell and Eisingerich, 2007) may—given the students current circumstances—simply did not yet appear to be beneficial for them. Conducting the same experiment with different products could correct for this. An approach to overcoming the limitation of having conducted the experiment with students only would be to apply the concepts tested in real organizations and measure the effectiveness. This would allow the of testing them in real management teams and selling situations respectively.

Overall, in the lead up to the final concluding section of this thesis, and in line with Goebel (2012), we take the view that only the methodological approach of experiments warrants the scientific field of visualization to take one step ahead and we thus encourage researchers and scholars to further investigate this under-explored research area.

Conclusion

In this study, we have made an attempt to gain an understanding of whether management teams can be more effectively supported by means of ad hoc hand drawings, as compared to the traditional standard of PowerPoint presentations. The results of the three studies indicate that collaborative sketching has the potential to enhance the communication and knowledge sharing performance, as well as the problem-solving capability of management teams.

This makes a contribution towards the establishment of the visual collaboration practice of sketching in management, via the provision of a theoretical basis and the illustration of the vast, yet unexploited within business contexts, potential benefits of ad hoc, hand-drawn sketches for managerial communication.

While entering uncharted waters in a promising yet under-explored research area, we are fully aware of the fact that the present study is not without limitations; further research is needed to gain a more profound understanding of this visual collaboration practice. Although, this study is considered to be rather broad in nature, it has probably raised more questions than it has answered. While providing some evidence of a phenomenon thus far widely neglected by business scholars, we hope to have shown that the technique of ad hoc hand-drawn visualizations is certainly a topic worthy of further investigation.

The quote "all research is subject to revision" is accredited to Sir Karl Raimund Popper (1968), who is generally regarded as one of the 20th century's greatest philosophers of science (Horgan, 1992). As demonstrated throughout this thesis, revisability is the essence of sketching. To conclude this work, I want to practice what I preach and thus ultimately present the synthesis as a sketch.

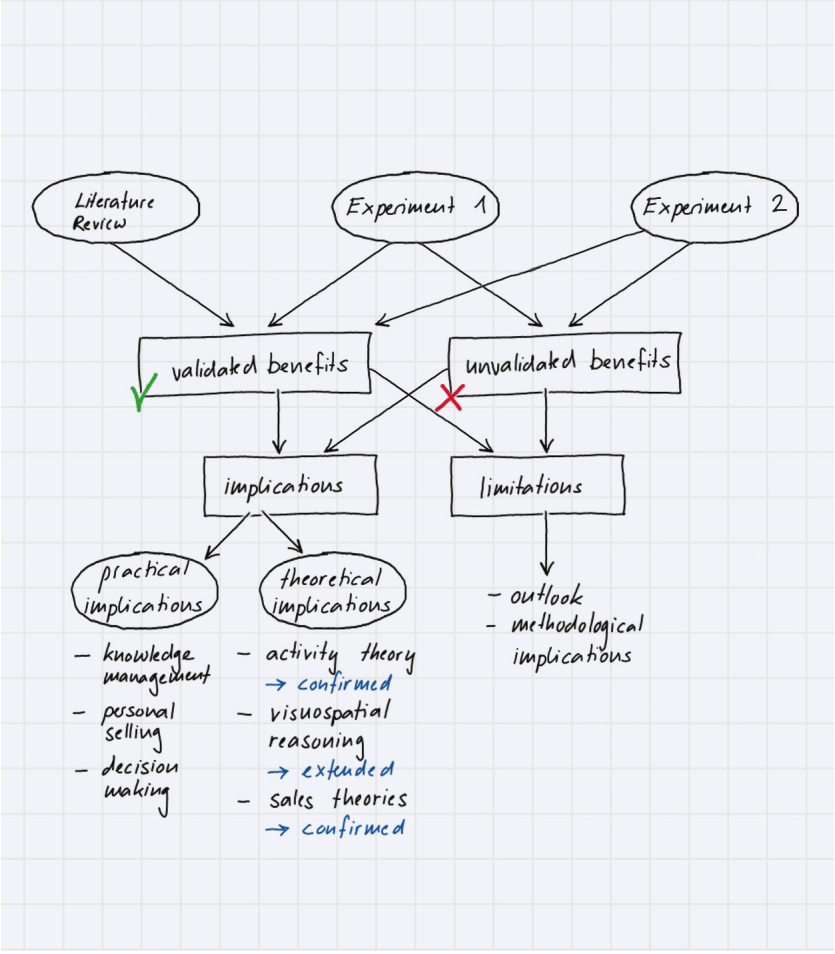

Figure 4.1 The thesis' synthesis as a sketch.

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Appendix I

Chapter 2: Pre-Experiment Survey

University of St.Gallen
Thursday, March 18th

Number:
Scenario:

Questionnaire

1.1.	Did you ever get professional advice on financial products?		
	☐ Yes	☐ No	

1.2.	Did you ever by a fund?		
	☐ Yes	☐ No	

		Strongly disagree			Agree partially		Completely agree		Don't know
2.1	I can well imagine to buy a fund in future.	☐	☐	☐	☐	☐	☐	☐	☐
2.2	I like funds.	☐	☐	☐	☐	☐	☐	☐	☐
2.3	I think funds have a lot of beneficial characteristics.	☐	☐	☐	☐	☐	☐	☐	☐
2.4	I have a favorable opinion of funds.	☐	☐	☐	☐	☐	☐	☐	☐
2.5	The decision to buy funds is foolish.	☐	☐	☐	☐	☐	☐	☐	☐
2.6	Buying funds is a good decision.	☐	☐	☐	☐	☐	☐	☐	☐

		Strongly disagree			Agree partially		Completely agree		Don't know
3.1	I am well versed in financial products.	☐	☐	☐	☐	☐	☐	☐	☐
3.2	I could well explain what funds are.	☐	☐	☐	☐	☐	☐	☐	☐
3.3	I know what you have to pay attention to when buying funds.	☐	☐	☐	☐	☐	☐	☐	☐
3.4	I know which criteria are relevant when purchasing a fund.	☐	☐	☐	☐	☐	☐	☐	☐

		Strongly disagree			Agree partially		Completely agree		Don't know
4.1	Financial consultants are very customer-oriented.	☐	☐	☐	☐	☐	☐	☐	☐
4.2	Financial consultants try to help customers achieve their goals.	☐	☐	☐	☐	☐	☐	☐	☐
4.3	Financial consultants try to get customers to discuss their needs with them.	☐	☐	☐	☐	☐	☐	☐	☐
4.4	Financial consultants try to find out what kind of product would be most helpful to a customer.	☐	☐	☐	☐	☐	☐	☐	☐
4.5	Financial consultants are not trustworthy.	☐	☐	☐	☐	☐	☐	☐	☐
4.6	Financial consultants are not concerned with customers' needs.	☐	☐	☐	☐	☐	☐	☐	☐
4.7	Financial consultants are not completely open in dealing with customers.	☐	☐	☐	☐	☐	☐	☐	☐
4.8	Financial consultants are frank in dealing with customers.	☐	☐	☐	☐	☐	☐	☐	☐

University of St.Gallen
Thursday, March 18th

Number:
Scenario:

		Strongly disagree					Agree partially		Completely agree	Don't know
5.1	If products differ from each other, I try to figure out the differences.	☐	☐	☐	☐	☐	☐	☐		☐
5.2	I like to deal intensively with the characteristics of different products.	☐	☐	☐	☐	☐	☐	☐		☐
5.3	If there are multiple products to choose from, I always try to identify the best ones.	☐	☐	☐	☐	☐	☐	☐		☐
5.4	The idea to make the best choice from a variety of products inspires me.	☐	☐	☐	☐	☐	☐	☐		☐

		Strongly disagree					Agree partially		Completely agree	Don't know
6.1	I like using computers.	☐	☐	☐	☐	☐	☐	☐		☐
6.2	I find it easy to get a computer to do what I wanted it to do.	☐	☐	☐	☐	☐	☐	☐		☐
6.3	All the things that can be done by a computer should be done by the computer.	☐	☐	☐	☐	☐	☐	☐		☐
6.4	Working with a computer is always more productive than working without computer.	☐	☐	☐	☐	☐	☐	☐		☐

		Strongly disagree					Agree partially		Completely agree	Don't know
7.1	My decisions are usually based on objective facts.	☐	☐	☐	☐	☐	☐	☐		☐
7.2	I tend to think through many alternatives before I make decisions.	☐	☐	☐	☐	☐	☐	☐		☐
7.3	I often take decisions for which there are not really arguments.	☐	☐	☐	☐	☐	☐	☐		☐
7.4	I am more of a rational person.	☐	☐	☐	☐	☐	☐	☐		☐

		Strongly disagree					Agree partially		Completely agree	Don't know
8.1	Emotions are an important source of information.	☐	☐	☐	☐	☐	☐	☐		☐
8.2	I let my actions guide by emotions.	☐	☐	☐	☐	☐	☐	☐		☐
8.3	My decisions often get affected by my emotions.	☐	☐	☐	☐	☐	☐	☐		☐
8.4	I often get too emotionally involved.	☐	☐	☐	☐	☐	☐	☐		☐

9.1.	Your gender?		
	☐ female	☐	male

9.2.	Your age?
	years

Chapter 2: Post-Experiment Survey

University of St.Gallen
Thursday, March 18th

Number:
Scenario:

Feedback questionnaire

1.1.	Would you like to arrange a real appointment with this consultant?
	☐ Yes ☐ No

		Strongly disagree			Agree partially			Completely agree	Don't know
2.1	This consultant knew funds very well.	☐	☐	☐	☐	☐	☐	☐	☐
2.2	This consultant was well informed about funds.	☐	☐	☐	☐	☐	☐	☐	☐
2.3	This consultant had the expertise that was needed to understand the information provided by me as a customer.	☐	☐	☐	☐	☐	☐	☐	☐
2.4	This consultant was a very knowledgeable person.	☐	☐	☐	☐	☐	☐	☐	☐

		Strongly disagree			Agree partially			Completely agree	Don't know
3.1	This consultant had a high level of empathy with respect to my needs as a customer.	☐	☐	☐	☐	☐	☐	☐	☐
3.2	It was not difficult for this consultant to find out my needs.	☐	☐	☐	☐	☐	☐	☐	☐
3.3	This consultant tried to find out my needs by taking my perspective.	☐	☐	☐	☐	☐	☐	☐	☐
3.4	This consultant was able to adapt his interaction to my needs.	☐	☐	☐	☐	☐	☐	☐	☐

		Strongly disagree			Agree partially			Completely agree	Don't know
4.1	Overall, I was very satisfied with the consultancy interaction.	☐	☐	☐	☐	☐	☐	☐	☐
4.2	I was very satisfied with the flow of the consultancy interaction.	☐	☐	☐	☐	☐	☐	☐	☐
4.3	How the consultant made the sales presentation was a very good experience.	☐	☐	☐	☐	☐	☐	☐	☐

		Strongly disagree			Agree partially			Completely agree	Don't know
5.1	I like funds.	☐	☐	☐	☐	☐	☐	☐	☐
5.2	I think funds have a lot of beneficial characteristics.	☐	☐	☐	☐	☐	☐	☐	☐
5.3	I have a favorable opinion of funds.	☐	☐	☐	☐	☐	☐	☐	☐
5.4	The decision to buy funds is foolish.	☐	☐	☐	☐	☐	☐	☐	☐
5.5	Buying funds is a good decision.	☐	☐	☐	☐	☐	☐	☐	☐
5.6	I can well imagine to buy a fund in the future.	☐	☐	☐	☐	☐	☐	☐	☐
5.7	Following this consultancy session, I could imagine buying a fund.	☐	☐	☐	☐	☐	☐	☐	☐

University of St.Gallen
Thursday, March 18th

Number:
Scenario:

		Strongly disagree					Agree partially		Completely agree	Don't know
6.1	The consultant was very customer-oriented.	☐	☐	☐	☐	☐	☐	☐		☐
6.2	The consultant tried to help me achieve my goals.	☐	☐	☐	☐	☐	☐	☐		☐
6.3	The consultant tried to get me to discuss my needs with him.	☐	☐	☐	☐	☐	☐	☐		☐
6.4	The consultant tried to find out what kind of fund would be most helpful to me.	☐	☐	☐	☐	☐	☐	☐		☐

		Strongly disagree					Agree partially		Completely agree	Don't know
7.1	This consultant was not trustworthy.	☐	☐	☐	☐	☐	☐	☐		☐
7.2	This consultant did not seem to be concerned with my needs.	☐	☐	☐	☐	☐	☐	☐		☐
7.3	This consultant was not completely open in dealing with me.	☐	☐	☐	☐	☐	☐	☐		☐
7.4	This consultant has been frank in dealing with me.	☐	☐	☐	☐	☐	☐	☐		☐

		Strongly disagree					Agree partially		Completely agree	Don't know
8.1	The consultant actively involved me in the development of the solution.	☐	☐	☐	☐	☐	☐	☐		☐
8.2	I collaborated with the consultant in the development of the solution.	☐	☐	☐	☐	☐	☐	☐		☐

9.1.	If you think back to your conversation with the consultant: Do you think that such a conversation could take place in reality?
	☐ yes ☐ no

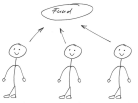
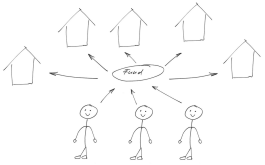
		Not even close to reality					Very close to reality	Don't know
9.2.	How realistic was the meeting with the consultant in your view?	☐	☐	☐	☐	☐		☐

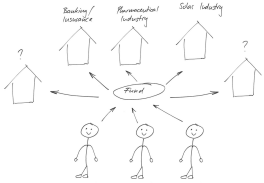
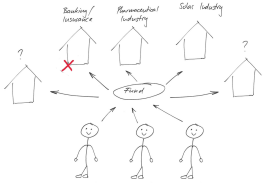
		Strongly disagree					Agree partially		Completely agree	Don't know
10.1	I would recommend this consultant.	☐	☐	☐	☐	☐	☐	☐		☐
10.2	If this had been a real consultation, I would get some advice for future needs once again from this consultant.	☐	☐	☐	☐	☐	☐	☐		☐
10.3	If I want to actually buy financial products, I'll look for a consultant like this one.	☐	☐	☐	☐	☐	☐	☐		☐

Appendix II

Chapter 2: Script for the Counselling Interview

In the following, an exemplary version of the script followed during the counselling interviews in Chapter 2 is presented.

Kommentar	Skizze
Ein Investmentfonds kann man sich als grossen Topf vorstellen.	
Viele Anleger zahlen verschieden hohe Beiträge in diesen Topf ein. Bereits mit einem kleinen Betrag kann man als Anleger partizipieren. Kauft ein Anleger Anteile eines Investmentfonds, richtet sich seine Beteiligung an diesem Topf nach der Höhe seiner Einlage.	
Der Fonds wird von Experten nach dem Grundsatz der Risikomischung verwaltet. Sie investieren das Geld des Fonds möglichst gewinnbringend in verschiedene Unternehmen verschiedener Branchen. Der Vorteil für den Kunden besteht nun darin, dass er sich nicht bloss an einem Unternehmen beteiligt sondern sein Kapital auf verschiedene Unternehmen verteilt und durch diese Diversifizierung sein Risiko verkleinert. Die Fondsanteile werden wie Aktien oder Devisen täglich an der Börse gehandelt.	
Der Gesamtbetrag des Fondsvolumen steigt demnach durch neue Einlagen von Anlegern und durch erwirtschaftete Gewinne der einzelnen Unternehmen beziehungsweise fällt durch Rückerstattung von Anteilen der Anleger oder Verluste. Dank der Diversifizierung ist man als Anleger jedoch Schwankungen auf dem Aktienmarkt nicht in dem Masse ausgesetzt, wie dies bei reinen Aktien der Fall ist.	
Die Aufnahme/Rückgabe von Anteilen am Fondsvolumen hat jedoch keinen Einfluss auf den Wert des einzelnen Anteils wie auch das folgende Beispiel zeigt: Anleger 1 tätigt eine Anlage von CHF 100.00 Anleger 2 tätigt eine Anlage von CHF 1'000.00 Anleger 3 tätigt eine Anlage von CHF 10'000.00	
Das Fondsvolumen (NAV) beträgt demnach CHF 11'100.00 Setzt man zu Beginn einen Anteilswert von CHF 100.00 an, ergibt sich eine Gesamtzahl von 111 Anteilen.	

Kommentar	Skizze
Der NAV steigt durch erwirtschaftete Gewinne um 10%, ohne dass neue Anteilseigner hinzukommen. Nun ergibt sich ein neues Fondsvolumen (NAV neu) in Höhe von CHF 12'210. Der Wert eines einzelnen Anteils liegt nun bei CHF 110 (CHF 12'210 geteilt durch 111 Anteile = CHF 110). Anleger 2 entschliesst sich jetzt, seine Anteile zu verkaufen. Er erhält für seine 10 Anteile CHF 1'100. Das Fondsvolumen ändert sich nun wieder und liegt nun bei CHF 11'110, die sich jetzt auf 101 Anteile verteilen. Der Anteilswert hat sich jedoch durch die Rückerstattung der Anteile an Anleger 2 nicht verändert: CHF 11'110 (Fondsvolumen) geteilt durch 101 Anteile = CHF 110 (Anteilswert).	
Bei der Auswahl des richtigen Fonds sollte man sich niemals von den Werteentwicklungen in der Vergangenheit beeinflussen lassen. Diese Werte haben keine Aussagekraft bezüglich künftiger Wertentwicklungen.	
So wie es unzählige Anbieter von Fonds gibt, so existieren auch viele verschiedene Fonds. Es gibt zum Beispiel Aktienfonds, Geldmarktfonds, Immobilienfonds, Obligationenfonds. Vor allem bei den Aktienfonds werden spezielle Produkte entwickelt, bei denen bspw. bloss in Unternehmen in einer bestimmten Region oder Branche investiert wird.	
Wir konzentrieren uns heute auf Aktienfonds. Als Kunde hat man nun die Möglichkeit, einen Fonds zu konfigurieren, der optimal auf die eigenen Bedürfnisse, Risikobereitschaft und persönlichen Werte abgestimmt ist. Die einzelnen Fonds sind so zusammengesetzt, dass sie jeweils Anteile verschiedener Unternehmen einer einzelnen Branche beinhalten. Der Kunde hat nun die Möglichkeit, seinen individuellen Fonds zusammenzustellen, indem er auswählt, welche Branchen ihm zusagen, und welche nicht. Jene Branchen, die nicht in seinem Fonds vertreten sein sollen, werden gestrichen. Sie würden nun also Fondsanteile eines Fonds kaufen, der in die Branchen <…> investiert.	
Haben sie noch weitere Fragen? Ansonsten danke ich für das Gespräch und bitte sie, sich anschliessend noch kurz Zeit zum Ausfüllen dieses Fragebogens zu nehmen.	

List of Publications

Eppler, M.J. and Pfister, R.A. (2012), *Sketching at Work: 35 starke Visualisierungs-Tools für Manager, Berater, Verkäufer, Trainer und Moderatoren,* Schäffer-Poeschel Verlag, Stuttgart.

Pfister, R.A. (2012), "Does the medium matter? An Experiment on the Impact of Collaboration on Visual Sales Sessions", *Information Visualization*, Proceedings of the 16th International Conference on Information Visualization, IV12, Montpellier, July 11-13, 2012, IEEE Computer Society, Los Alamitos, CA, pp. 343-48.

Eppler, M.J. and Pfister, R.A. (2012), "Paths to Success: A sketch-based creativity technique for individuals and teams", *Information Visualization*, Proceedings of the 16th International Conference on Information Visualization, IV12, Montpellier, July 11-13, 2012, IEEE Computer Society, Los Alamitos, CA, pp. 337-42.

Eppler, M.J. and Pfister, R.A. (2012), "The Benefits of Sketching for Knowledge Management", *Journal of Knowledge Management*, Vol. 16 No. 2, pp. 372-82.

Pfister, R.A. (2012), *Making the Invisible Visible: Knowledge Visualization at Open Systems Inc.*, Case Study, The European Case Clearing House (eech), Bedfordshire.

Eppler, M.J. and Pfister, R.A. (2011), "Sketching as a Tool for Knowledge Management: An Interdisciplinary Literature Review on its Benefits", in Lindstaedt, S. and Granitzer, M. (Eds.), *Proceedings of the 11th International Conference on Knowledge Management and Knowledge Technologies (i-KNOW '11), Graz, September 7-9, 2010*, ACM, New York, NY, Article 11.

Pfister, R.A. (2012), "Kreative Kartensets für Teams: Der Bericht eines Kartenentwicklers", *Organisationsentwicklung*, Vol. 31 No. 2, pp. 81-3.

Eppler, M.J., Hoffmann, F. and Pfister, R.A. (2011), "Rigor and Relevance in Management Typologies: Assessing the Quality of Qualitative Classifications", working paper, =mcm institute, University of St.Gallen (HSG), St.Gallen.

Eppler, M.J. and Pfister, R.A. (2011), *Sketching at Work: A Guide to Visual Problem Solving and Communication for Managers, Consultants, Sales Professionals, and Trainers*, mcm institute, St.Gallen.

Eppler, M.J. and Pfister, R.A. (2010), "Drawing conclusions: Supporting decision making through collaborative graphic annotations", *Information Visualization*, Proceedings of the 14th International Conference on Information Visualization, IV10, London, July 26-29, 2010, IEEE Computer Society, Los Alamitos, CA, pp. 369-74.

Curriculum Vitae

Roland Andreas Pfister
Born January 8, 1977 in Lucerne, Switzerland
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Education

09/2009 – 03/2013	University of St.Gallen, Switzerland *Conferral of a Doctorate (PhD in Management)*
09/2012	The City College of New York, NY, USA *Visiting Researcher / Assistant Professor*
10/2010 – 11/2012	Center for University Didactics, St.Gallen, Switzerland *Certificate of Advanced Studies in Higher Education*
05/2011	Swiss Journalist School (MAZ), Lucerne, Switzerland *Media Training for Researchers*
03/2008	Credit Suisse Business School, Zürich, Switzerland *Lean Sigma, Operational Excellence DMAEC Green Belt Training*
11/1999 – 03/2004	University of St.Gallen, Switzerland *Graduate Studies in Business Administration. Majoring in marketing and controlling*
09/1998 – 12/1998	University of California San Diego, CA, USA *3 months visiting term*
08/1992 – 01/1998	Gymnasium Cantonal School, Wattwil, Switzerland

Working Experience

09/2009 – 01/2013	University of St.Gallen, Switzerland *Research Assistant at the Institute for Media and Communications Management*
05/2007 – 08/2009	Credit Suisse Group, Zürich, Switzerland *Senior Business Analyst in the COO division*
11/2004 – 04/2007	Accenture AG, Zürich, Switzerland *Consultant for business processes*