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Sorting out card sorting: Comparing methods for information architects, usability specialists, and other practitioners

CAPSTONE REPORT

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Abstract

Sorting out card sorting: Comparing methods for

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This study examines open and closed card sorting methods used by information architects and usability engineers. A hybrid data analysis strategy, combining conceptual analysis (Palmquist et.al, 2005) and constant comparative method (Glaser and Strauss, 1967) is employed to review 14 references. Characteristics of card sorting methods and their properties are organized into twelve emergent categories. Results are presented in a hypertext table, designed to be extended by others, and supported with explanations of each category.

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CHAPTER 1 – PURPOSE OF STUDY

Brief Purpose

The purpose of this study is to design a comprehensive, replicable, extensible tool for comparing card sorting methodologies as they are described in selected literature. The card sorting methods under examination are broadly classified as one of two types, known as "open sorting" and "closed sorting" (Deaton, 2002) (Morville & Rosenfeld, 2001) (Maurer & Warfel, 2004).

Card sorting "involves [the] sorting [of] a series of cards, each labeled with a piece of content or functionality, into groups that make sense to users or participants" (Mauer & Warfel, 2002, p.2). Closed sorting is defined as "[a methodology] in which the groupings are defined by the researcher and the subject is putting object cards into the defined groups" (Deaton, 2002, p.4). Open sorting is defined as "[a methodology] in which subjects can determine their own groupings by first sorting the cards and then labeling the resulting piles" (Deaton, 2002, p.4).

A wide range of professionals use card sorting methods, including information architects, website designers, usability specialists, and related professionals, collectively called "practitioners" in this paper. People who work in these disciplines are responsible for the design and testing of navigation systems and taxonomic structures for information systems. However, practitioners often view the information domain from different perspective and "frame of reference" than the intended users of the information. Card sorting methods can help practitioners understand the users' "mental models" and may provide insight into how users would group content to perform common tasks

(Akerelrea & Zimmerman, 2002, p. 438) (Mauer & Warfel, 2004, p.1) (Morville & Rosenfeld, 2001, p.235).

This study is designed as a literature review of selected references related to card sorting methodologies used by information architects and usability practitioners. Using a combination of the conceptual analysis process (Palmquist, et. al, 2005) and the constant comparative method (Glaser & Strauss, 1967), the characteristics of the various card sorting methods are interactively coded and then grouped into categories. The results of the coding are displayed in a table, which seeks to identify themes and patterns that emerge from the data rather than being imposed on the data (Glaser & Strauss, 1967).

The primary outcome of this study is a replicable and extensible tool (see Table 1: Twelve Categories of Card Sorting Characteristics), formatted as a set of criteria, to assist practitioners when comparing and choosing a card sorting method, or combinations of methods, for use in a given situation.

Full Purpose

The field of information architecture is so new that it is still evolving as a recognized discipline (Morville & Rosenfeld, 2001). As a result, this study is designed for a broad range of professionals who work in the area of information architecture and who use, or may be interested in using, card sorting methods as input into in the design of an information system.

In a discussion of "who is qualified to practice information architecture," Morville and Rosenfeld (2001) suggest that a wide range of disciplines may collectively provide insight into this evolving science. Among the practices mentioned are graphic and information designers, information and library science professionals, usability engineers, marketing professionals, and computer science professionals (Morville & Rosenfeld, 2001). According to Morville and Rosenfeld (2001), graphic and information design professionals are interested in the communication of information with visual and verbal clarity. Information and library science professionals study the efficient and intuitive categorization and organization of information. Usability engineers, often called Human Computer Interaction (HCI) professionals, evaluate and assess how users interact with an information system or software interface. Marketing professionals are expert at defining and understanding audiences. Computer scientists and software programmers can provide technical methods for identifying content and they are responsible for the design of software interfaces (Morville & Rosenfeld, 2001).

Even though professionals in each of these disciplines use card sorting as part of their work, their goals are not always the same. For example, the disciplines of usability and information architecture, although similar in some respects, have significantly different purposes (Lash, 2002). The usability of an information resource may include navigation, categorization, and labeling but usability also includes fonts, colors, and other visual aspects. Information architecture encompasses the navigation, categorization, and labeling of information but also is concerned with other information issues, such as metadata and content management (Lash, 2002).

The confluence of professionals involved in the field of information architecture can create a confusing mix, even among the professionals themselves. For example, Lash (2002) states that while the difference between the fields of information architecture and usability is relatively distinct, for many people the distinction is often blurred. This is understandable since professionals whose roles fall within these disciplines often perform duties that cross over into other disciplines (Lash, 2002). Thus, the intended audience for this study is a cross disciplinary group of professionals who work in the field of information management. In this paper, this larger group of related professionals is referred to as "practitioners." This term designates an inclusive description of people who use, or may be interested in using card sorting methods as input into in the design of an information system.

Practitioners of all types use card sorting to elicit end user input into the organization of an information structure (Mauer & Warfel, 2004) (Deaton, 2002). A practitioner may design a card sorting exercise by choosing between variants of card sorting methodologies, including open sorting, closed sorting, multiple sorting, and successive sorting (Deaton, 2002). The most commonly used methods, open and closed sorting (Mauer & Warfel, 2004), are examined in this study. Open card sorting is generally used to elicit user input in the initial information design phase (Mauer & Warfel, 2004, p.2) (Boutelle & Sinha, 2004, p.350) (Deaton, 2002). Closed sorting is typically used for testing proposed or existing designs, or for testing information categories and labels that emerge from an open sort exercise (Mauer & Warfel, 2004, p.2) (Boutelle & Sinha, 2004, p.350) (Deaton, 2002).

Many practitioners contend that card sorting can be valuable in the early design or redesign stages of an information system (Faiks & Hyland, 2000) (Fuccella, 1997). However, card sorting results should not necessarily dictate the design of the information resource, but rather should be used as one source of input in the design process (Deaton, 2002) (Mauer & Warfel, 2004) (McGeorge & Rugg, 2003).

This study is designed as a literature review of articles and research related to card sorting methodologies used by information architects and usability practitioners. As a research methodology, a literature review provides a "theoretical perspective" of a body of knowledge and provides the researcher with a valuable source of data gleaned from previous research conducted in the discipline (Leedy & Ormrod, 2001, p. 70). The data are reviewed using a combination of the conceptual analysis process (Palmquist, et. al, 2005) and the constant comparative method (Glaser & Strauss, 1967). Through emergent identification and selective reduction, the characteristics of the various card sorting methodologies are interactively coded. The data analysis process seeks to:

- Identify quantitative characteristics of open and closed card sort methods. Examples of such quantitative characteristics include, but are not limited to: the number of participants, number of cards, length of session, and others.
- Identify qualitative characteristics of open and closed card sort methods. Examples of such qualitative characteristics include, but are not limited to: authors' perspectives on individual vs. group sort, methods for participant or content selection, and others.

As distinct characteristics of the card sorting methods are identified, they are grouped with similar characteristics identified across the selected literature. When a group of characteristics reaches a significant point of saturation, categories are created and the properties of the categories are identified using a grounded theory approach (see Figure 1). This approach seeks to identify themes and patterns that emerge from the data rather than being imposed on the data (Glaser & Strauss, 1967).

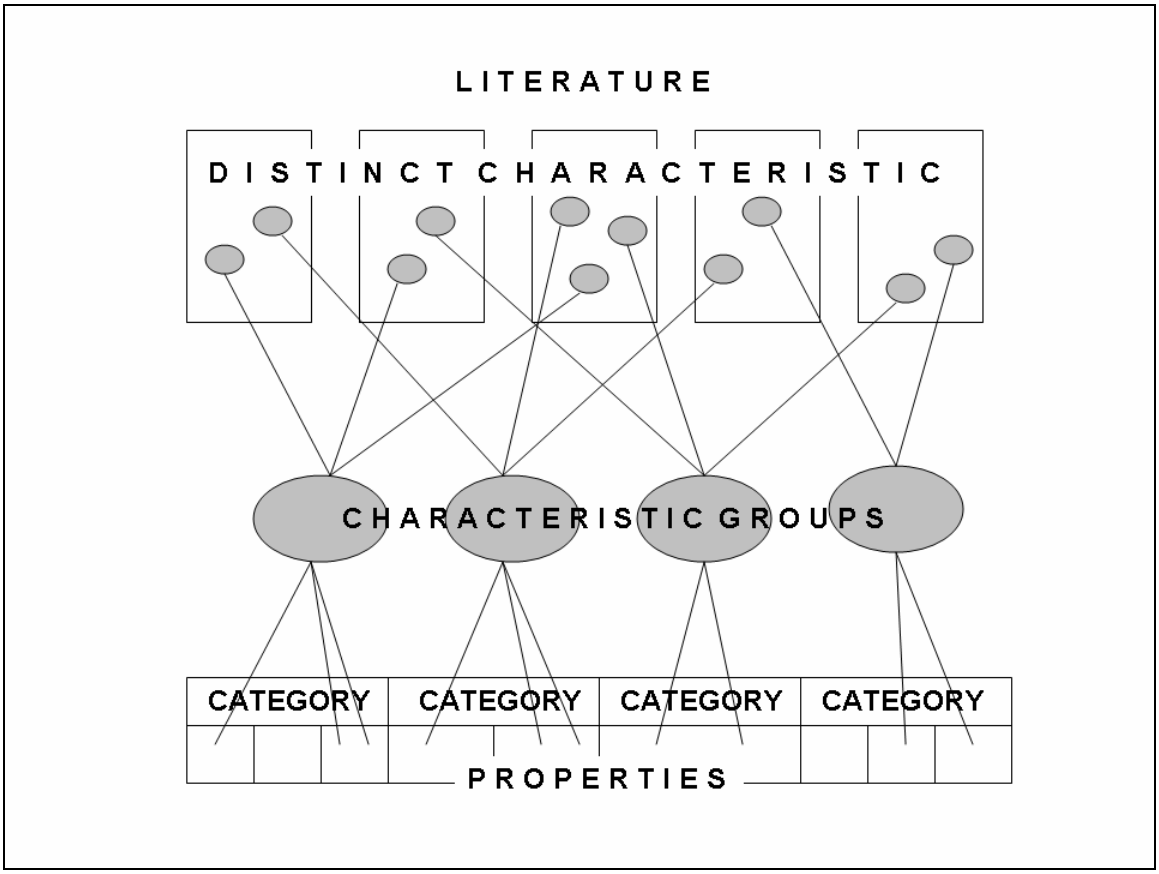

Figure 1: Combined Conceptual Analysis and Constant Comparative Method Process

The primary outcome of this study is a replicable and extensible tool (see Table 1: Twelve Categories of Card Sorting Characteristics), formatted as a set of criteria, to assist practitioners with comparing and choosing an open or closed card sorting method, or combinations of methods, for

use in a given situation. Results from the data analysis are framed for use by practitioners, who may find value in this tool for a number of reasons. Specifically the tool is designed to:

1. Reveal characteristics of card sorting methods that may be overlooked in card sorting exercise design;
2. Provide a tool for practitioners to compare the methods of other practitioners;
3. Aid with the design of a card sorting exercise based on standardized criteria; and
4. Provide a method for extending the data set by coding literature from other card sorting guidelines and case reports.

Significance of the Study

Card sorting is most valuable in the early development stages of an information system because it provides an opportunity for users to provide input into the design of an information structure rather than evaluating a structure that has already been designed (Faiks & Hyland, 2000). Other benefits of using card sorting in the early design phases include increased usability, reduced subjectivity introduced into the design by developers or internal pressures, and increased acceptance of the design by end users (Hahsler & Simon, 2001).

A review of the literature reveals a number of articles that describe the design of card sorting exercises; however, none of the resources identified by this researcher offers a compendium of card sorting methods in the manner presented in this study. The literature reviewed in this study is grouped into three broad categories:

- Brief summaries of card sorting exercises as they are described in literature written by practitioners.
- In-depth descriptions of a single card sorting exercise, called a "case report" in this paper.
- Generalized descriptions and recommendations for card sorting exercises, termed "guidelines" in this paper.

Mauer and Warfel (2004 state that card sorting is briefly mentioned in a few texts, but contend there "is not a definitive article that describes the technique and its variants and explains the issues to watch out for." The authors provide a generalized set of guidelines for the design of card sorting exercises (Mauer & Warfel, 2004).

Akerelrea and Zimmerman (2002) briefly summarize literature on card sorting techniques used by a number of practitioners, including Fuccella (1997), Fucella & Pizzolato (1998), Koubec & Montjoy (1991), Dearholt, McDonald, Papp, & Schvaneveldt (1986), Martin (1999), and Nielsen (1993, 2000). While Akerelrea & Zimmerman do not provide an analysis of the card sorting literature they review, they do provide a generalized set of card sorting guidelines. They conclude with a recommendation for further research in card sorting methods, including a "comparison of the various card sorting methodologies" (Akerelrea & Zimmerman, 2002). This study attempts to reach that goal.

Limitations to the Research

No time frame is specified for the selection of literature although the predominance of literature is dated from 1994-2005. The works of founding masters of social science research methodology, such as Glaser and Strauss (1967), are given particular credit and attention. Foundational studies in the application of card sorting methods to information design are noted, including Dearholt et al. (1986). The literature referenced in this study is gathered from the following sources and is subject to the following criteria:

Source: Online library databases of the University of Minnesota and the University of Oregon.

Criteria: Articles from these sources include refereed journals, papers presented at conferences, extended abstracts, and non-refereed journals and periodicals.

Source: The World Wide Web (WWW).

Criteria: Articles from the WWW must meet minimum criteria that include the author(s) name, date of publication, and the article must contain cited references. The credentials of the author(s) must be included in the article or available from another source. Articles or postings from commercial web sites, BLOGS, discussion boards, and other non-qualified sites are specifically excluded (Kapoun, 1998).

Source: Books and periodicals

Criteria: Books and periodicals are admissible if they have been cited or recommended in other admissible literature.

It should be noted that some of the WWW articles used in this study are written by information design practitioners who present descriptive, generalized guidelines on card sorting methods based on their personal observations and experience. These materials are referred to as "guidelines" in the data analysis and in the study. The decision to include these guidelines is made in response to the seeming shortage of substantially qualified case reports and a desire to include practitioner reports of applied, field based recommendations for card sorting as an information design methodology.

The qualitative research process used in this study is intended to provide sufficient controls to verify the validity of the research methodology; however, the data under analysis are not under the control of the researcher. Thus, a full set of comparable data are not available in all categories for all samplings of the literature. There is neither a claim, nor the intent, that the sampling of literature reviewed in this study should be considered inclusively representative of the literature available on card sorting methodologies.

The criteria for admissibility of sampling data are broadly guided by the "theoretical relevance" of the data (Glaser & Strauss, 1967). This flexible approach allows for the selection of data with the intent to identify as many categories and properties of the categories as possible, rather than restricting the selection to data that saturate a prescribed set of categories. The inclusion of data gleaned from diverse sources and that describe the use of card sorting methods in varied situations is also conducive to the discovery of a "generalized substantive theory" (Glaser & Strauss, 1967, p.49-54).

This study seeks to identify and categorize the characteristics of open and closed card sorting methodologies and to assign properties to the categories. This study does not deeply examine other

types of card sorting methods, or the data analysis methodologies used to interpret the results of the card sorting exercise. The analysis of the card sorting data can be either qualitative or quantitative (Akerelrea & Zimmerman, 2002) (Deaton, 2002) (Fucella & Pizzolato, 1998). If the method of analysis is provided or practitioner perspectives on the value of quantitative or qualitative analysis of data are offered, they are coded as a property of the card sorting method. A brief narrative analysis describes the quantitative and qualitative reconciliation of card sorting categories that emerge from an open sort. According to Deaton (2002) it is essential to first determine the method for analysis of the card sorting data before designing the card sorting exercise, yet many card sorting articles do not mention the method of data analysis (Deaton, 2002).

A large amount of qualitative data exists that describe physical, environmental, and hospitality considerations when conducting a card sorting study. Examples of this data include but are not limited to:

- The preparation of the physical media used for the card sort, such as how to prepare index cards (i.e. Word mail merge, etc.), lamination, using sticky notes, computerized sorting applications, etc.
- The environmental aspects of the area used for the sorting exercise, such as a quiet room, a table large enough for the participant to spread the cards out, etc.
- Hospitality recommendations, such as give the participants a break, provide refreshments; make the participants comfortable, etc.

Although these are important considerations for conducting a card sorting exercise, they are determined to be ancillary to the actual design of the card sorting exercise and are not coded as

characteristics of the method. The researcher wishes to note however, they could be coded in a more broadly framed analysis.

The researcher hopes that practitioners will find value in the representation of the data as presented in the outcome of the study – the hypertext Table 1: Twelve Categories of Card Sorting. However, limitations exist in this condensed view of the literature. The hypertext "tool tip" limits entries to 255 characters, often causing contextual explanations or author quotes to be truncated. The full conceptual and contextual intent of the author(s) of the articles under review is not conveyed well by this tool. As a preliminary study, the data are not coded to the fullest extent possible and considerable potential exists for the further identification of categories and for the addition of properties to existing categories. Thus, the reader is highly encouraged to study these resources to make their own determination on the validity of constructs used by this researcher for the classification and assignment of properties to the characteristics.

Problem Area

Card sorting is a time-tested method of data collection in the social sciences (Deaton, 2002). Coxon (1999) refers to literature on card sorting dating as far back as 1935, citing a number of studies conducted from 1956 to 1991 that use sorting techniques in the fields of psychology, anthropology, sociology, and mathematics (Coxon, 1999). A card sorting study conducted in the design phase of a UNIX command documentation interface is presented by Dearholt, et al. (1986), with references to the use of hierarchical clustering methods for computer interface design as far back as 1967. A frequently cited paper by Nielsen & Sano (1994) may have spurred the use of card sorting as a

method for gaining insight into user preferences in the design of web based information systems (Nielsen & Sano, 1994).

As a research methodology, card sorting is often described as a relatively simple, inexpensive method of gaining insight into user preferences for the organization of information. Practitioners have described card sorting as:

- "quick, inexpensive, and reliable" (Mauer & Warfel, 2004)
- "a relatively simple process from the participant's point of view" (Kidwell & Martin, 2001)
- "a powerful, but relatively straightforward methodology for designing websites based on user expectations and feedback" (Fuccella & Pizzolato, 1998)
- "particularly useful for understanding users' perceptions of relationships between items" (Martin, 1999)
- "so simple a 6 year old could do it" (Gordon, 2002)
- "easy to replicate" "a relatively easy task, for both those administering the study and those participating in it" (Faiks & Hyland, 2000)

However, Boorman and Arabie (1972) suggest that "it is perhaps a consequence of the deceptive simplicity of the method of sorting that so many of its problematic aspects have remained unexamined" (Boorman and Arabie, 1972, as quoted by Coxon, 1999). According to Gray and Salzman (1998), the design of many usability evaluation methods (UEM) experiments fall short of meeting the rigors of scientific integrity in that "neither the data they produce nor the conclusions

drawn from the data are reliable or valid" (Gray & Salzman, 1998, p. 206). Carey et al. (2002) contend that "many of the UCD [user centered design] methods discussed in the literature are not effective or practical for a variety of reasons…there is a need for practical UCD guidelines based on the collective wisdom of the industry-wide community of UCD practitioners" (Carey et al., 2002 p. 471). Akerelrea and Zimmerman (2002) suggest that different usability specialists, (supposedly) using the same usability methods, elicit vastly different results (Akerelrea & Zimmerman, 2002). They contend that the credibility of usability methods has come under criticism in recent years and to "minimize such criticisms," suggest further empirical research to "enhance the effectiveness of all usability testing methodologies." Eight areas are identified where further research in card sorting may be needed (Akerelrea & Zimmerman, 2002).

- A comparative analysis of the different card sorting methodologies
- Empirical assessments of the quantitative versus qualitative analyses of the data
- Empirical assessments of group and individual card sorting methodologies
- Considerations of validity and reliability of card sorting methodologies
- Assessments of potential differences across different populations and cultures
- Comparisons of results between random and purposeful recruitment of participants
- Determination of the optimal number of participants
- Establish a standard for the number of "idea" cards per sorting

(Akerelrea & Zimmerman, 2002, p. 443)

CHAPTER II – REVIEW OF REFERENCES

The Review of References briefly annotates key literature that serves as a foundation for this research. Annotations are intended to convey the basic purpose of the literature and its primary contribution to this research. Notations include a report of the constructs used to establish the credibility of the literature.

The selection of references for review is determined by one or more of the following criteria:

- The frequency of citation of the literature in this study
- The significance of the literature in the formulation of the Purpose, Significance, Problem, Method, or Definitions (see Appendix A)
- The contribution of the literature as a comprehensive source of data for the conceptual analysis

Selected references are organized into categories of:

- Articles that describe practitioner recommendations or guidelines for card sorting design
- Articles that describe a single card sorting exercise
- Readings that formulate and substantiate the research methodology
- Foundational readings on the larger topic of Information Architecture

Literature on Practitioner Guidelines

Akerelrea, C. & Zimmerman, D. (2002). A group card sorting methodology for developing informational web sites. In *Proceedings of the 2002 IEEE Professional Communications Conference.* 437 – 445.

According to Akerelrea and Zimmerman, as a communications medium the effectiveness of many websites is hindered because the websites fail to address the user's needs. With substantial supporting citations, the authors suggest that web developers often view the website's information from a different frame of reference than the audience for whom the information is intended. They contend that in order for communication to occur between the website and users, the sender's and receiver's frame of reference should overlap.

Akerelrea and Zimmerman review a number of reports and guidelines on card sorting methods and present a seven-point list of the strengths of card sorting as a research methodology. A general set of card sorting guidelines is provided by Akerelrea and Zimmerman. The authors propose a follow-up to an open card sort that uses a focus group approach for determining a level on consensus on categories.

Akerelrea and Zimmerman's paper is a primary resource for this study. It provides a set of card sorting guidelines as data for the conceptual analysis and supporting rationale for the Problem Area, Purpose, and Significance. The most significant contribution of this paper is

Akerelrea & Zimmerman's suggestion that, in response to criticisms of the scientific validity of usability methods, further research is needed including "a comparative analysis of the different card sorting methodologies." This has become the foundation for this study.

The formulation of Akerelrea and Zimmerman's paper is well cited and the authors provide 27 references. It was accepted for presentation at the 2002 IEEE Professional Communications Conference. The IEEE was formed in 1963 with the adoption of the first bylaws of the Institute of Electrical and Electronic Engineers (IEEE), with predecessor societies dating to 1884. The society has grown to over 365,000 members in 1446 chapters located in 150 countries. The IEEE Xplore electronic library contains more than 1.1 million documents as of January 2005.

Deaton, M. (2002). *Sorting techniques for user-centered information design*. Retrieved March 30, 2005 from http://www.mmdeaton.com/SortingTechniquesforInformationDesign.doc

Deaton begins with an historical overview of card sorting in the social sciences. The article contains quotes by other practitioners and researchers who expound on the value of card sorting as a methodology for understanding the organization of information from a users' perspective. Deaton explains four card sort methods: "free" or open sorting, closed sorting, multiple sorting (a form of open sorting where participants sort the same set of objects multiple times based on different criteria), and successive sorting.

Of the references located for this study, this researcher contends that Deaton's work most closely examines a body of literature with the intent to identify characteristics of card sorting, categorize them, and assign properties to them. The author cites and compares the recommendations of two or three authors under each of the following headings:

- How many objects?
- How many sorters?
- How many sorts?
- How to carry out the sort.

Deaton's work is used in this study as a source for definitions of a number of card sorting terminologies as well as supporting concepts presented by other authors in paraphrased statements made by this researcher. Deaton's ideas are particularly instrumental in the formulation of the Full Purpose of this paper. Deaton's article provides a brief comparison of quantitative card sorting characteristics from referenced literature and offers no suggestion of guidelines. As such, the quantitative characteristics are excluded from coding in the conceptual analysis.

Deaton's paper contains thirty references and the paper is well cited throughout. Deaton is a graduate research assistant in technical communications at the University of Washington and works as a documentation writer for Microsoft. A number of Deaton's articles have been published in conference proceedings of the Society for Technical Communications, and on Builder.com and CNetBuilder.com.

Fuccella, J. & Pizzolato, J. (1998). *Creating web site designs based on user expectations and feedback.* Retrieved April 3, 2005 from http://www.internettg.org/newsletter/june98/web_design.html

IBM Usability Specialists Fuccella and Pizzolato offer a number of reasons for involving end users in a website design process. This paper discusses research methods used for input into a card sorting exercise design. The authors describe the use of "active" and "passive" user surveys to define their audience and the use of focus groups, iterative surveys, exploratory surveys, scenario building exercises, and competitive review for identifying requirements and tasks and ultimately, identifying content for the card sort. The authors provide generalized set of guidelines for the design of a card sorting exercise.

Although the paper is not widely cited in this study, Fuccella and Pizzolato strongly contribute to this research with their suggestion of methods for defining audiences and tasks. These topics are not specifically covered in this research; however, their paper is used as a basis for the identification of potential properties in the categories of audience and task definition. The identification of these properties may prove beneficial for an extended study of card sorting criteria.

Fuccella and Pizzolato do not provide references in this 1998 paper, published in a newsletter of the Internet Technical Group. However, the paper is cited and referenced in at least three other resources used in this research and the expertise of the authors, by nature of their employment, was deemed credible and within the criteria for admissibility of literature.

Maurer, D., & Warfel, T. (2004). *Card sorting: A definitive guide.* Retrieved March 25, 2005 from http://www.boxesandarrows.com/archives/card_sorting_a_definitive_guilde.php

Maurer and Warfel's article on card sorting is an informative work that identifies a number of considerations for the design and conducting of a card sorting exercise. The authors work at private information design firms as usability specialists and have worked under contract for a number of large multinational firms.

This "definitive guide" is written based on the collective experiences of the authors and provides data for a number of categories in the conceptual analysis in this paper. Maurer and Warfel's article also provides supporting conceptual reinforcement for paraphrased statements and definitions in the Full Purpose of this study.

Although the article is not cited or published in a peer-reviewed journal, the experience of the authors, its acceptance for publishing on the reputable Boxes and Arrows.com website, and informal references to the article on a number of practitioner web sites provided credibility to the resource and to the guidelines.

Literature on Case Reports

Ahlstrom, V. & Allendoerfer, K. (2004). Information organization for a portal using a card-sorting technique. *U.S. Department of Transportation, Federal Aviation Administration.* Retrieved March 31, 2005 from http://hf.tc.faa.gov/technotes/dot-faa-ct-tn04-31.pdf

This is a comprehensive and descriptive case report that outlines the card sorting methods used in the navigation design of an employee portal for the William J. Hughes Technical Center (WJHTC) of the Federal Aviation Administration (FAA). Ahlstrom and Allendoerfer present well-formed arguments on the advantages and disadvantages of a number of characteristics of card sorting methods. The introduction to the report is cited and the description of the card sorting exercise provides a rich set of data for the conceptual analysis in this paper. Ahlstrom & Allendoerfer's paper should be studied by practitioners for a full understanding of the concepts presented in their paper.

Ahlstrom and Allendoerfer present the only empirical study located by this researcher that investigates a qualitative vs. quantitative analysis of the card sorting results. Although the entire set of results of the data analysis is not made available, examples are provided and a brief conclusion is offered.

The authors are employed by the FAA and they were involved with the design of navigation structures for the WJHTC employee portal. The authors have also worked on a number of other FAA information design projects. This status provides substantial credibility to Ahlstrom and Allendoerfer. The paper is published on the Technotes website of the FAA.

Literature on Research Methodology

Glaser, B. & Strauss, A. (1967). *The discovery of grounded theory: Strategies for qualitative research.* Chicago: Aldine Publishing Company.

Originally presented by Glaser and Strauss as a methodology for sociological research, grounded theory and the constant comparative method have been adapted for qualitative research in a wide range of disciplines. The underlying premise of grounded theory research is the absence of hypothetical presumption by the researcher. A sampling of qualitative data is reviewed with "theoretical sensitivity," with the intent to identify recurring themes or concepts, categorize them, and assign qualitative properties to those concepts. The researcher may then seek further data to strengthen an emergent theory. This resource serves as a primary foundation for the development of the hybrid conceptual analysis and constant comparative methodology used in this study.

This groundbreaking monograph on qualitative research methodology has withstood nearly four decades of scrutiny and has survived virtually unscathed. The latest printing is 1999 and it ranks Number 12,240 in sales on Amazon.com, attesting to its continued popularity as a research methodology.

Palmquist, M., et al. (2005). *Content analysis*. Writing@CSU. Colorado State University Department of English. Retrieved April 8, 2005 from http://writing.colostate.edu/references/research/content/

This website on the basics of content analysis is brief and succinct; the presentation of the conceptual analysis process is written clearly for the novice researcher and may be an excellent refresher resource for the experienced researcher. This resource serves as a primary foundation for the development of the hybrid conceptual analysis and constant comparative methodology used in this study and provides a number of Definitions (see Appendix A) for the study.

A search on Google for "writing@csu" (the name of the Colorado State University online writing resource) uncovers a large number of accredited Universities and Colleges, government sites, and other educational sites that reference the Writing@CSU site as a prime resource for tips on writing. It is also recommended as a reference by the University of Oregon.

Literature for Foundational Reading

Morville, P. & Rosenfeld, L. (2002). *Information architecture for the world wide web.* Sestabol, CA: O'Reilley and Associates, Inc.

This popular book on the emerging science of Information Architecture is widely cited in recent literature. Morville and Rosenfeld present a wide range of concepts that provide both the novice and experienced information architect with a foundational understanding of how this emerging discipline has evolved and where it may be destined. Although card sorting is only one of the many topics discussed, this text provides context for practitioners who are interested in card sorting as an information design tool.

Morville and Rosenfeld provide reinforcement for concepts and definitions in the Full Purpose and Significance sections of this study. This recent book is referenced by Mauer and Warfel (2004) and is widely referenced on practitioner websites.

CHAPTER III – METHOD

The overarching method of inquiry for this study is the Literature Review (Leedy & Ormrod, 2001) (Proctor & Taylor, 2005). The objective of this study is to aggregate and analyze selected literature on card sorting methods. As a research methodology, literature review is useful for summarizing similarities and differences found within the literature, identifying what is known and formulating questions about what is not known, and for discovering controversy within the literature (Proctor & Taylor, 2005).

An outline of each phase of the research process is presented below, followed by a detailed description.

Data Collection

- Criteria for the admissibility of data are established (Leedy & Ormrod, 2001, p. 97).
- Searches of the Internet and the online libraries of the Universities of Minnesota and Oregon are conducted to identify admissible data (Leedy & Ormrod, 2001, pps. 71-82).
- An admissible set of literature related to card sorting methodologies is secured.

Data Analysis

- A conceptual analysis process (Palmquist, et al. 2005) is conducted to code an initial sample of data, with the coding results entered into a spreadsheet.
- The sampling of data is interpreted using a constant comparative method, which seeks to categorize the properties of the phenomena while concurrently generating theory (Glaser & Strauss, 1967, p. 102-103).

Data Presentation

- The data are displayed in a table, with hypertext notations that display quotations or paraphrases from the literature. These serve as the logical constructs used by this researcher for the assignment of the property.

Data Collection

The first search for card sorting literature is conducted on the Internet by querying the search engines Google and Profusion using the basic phrases "card sorting" "card-sorting" or "card sort." This search identifies a number of practitioner guidelines that are used as a foundation for additional search terminology. Further Internet searches include various combinations of "information architecture," "usability," and "human computer interaction." These basic search terms are also used to search the online library of the University of Minnesota. Databases that produce relevant literature include Academic Search Premiere, Business Source Premiere, IEEE Explore, Association for Computing Machinery, Communication and Mass Media, and Wilson Web. Books and other monographs are secured through the University of Minnesota interlibrary loan process or are purchased. All of the literature coded in the conceptual analysis was found using only "card sorting" as a search term.

Data Analysis

Once the literature is collected, it is reviewed to identify characteristics of card sorting methods. The identification of the characteristics of each card sorting method described in the literature under review begins by categorizing the method as either open or closed sorting. During the first phase of the analysis, a hybrid approach of conceptual analysis (Palmquist, et al. 2005) and constant

comparative method (Glaser & Strauss, 1967) is used. Categories are created for similar characteristics of the card sorting methods. During the second phase of the analysis, properties of the data within each of the defined categories are determined and values assigned to the properties, as described below.

This study draws data from generalized guidelines written by practitioners and from other forms of empirical research published in juried journals and periodicals. A pre-screening of the literature reviewed in this study reveals that similar observations and data are available in these types of sources, including, for example, the following list of characteristics:

- How many participants to involve in the test (Ahlstrom & Allendoerfer, 2004) (Deaton, 2002) (Fuccella & Pizzolato, 1998) (Hahsler & Simon, 2001) (McGovern, 2002) (Nielsen, 2004)
- How many information items to sort (Ahlstrom & Allendoerfer, 2004) (Akerelrea & Zimmerman, 2002) (Hahsler & Simon, 2001) (Lamantia, 2003) (Mauer & Warfel, 2002) (Deaton, 2002)
- Benefits of individual vs. group card sorts (Ahlstrom & Allendoerfer, 2004) (Martin, 1999) (Mauer & Warfel, 2002)

The data analysis process seeks to explicate the characteristics in open and closed card sorting methods in the follow broad two categories:

- Identify and categorize quantitative characteristics of open and closed card sort methods. Examples of such categories include, but are not limited to the number of participants, number of cards, length of session, number of sorts, and others.
- Identify and categorize qualitative characteristics of open and closed card sort techniques. Examples of such categories include, but are not limited to authors' perspectives on individual vs. group sort, methods for selection of participants, and others.

Conceptual Analysis and Constant Comparative Method

The data are reviewed using a conceptual analysis process (Palmquist, et. al, 2005). Data not specifically relevant to a card sorting methodology or technique are ignored. The data are coded only for the existence of the characteristic and not for the frequency of appearance. When a specific characteristic of a card sorting method is identified in a reference, it is assigned to a group of similar characteristics (Palmquist, et. al, 2005). A notation of the presence of the characteristic is made in a spreadsheet column and the column is labeled. If the characteristic is quantitative in nature (i.e. number of cards to sort, number of participants, etc.) the notation is the data itself, such as the numeric value or a range of values assigned to the property of the characteristic. If the characteristic is qualitative in nature, conceptual, or easily classified (such as guideline or case report), an "X" mark is noted in a labeled column. If the researcher determines that additional explanation is needed, a hypertext "tool tip" reference is created. Hovering over the hypertext link with a mouse cursor in the electronic version of the spreadsheet will reveal a direct quotation or a paraphrase from the literature that substantiates the researchers' interpretation behind the notation.

When a characteristic group reaches sufficient saturation, a category of card sorting characteristics is created. If a characteristic is identified and a category exists with similar characteristics identified in other literature, the characteristic is evaluated to determine if it warrants the creation of a new characteristic group or if it should be added to the existing category. The researcher then reviews previously coded literature to reveal if specific properties of the phenomena exist that may have been overlooked. This organic and iterative process may lead to the identification of additional properties of the category, the division of a category into two or more categories, or the recombination of two or more categories into a single category.

In order to assign property values to conceptual semantics of the language, a level of generalization is accepted. The researcher "rates" the authors' perceptions of the characteristic as positive, neutral, or negative. This property is similar to a Likert scale (Usability First, n.d.) but this researcher does not attempt to infer any degrees of positive or negative. This rating is noted in the coding as X+ (positive) Xo (neutral or no perception) and X- (negative). A positive perception of group card sorting is determined by the use of positive terminology, such as "a benefit of group sorting is …" (Mauer and Warfel, 2004) and "sorting collectively can produce valuable information" (Deaton, 2002). For example, as a distinct characteristic of a card sorting method, a Group Card Sorting category is formed with properties of Positive, Neutral, and Negative. This positive condition is suggestive of "minimized differences" in the category (Glaser & Strauss, 1967). Conversely, a negative property of the Group Card Sorting category is determined by negative perceptions, such as "if the participants work as a group … individual approaches to the information organization might be lost" (Ahlstrom & Allendoerfer, 2004). The presence of both positive and negative

properties in the Group Card Sorting category is representative of "maximized differences" in the category (Glaser and Strauss, 1967).

Qualitative and Quantitative Data

Leedy and Ormrod (2001) suggest that it would be irresponsible to assume a single research methodology could effectively analyze all the data with validity and reliability (Leedy & Ormrod, 2001, p. 100-101). In this study, both quantitative and qualitative data are coded through a hybrid process, combining conceptual analysis (Palmquist et al. 2005) and constant comparative method (Glaser and Strauss, 1967). Quantitative data include such characteristics as number of cards to sort and the number of participants in the experiment. Qualitative data include such characteristics as the methods used for selection of participants, methods used for the target audience identification, and methods for identifying content used in the card sort.

Grounded Theory and Constant Comparative Method

For this study, the data gathered from the conceptual analysis process is further interpreted using a grounded theory approach, which seeks to identify themes and patterns that emerge from the data rather than being imposed on the data (Glaser & Strauss, 1967). The researcher must be "theoretically sensitive," continually seeking new insights into the data itself (Glaser & Strauss, 1967, p. 46).

The constant comparative method of interpretation is "concerned with generating and plausibly suggesting (but not provisionally testing) many categories, properties, and hypotheses about general problems" (Glaser & Strauss, 1967, p. 104). The intent of this study is to identify the characteristics

of card sorting methods; suggest categories to group those characteristics, assign properties to the categories, and saturate the categories with substantive data drawn from research and practice. This study does not seek to test the reliability or validity of these properties or methods.

Data Presentation

The outcome of this study is described as a replicable and extensible tool, formatted as a set of criteria, to assist practitioners with comparing and choosing an open or closed card sorting method, or combinations of methods, for use in a given situation. The following set of definitions is presented to clarify the intent of this outcome. The American Heritage Dictionary (2000) defines 'replicable' as "[able] to duplicate, copy, reproduce, or repeat." 'Extensible' is defined as "a system that can be modified by changing or adding features." A 'tool' is defined as "something regarded as necessary to the carrying out of one's occupation or profession." To 'compare' is "to examine in order to note the similarities or differences of." 'Criteria' are defined as "a standard, rule, or test on which a judgment or decision can be based" (American Heritage Dictionary, 2000).

In order to achieve the primary outcome of this study, a global view of a relatively large body of literature is taken. The objective of this study is to identify and categorize, within the confines of the literature under review, the characteristics of card sorting methods as they are described or documented by practitioners. The identified characteristics, when categorized, may be viewed as criteria that practitioners should consider when designing a card sorting exercise. The global view presented in this study is intended as a starting point for further analysis and comparison. This study does not draw conclusions from the data, nor does it suggest the data comprehensively identify all card sorting characteristics.

A spreadsheet is used to record and display the results of the conceptual analysis data, providing the reader with a condensed visual overview of the card sorting characteristics identified in the study (*see* Table 1: Twelve Categories of Card Sorting Characteristics). In literature where both open and closed sorting methods, or where alternative methods are described, the literature is coded in two separate rows of the spreadsheet. The hypertext version of the completed spreadsheet is presented in the Microsoft .mht file format and is designed with Microsoft Excel 2003. A table containing preliminary data is embedded in this Microsoft Word 2003 document, and an interactive spreadsheet may be viewed with the Microsoft Internet Explorer browser in a web-based representation of the data. No other configurations are tested. A printed copy of the spreadsheet does not display the extended hypertext notations underlying the coding of the data. For a full experience of this tool, it is highly recommended the data be reviewed using a hypertext version.

CHAPTER IV – ANALYSIS OF DATA

This chapter presents a comprehensive, replicable, extensible tool (*see* Table 1: Twelve Categories of Card Sorting Characteristics), designed for practitioners to use in two ways:

(1) to review data gleaned from the guidelines and case reports presented in this study in order to assist them with choosing criteria for their own card sorting exercise; and

(2) to extend the data set by coding their own card sorting exercises and observations into the table.

Table 1 is intended to represent one proposed model for the identification of criteria that practitioners should consider when designing a card sorting exercise. The researcher hopes that practitioners may discover literature in the references that warrants further study. The aggregated observations of practitioners may provide discursive rationale for decisions made in card sorting design. Contradictory observations may prompt reconsiderations in methodology design or promote considerations of further empirical research. Practitioners and researchers may extend the data set to include other literature, or incorporate their own observations and property values for analysis.

Table 1 is the report of the data analysis of fourteen articles – seven articles are classified as practitioner guidelines and seven are classified as case reports that describe a single study. This literature under review represents the boundaries of this analysis and as such, there is no intent to project this data as representative of all card sorting methods used in information design and

testing. The reader should assume that these presumptions exist throughout the reporting of the analysis of data.

A conceptual analysis process (Palmquist, et al. 2005) is conducted to code these fourteen references, and the coding results are entered into a spreadsheet. The results of the coding process are interpreted using a constant comparative method, which seeks to categorize the properties of the phenomena while concurrently generating theory (Glaser & Strauss, 1967, p. 102-103).

Forming Categories

A preliminary discussion on the process and value of the identification of categories is important for a number of reasons. According to Coxon (1999), "The two most basic principles about category formations are (1) that they provide maximum information with the least cognitive effort and (2) that the perceived world comes as structured information rather than as arbitrary or unpredictable attributes" (Coxon, 1999, p. 13). Categories are often identified by first identifying a "prototypical instance" of the phenomena to serve as a foundational representation of the properties or attributes of the category (Coxon, 1999, p. 13). The essential criterion for the formulation of categories is the presence of a "similarity of meaning" in the semantics of the language. This does not imply that the "same" meaning is sought, which would "reduce the semantic task to finding synonyms" (Coxon, 1999, p.14; attributed to Miller, 1969).

Categorizing the properties of a phenomenon is intended to provide a basis for comparing both the "maximization and minimization of similarities and differences" discovered within the data (Glaser and Strauss, 1967, p.55). This process may reveal interrelationships within or between categories, or

may generate new categories. The identification of minimized differences (similarities) within a category tends to establish a "probability of a theoretical prediction" (Glaser and Strauss, 1967, p. 55). Maximized differences within a category may help to identify ranges of values, causes of outcome, variations in approach, degrees of consensus, or other quantitative or qualitative insight that furthers the formulation of substantive theory (Glaser and Strauss, 1967, p. 32, 56).

Definition of Twelve Card Sorting Categories

The content analysis process begins with a thorough reading of four of the references annotated in the Review of Literature for this study. These core references include Akerelrea and Zimmerman (2002), Deaton (2002), Mauer and Warfel (2004), and Ahlstrom and Allendoerfer (2004). The first three references are classified as practitioner guidelines; Ahlstrom and Allendoerfer (2004) is classified as a case report. These references serve as "prototypical instances" (Coxon, 1999) or "theoretical samplings" (Glaser & Strauss, 1967) of the literature. As the literature is studied, potential groupings of characteristics are noted on a sheet of paper with notations made on the printed literature. A set of five or six colored highlighter markers are instrumental for locating the notations in the literature. These characteristic groupings identified ten of the eventual twelve categories. Spreadsheet columns were created and the references were coded in the random order that resulted from the continuous shuffling of the printed versions of the literature.

The initial twelve categories identified at the completion of the conceptual analysis are:

1. **Sort Type.** This category identifies the description of the card sort as either open sort or closed sort.

2. **Information Domain Defined.** If identified in the literature, this category indicates the type of information resource referred to in the guideline or case report reference.

3. **Group or Individual Sort.** This category identifies whether the literature discusses using groups or individuals for the sorting exercise. Where practitioners offered perspectives on advantages or disadvantages of the two designs, these notations were assigned a positive, neutral, or negative property.

4. **Reconciling Categories.** This category was defined at the end of the content analysis in response to the researcher's determination that the method of sorting analysis did not adequately address this essential component of card sorting exercise design. Reconciling Categories from an open card sort should be viewed as a potential property of Sorting Analysis.

5. **Sorting Analysis.** This category identifies the whether the method used to aggregate the results of the open sort is quantitative or qualitative. If identified in the literature, practitioner perspectives on the benefits or drawbacks of the method are assigned properties of positive, neutral, or negative.

6. **Number of Cards Sorted.** Where reported, the number of cards sorted or recommended numeric range of cards to sort is recorded.

7. **Number of Participants.** Where reported, the number of participants involved in the sort, or the recommended numeric range of participants to include is recorded.

8. **Minutes for Card Sorting Exercise.** When identified, the typical time or range of time needed for the card sort is noted.

9. **How to Define Target Audiences.** This category briefly identifies methods used, or recommendations for identifying the primary users of the information domain.

10. **How to Select Participants.** This category briefly identifies methodologies and recommendations used to select participants for the card sorting exercise.
11. **Content Selection Process.** This category briefly identifies methodologies and recommendations for selecting the content to include on the cards to be sorted.
12. **Term for Content Sorted.** This category does not truly represent a characteristic of the design of the card sorting exercise. It is included to demonstrate semantically the range of concepts included in the content selected for the card sort.

Table 1: Twelve Categories of Card Sorting Characteristics is shown below. This represents a condensed hypertext tool that is intended to display the results of the conceptual analysis. The condensed hypertext tool is prefaced by a list of the references cited in Table 1. Following Table 1, a narrative analysis of the data is provided.

References cited in Table 1, including analysis notations:

Akerelrea & Zimmerman, 2002, *analysis 1*.

Fuccella & Pizzolato, 1998*, analysis 2*.

Kidwell & Martin, 2001*, analysis 3*.

McGeorge & Rugg, 2003*, analysis* 4.

Ahlstrom & Allendoerfer, 2004*, analysis 5*.

Faiks & Hyland, 2000*, analysis 6*

Fuccella, 1997*, analysis 7*.

Dearholt et al., 1986*, analysis 8*.

Mauer and Warfel, 2004*, analysis 9*.

Deaton, 2002*, analysis 10*.

Martin, 1999*, analysis 11*.

Nielsen & Sano, 1994*, analysis 12*.

Hahsler & Simon, 2001*, analysis 13*.

Robertson, 2002*, analysis 14*.

X Property Exists.

X- Negative Property Exists.

Xo Neutral Property Exists.

X+ Positive Property Exists.

Z Alternative Property Exists.

Hover cursor over underlined blue notations to view quotations, paraphrases, or logical constructs used for determination of properties and values.

Source	Case Report or	Guideline	Sort Type	Information Domain	Defined	Group or	Individual Sort	Categories (from open sort)	Sorting Analysis		Number of Cards		Number of Participants		Minutes for Card Sorting Exercise		How to Define Target Audiences	How to Select Participants	Content Selection Process	Term for Content Sorted
SOURCE	REPORT	GUIDE	OPEN	CLOSED	DOM	GROUP	INDIV	CAT	QUAL2	QUAL	QUANT	NCMIN	NCMAX	NPMIN	NPMAX	MINMIN	MINMAX	AUD	PART	CONT	TERM
1		X	X				X+	X		Xo	Xo	75	100						X	X	idea units
1		X		Z		Z+		X		Xo	Xo	75	100						X	X	idea units
2		X	X					X		X+				5	10			X		X	content objects
3	X		X		X		X+	X		X-	X+	66	66	30	30	20	70	X	X	X	content
4	X		X		X		X	X		X				2	2	15	20	X	X	X	elements
5	X		X		X	X-	X+	X	X-	X+	X+	95	95	9	9	60	60	X	X	X	information items
6	X		X		X		X	X		X+	X+	50	50	12	12	20	60	X	X	X	concept
7		X	X		X		X	X		X+	X							X		X	web site objects
7		X		Z	X	X		X		X+	X							X		X	web site objects
8	X		X		X		X	X			X	219	219	14	14	20	120	X	X	X	commands
9		X	X				X-	X		X+	X+	30	100/200	7	10			X	X	X	content labels
9		X	X			X+		X		X+	X+	30	100/200	15	15			X	X	X	content labels
10		X	X	X		X+	X	X		X	X	Z	Z	Z	Z	60	60		Z	X	objects or terms
11		X	X		X	X-	X+	X		X-	X+							X			content
12	X		X		X		X	X		X		51	51	4	4	30	40	X		X	cards
13	X		X		X		X	X			X	120	120	5	10	30	40	X	X	X	web objects
14		X	X		X	X+		X		X+				4	8			X	X	X	topics

Table 1: Twelve Categories of Card Sorting Characteristics

Discussion of Category # 1: Sort Type

Open Sorting

The data analysis begins by identifying the card sort as either open or closed. Open sorting is defined as "[a methodology] in which subjects can determine their own groupings by first sorting the cards and then labeling the resulting piles" (Deaton, 2002, p.4). The predominance of literature reviewed describes open sort methods, where no pre-existing categories are provided and limited instructions are offered on how to group the cards. Most practitioners recommend providing simple instructions that allow the participants considerable flexibility. For example, the following approaches are described:

- "It is important to highlight to the users that they should organize the cards in a way that works for them" (Robertson, 2002). *See Table 1, analysis* 14.
- "The users were asked to sit down at a table and sort the cards into piles according to similarity" (Nielsen & Sano, 1994). *See Table 1, analysis* 12.
- "Ask each participant to arrange the cards into logical groups. Explain that the groups should contain topics that seem to the participant to be related" (Martin, 1999). *See Table 1, analysis* 11.
- "Instruct the subjects to sort the cards into at least two groups" (Deaton, 2002). *See Table 1, analysis* 10.
- "[Participants are instructed to] sort the cards into groups that make sense to you" (Mauer & Warfel, 2004). *See Table 1, analysis* 9.

- "[Users] are instructed to organize the cards in any way that is meaningful to them. Users can create any number of groups and any group can have any number of cards in it" (Fuccella, 1997). *See Table 1, analysis* 7.

- "[Users] were instructed to sort the cards by placing similar cards into piles. Users were asked to try not to make piles of a very few or a great many cards but were given no other instructions" (Faiks & Hyland, 2000). *See Table 1, analysis* 6.

- "We asked the participants to choose their own group names, allowed them to use as many groups as they wanted, and told them they should create an 'I don't know' group if necessary" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis* 5.

- "The participant arranges cards representing content into groups of items that he or she sees as interrelated" (Kidwell & Martin, 2001). *See Table 1, analysis* 3.

- "Users are given the stack of cards (arranged randomly) and are instructed to organize the cards in any way that is meaningful to them" (Fuccella & Pizzolato, 1998). *See Table 1, analysis* 2.

- "Ask participants to lay the cards out in front of them on the table, arrange the cards into groups or piles that make sense to them. Stress that there are no right or wrong answers, number of piles, or number of cards required" (Akerelrea & Zimmerman, 2002). *See Table 1, analysis* 1.

The spreadsheet representation of the coded data in this study does not specify properties of the open sort category or identify a category for instructions to participants. However, this narrative analysis suggests that by providing minimal instructions given to participants related sorting criteria, practitioners generally adhere to the conceptual definition of "open sorting"

used in this study. Two exceptions to this generalization in participant instructions are noted – McGeorge and Rugg (2003) and Dearholt et al. (1986).

McGeorge and Rugg (2003) suggest that "it is usually advisable to tell respondents explicitly not to lump two sorting criteria together into one sort. For example, 'big and expensive' should be sorted once for 'big' and once for 'expensive'" (McGeorge and Rugg, 2003). In this referenced study, the information domain is a collection of scientific journals and the participants are a librarian and an experienced researcher. To minimize introducing bias to the sort, McGeorge and Rugg (2003) suggest providing sorting instructions using examples that are greatly distanced from the information domain (McGeorge & Rugg, 2003). *See Table 1, analysis* 4.

Dearholt et al. (1986) instructed the participants to "sort the cards into piles based on function. They were told to first select the cards (commands) from the deck that they were definitely familiar with and sort them into as many piles as they wished according to function" (Dearholt et al. 1986). *See Table 1, analysis* 8. In this referenced study, the information domain is a collection of UNIX commands and the participants are experienced UNIX administrators.

Closed Sorting

This study does not reveal substantial data on the use of closed card sorting methodologies in information design. Closed sorting is defined as "[a methodology] in which the groupings are defined by the researcher and the subject is putting object cards into the defined groups"

(Deaton, 2002, p.4). Closed sorting is typically used for testing proposed or existing designs, or for testing information categories and labels that emerge from an open sort exercise (Mauer & Warfel, 2004, p.2) (Boutelle & Sinha, 2004, p.350) (Deaton, 2002).

Discussion of Category # 2: Information Domain Defined

The information domains in the comparative studies, where identified, are either public Internet or corporate intranet sites with broadly diverse audiences and information items. The information domain, the intended audience, and the participants selected in the studies conducted by McGeorge and Rugg (2003) and Dearholt et al. (1986) are substantially dissimilar and represent exceptions to the comparative studies. In both cases where exceptions are noted, the participants are highly familiar with the information domain and the information sorted represents relatively narrow and specialized topics. Thus, for insight into the design of these exception studies, the participant instructions should be viewed within the context of the information domain, and the participant knowledge of the information domain.

Discussion of Category # 3: Individual or Group Sort

Practitioner perceptions vary on the value of having participants sort information individually or in groups. The perspectives offered by practitioners in the Individual or Group Sort category may be interrelated with the How to Select Participants and How to Define Target Audiences category, as noted in this summary. The Individual or Group Sort category has properties of positive, neutral, and negative. The more salient points are listed below.

Positive Perspectives on Individual Sorting

- "Each participant completed the exercise in an individual session to assure independence of grouping strategies" (Kidwell & Martin, 2001). *See Table 1, analysis 3.*
- "Scheduling individuals can be easier than scheduling groups of people" (Mauer & Warfel, 2002). *See Table 1, analysis 9.*

Negative Perspectives on Individual Sorting

- "Individuals can find it difficult to sort larger numbers of cards, providing less valuable input" (Mauer & Warfel, 2002). *See Table 1, analysis 9.*

Positive Perspectives on Group Sorting

- "A benefit of group sorts is that they typically provide richer data than individual sorts. Whereas individuals need to be prompted to 'think aloud,' groups tend to discuss their decisions aloud openly" (Mauer & Warfel, 2004). *See Table 1, analysis 9.*
- "Sometimes, having a group of users get together and do the sorting collectively can produce valuable information not only with the results of the sorting, but in the conversations carried on while the sorting process" (Deaton, 2002). *See Table 1, analysis 10.*
- "The use of a group format also has considerable benefits. Often, the participants will bring to the session quite different opinions. Through the discussion and eventual resolution of these differences, it becomes possible to identify a workable structure" (Robertson, 2002). *See Table 1, analysis 14.*

Negative Perceptions of Group Sorting

- "If the participants worked as a group, deciding the categories through a consensus process, individual approaches to the information organization may be lost" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*
- "In a multiple participant situation, participants may influence one another's number of card groups or sorting criteria" (Martin, 1999). *See Table 1, analysis 11.*

Other than one notation on the difficulties individuals may face in sorting large numbers of cards, there is not substantial data that suggest practitioners have a negative perception of Individual Sorting. The positive practitioner perspectives on the benefits of Group Sorting may be interrelated to the design of these studies, where the selection of participants for a group sort represents various audience definitions and the practitioners' desire to observe and record participant interaction during the sorting session.

Substantial data exist that support the identification of additional properties within this category, or the creation of a "super-category" of Card Sorting Session with Individual and Group Sort as properties of the category. Although not specifically coded in this analysis, there are significant variations in the practitioner approaches to the monitoring of the card sorting session.

Discussion of Category # 4: Process of Reconciling Categories

A significant amount of data exists that describes methodologies used to reconcile information categories that emerge from an open sort. Although the description of closed sorting suggests that it may be used for this purpose, the data do not support the reconciliation of categories as

a property of closed sorting. However, every article reviewed addresses the topic of category reconciliation from open sorting. As a result, a category of Reconciling Categories is created.

The method used for the reconciliation of categories that emerge from an open sort is directly related to the method of data analysis used. However, hybrid qualitative and quantitative methods of category reconciliation are mentioned. In several cases (Nielsen & Sano, 1994) (Alhstrom & Allendoerfer, 2004), a quantitative method of category reconciliation is used to verify the results of a qualitative analysis. The data indicate that a number of variations in methodology exist within this category, an indication that potential exists for the identification of additional properties of the category. If this study were intended to categorize the characteristics of card sorting data analysis, this category would likely be considered as a property of the sorting analysis method. Due to the large amount of contextual and descriptive data that explain these processes, it was decided the data are best compared in narrative form, presented below.

Reports of Qualitative Category Reconciliation

- A set of guidelines provided by Robertson (2002) recommends a group sort, with several different groups that are representative of different target audiences. The steps as outlined by Robertson (2002) are: 1) "when a pile is finalized, ask the group to nominate a label for the pile." 2) "write down the groupings identified by the participants." 3) "[create] a graphical presentation that displays a 'mock-up' of what the structure would look like." Robertson (2002) contends, "it is often very revealing to compare the results of card sorting sessions with your different user groups. If a

common structure appears across a wide range of users, you can be confident that this is the right way to go." (Robertson, 2002). *See Table 1, analysis 14*.

- A case report by Hahsler and Simon (2001) describes their process as 1) "the users [participants] are asked to provide each set [grouping] with a unique name and a short description." 2) "the project team compiles a preliminary navigation structure, a challenging task which requires a considerable degree of creativity." 3) "evaluation of categories and the assignment of web objects is carried out by conducting a user survey" (Hahsler & Simon, 2001). *See Table 1, analysis 13*.
- A case report by Nielsen and Sano (1994) verifies the qualitative analysis of the card sorting data with a quantitative cluster analysis. The qualitative analysis process begins by 1) "[users] group the piles into larger groups…and [are] asked to invent a name for each group." 2) "our design was based on 'data eyeballing' and not on formal statistics. For our manual clustering, we worked bottom-up and expanded these small groups into larger clusters by adding concepts that some users had sorted with most of the concepts in the group if the grouping made sense to us. This subjective interpretation of the data is dubious if the objective 'truth' is desired, but in our case we were after a coherent design" (Nielsen & Sano, 1994). *See Table 1, analysis 12*.
- A set of guidelines provided by Mauer and Warfel (2004) briefly mention both quantitative and qualitative approaches to reconciling categories that emerge from an open sort. The authors suggest that with a smaller number of cards, "you may be able to see patterns by simply laying the groups out on a table, or taping them on a whiteboard" (Mauer & Warfel, 2004). *See Table 1, analysis 9*.

- A set of guidelines provided by Fuccella (1997) 1) asks users to "provide a description for each group [not] a label or category name…[this activity] ideally should be performed with two separate sets of users, one for the sorting, and one for the description." 2) "the designer can begin the iterative process of identifying the appropriate labels and clusters of information for the site". *See Table 1, analysis 7.*
- A case report by Akerelrea and Zimmerman (2004) correlates the results of qualitative categorization of the card sort with a cluster analysis. For the qualitative analysis 1) "we asked the participants to choose their own group names." 2) "it is straightforward to examine the group names used and look for patterns…these patterns are used to derive categories" (Akerelrea & Zimmerman, 2004). *See Table 1, analysis 5.*
- A set of guidelines presented by Fuccella and Pizzolato (1998) mirrors the description provided by Fuccella (1997). *See Table 1, analysis 2.*
- Akerelrea and Zimmerman (2002) provide the most distinct variation of the category identification process in their description of the reconciliation activity in step 4. After completing the individual open card sort, 1) "ask the participants to write a label … for each group. The label might be a single word, a phrase, or a sentence." 2) "sort all the participants' labeled groups into common piles." 3) "write descriptive titles for the major groups based on the participants' labels." 4) "bring participants back into the room and read each card aloud individually and ask the group under which descriptive label or labels they would look to find the idea." (Akerelrea & Zimmerman, 2002) *See Table 1, analysis 1.*

A number of similarities (minimized differences) exist within these descriptions of qualitative category reconciliation. This suggests these activities are a generally accepted design practice.

- The participants are asked to provide a name or description for the card grouping.
- The practitioner conducting the card sort organizes the groupings.
- The practitioner suggests labels for the reconciled categories.

Reports of Quantitative Category Reconciliation

Many practitioners acknowledge the value of either qualitative or quantitative analysis of the card sorting data. For further insight into practitioner perspectives on quantitative and qualitative analysis of the data, see Category # 5: Sorting Analysis. The following excerpts summarize data concerning quantitative category reconciliation as revealed in the literature under review.

- In a case report by Kidwell and Martin (2001), the practitioners use the IBM USort® module of the IBM EZSort® tool to "convert each participant's raw data to a set of distance scores for each possible card pair. Then, in the EZCalc® module, individual distance scores were averaged across participants to obtain a mean distance score for each card pair, and the mean scores were expressed in a distance matrix. The mean distance scores were analyzed using a complete linkage algorithm, a hierarchical agglomerative method of cluster analysis" (Kidwell & Martin, 2001). *See Table 1, analysis 3.*

- A case report by Martin (1999) reports the development of the IBM EZSort® and EZCalc® tools. Martin (1999) presents and analyzes the dendrograms generated from a cluster analysis performed by these tools (Martin, 1999). *See Table 1, analysis 11.*
- A case report by Dearholt et al. (1986) elaborates on a number of quantitative analyses performed on the card sorting results, including the creation of a co-concurrence matrix, a conditional probability matrix, and performing a cluster analysis (Dearholt et al. 1886). *See Table 1, analysis 8.*

Quantitative Verification of Qualitative Analyses

- A case report by Nielsen and Sano (1994) reports on the use of a cluster analysis to verify the results of the qualitative "eyeballing" of the data. The authors concede that "[with only four participants] statistical methods are not very reliable…as it turned out, the statistical cluster analysis was very similar to that we had constructed manually" (Nielsen & Sano, 1994). *See Table 1, analysis 12.*
- A case report by Ahlstrom and Allendoerfer (2004) presents a comprehensive comparison of both the quantitative and qualitative analyses of the card sorting data. The authors begin by manually creating an "association matrix" which assigns values of 0-9 (reflecting the results of the nine participant card sorts) to each card sorted. A value of '9' indicates that all participants placed the card in a similar pile; a value of '0' indicates that no participants placed the card in a similar pile. These results were then subjected to a cluster analysis by the Statistica® software from Statsoft® and the results displayed in a dendrographic tree. Ahlstrom and Allendoerfer (2004) report "the large branches of the tree related well to the categories derived by hand, even

when the precise members of the category differed somewhat" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*

The predominance of literature reviewed describes qualitative methods for analyses of the card sorting data. The references reviewed in this study that describe quantitative methods indicate the following similarities:

- Cluster analysis is an accepted form of quantitative analyses for card sorting data.
- The results of a cluster analysis are typically displayed by a dendrographic tree.
- In both cases where qualitative and quantitative analyses were performed on the same card sorting data, the identified relationships between the information items sorted were significantly similar.

Discussion of Category # 5: Sorting Analysis

The Sorting Analysis category is intended to reveal practitioner perceptions on the benefits and drawbacks of qualitative and quantitative analysis of the card sorting data. Perceptions and comments made by practitioners on the value of qualitative and quantitative sorting analysis are represented as properties of this category, and are "rated" as positive, neutral, or negative. Rather than iterating the entire scope of the data available in the references, the most salient points are provided in this analysis.

Positive Perceptions of Qualitative Analysis

- "We prefer a qualitative approach due to the low number of participants" (five to ten participants are mentioned) (Fuccella & Pizzolato, 1998). *See Table 1, analysis 2.*

- "This manual method has a number of benefits. First, it is straightforward to execute and does not require sophisticated analysis tools. Second, unlike many statistical techniques, small sample sizes do not restrict it. Third, results from this method are easy to present to audiences who are not experienced at interpreting multivariate statistics" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*
- "Results, if not too extensive or complex, can be gathered by 'eyeballing' the card groupings" (Faiks & Hyland, 2000). *See Table 1, analysis 6.*
- "[Fuccella] prefers a more qualitative approach in which specific questions regarding the organization of the information have been identified prior to the card sorting tasks" (Fuccella, 1997). *See Table 1, analysis 7.*
- "When performing analysis on smaller numbers of cards, you may be able to see patterns by simply laying the groups out on a table" (Mauer & Warfel, 2004). *See Table 1, analysis 9.*
- "…we were after a coherent design, so we felt justified in applying our judgment in those cases where the user data was too sparse for a clear conclusion to be drawn on the basis of the numbers" (Nielsen & Sano, 1994). *See Table 1, analysis 12.*

Negative Perceptions of Qualitative Analysis

- "This [qualitative] method also has several drawbacks. First, there is a level of subjectivity required to derive the categories. Second, the method becomes time consuming and extremely tedious when the number of items or participants is large. Third, the method examines the relationship of items to categories rather than items to other items" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*

- "Manually searching through sorted card sets for patterns is inherently vulnerable to bias, as patterns that confirm the observer's prior notions will be recognized more readily than those based on less familiar mental constructs" (Kidwell & Martin, 2001). *See Table 1, analysis 3.*
- "Some web site designers have 'eyeballed' card groupings created by a few test participants (e.g., Nielsen & Sano, 1994), and somehow divined a central tendency from the competing sorting structures. This method, if ever it were manageable, becomes unwieldy very quickly with the inclusion of more than a handful of topics or users" (Martin, 1999). *See Table 1, analysis 11.*
- "With a large data set, eyeballing a result is difficult" (Deaton, 2002).

The general perception among practitioners is that a qualitative analysis of data has value. Only Martin (1999) and Kidwell and Martin (2001) appear to reject qualitative analysis methods. However, a larger number of participants or a large number of cards sorted may negatively affect the practitioner's ability to use only qualitative analysis methods (Martin, 1999) (Ahlstrom & Allendoerfer, 2004) (Mauer & Warfel, 2004) (Faiks & Hyland, 2000) (Fuccella & Pizzolato, 1998) (Deaton, 2002).

Positive Perceptions of Quantitative Analysis

Deaton (2002) makes an interesting observation on the dendrographic representation of a quantitative data analysis: "cluster analysis is particularly apt for analyzing card sorting because it enables you to see how closely items are related across all your subjects. This is a form of

qualitative analysis, where how you 'see' the result is more important than the numbers" (Deaton, 2002).

Although a number of references (Martin, 1999) (Kidwell & Martin, 2001) (Dearholt, et al. 1986) (Nielsen & Sano, 1994) describe quantitative analysis of data, it was difficult to extract qualitative remarks pertaining to the value of cluster analysis. This may be the due to the nature of objective statistical analysis. Kidwell and Martin (2001) argue that "A more objective method of analyzing card sorting data is cluster analysis…cluster analysis can reveal an aggregate representations of users' internal models of the relatedness of data items" (Kidwell & Martin, 2001). Faiks and Hyland (2000) suggest, "Running the statistical analysis is very helpful, not too complicated, and recommended, but it is not a necessary component" (Faids & Hyland, 2000). Other practitioners who qualitatively analyze card sorting data briefly acknowledge value in quantitative methods without significant elaboration. No negative perspectives on quantitative analysis were identified.

Discussion of Category # 6: Number of Cards to Sort

Where values for this category are identified, the number of cards sorted or recommended for sorting range from 30 to 219. Practitioner perspectives on the number of cards to include in the sort are provided below.

- A set of guidelines presented by Akerelrea and Zimmerman (2002) recommend "limiting the ideas to 75 to 100 cards with each idea to the card." No explanation is provided for the recommendation (Akerelrea & Zimmerman, 2002). *See Table 1, analysis 1*.

- A case report by Kidwell and Martin (2001) sorted 66 cards, with no explanation as to why this number was chosen (Kidwell & Martin, 2001). *See Table 1, analysis 3.*
- A case report by Ahlstrom and Allendoerfer (2004) reports 95 cards in the sort. No explanation is provided (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*
- A case report by Faiks and Hyland (2000) reports using 50 cards in the sort. The 50 cards represent the 50 topics on the current online Help system under redesign (Faiks & Hyland, 2000). *See Table 1, analysis 6.*
- A case report by Dearholt et al. (1986) sorts 219 cards. The cards represent each of the UNIX command functions identified for inclusion in the online Help system (Dearholt et al., 1986). *See Table 1, analysis 8.*
- A set of guidelines provided by Mauer and Warfel (2004) recommend 30 to 100 cards. The authors contend, "…fewer than 30 cards typically does not allow for enough grouping to emerge and more than 100 cards can be time consuming and tiring for participants. However, we have performed successful card sorts with over 200 cards where the participants understood the content well" (Mauer and Warfel, 2004). *See Table 1, analysis 9.*
- A case report by Nielsen and Sano (1994) reports 51 cards in the sort. The development team "brainstormed about possible information services to be provided over the system" to arrive at this number of items (Nielsen & Sano, 1994). *See Table 1, analysis 12.*
- A case report by Hahsler and Simon (2001) had participants sort 120 cards that "[represent] the most important 120 web objects." The authors report, "…some of the users lost patience. One user did not finish the card sorting exercise at all, while

> another did not provide category names. Accordingly, we suggest that the number of cards should not exceed 100" (Hahsler & Simon, 2001). *See Table 1, analysis 13.*

The literature reveals that sorting 30 to 100 cards is a general practice, with the majority of studies or guidelines using or recommending between 50 and 100 cards. Hahsler and Simon (2001) provide a valid point to consider when the number of cards exceeds 100. They report that participants failed to complete the exercise or exhibited other signs of frustration. Conversely, an interesting contrary perspective is revealed in the comments made by Mauer and Warfel (2004), who contend, "We have performed successful card sorts with over 200 cards where the participants understood the content well" (Mauer & Warfel, 2004). The study provided by Dearholt et al. (1986) reports no difficulties with 219 cards. In this example, the information domain is a set of UNIX commands and the participants are experienced UNIX administrators (Dearholt et al, 1986). This suggests the participant knowledge of the information domain should be considered when using larger numbers of cards in the sort.

Discussion of Category # 7: Number of Participants

Within the references that state or recommend a number of participants for the card sorting exercise, the values range from 2 to 30. Where only 2 participants are used, there are other significant dissimilarities in the design and purpose of the experiment conducted by McGeorge and Rugg (2003). None of the references reviewed state any criteria used to determine the number of participants to involve.

It should be noted that in the case of a group card sort, the number of participants in a group should be multiplied by the number of groups involved in the experiment. The following recommendations are made for group sorts:

- A recommendation is made for five groups of three participants (Mauer & Warfel, 2004). *See Table 1, analysis 9.*
- Four to eight participants per group, with a sufficient number of groups to represent your various target audiences (Robertson, 2002). *See Table 1, analysis 14.*
- In a study by Hahsler and Simon (2001), five to ten participants per group for each of three target audiences were tested, with a total of 20 participants (Hahsler & Simon, 2001). *See Table 1, analysis 13.*

In an analysis of the work of Tullis and Wood (2004), Nielsen (2004) recommends 15 users for a card sorting exercise. Nielsen (2004) states that "for most usability studies I recommend testing five users, since that is enough data to teach you most of what you will ever learn in a test. For card sorting, however, there is only a .75 correlation between the results from five users and the ultimate results. That is not good enough … I think that correlations of .90 for fifteen users or maybe .93 for twenty users are good enough for most practical purposes" (Nielsen, 2004). Nielsen and Sano (1994) use four participants in their study, conceding that "given our discount usability engineering approach with only four users, the statistical methods are not that reliable" (Nielsen & Sano, 1994). *See Table 1, analysis 12.*

In an extensive review of five studies that compare usability evaluation methods, Gray and Salzman (1998) contend, "Low statistical power and random heterogeneity of participants may

be regarded as two sides of the same coin. Low statistical power may cause true differences not to be noticed; random heterogeneity of participants may cause noticed differences not to be true. Potential solutions to these problems are to increase the number of participants per group and to consider group differences in the context of individual differences" (Gray and Salzman, 1998).

Discussion of Category # 8: Minutes for Card Sorting Exercise

The values in this category may be related to the number of cards sorted and to the participant knowledge of the information domain. In general, practitioners expect the participants to finish in one hour or less.

Further Expansion of Categories 9 – 11

Categories 9-12 provide an abundance of data that suggest considerable opportunity exists for the analysis of research methods that are complementary to the design of a card sorting exercise. The following categories represent the first activities that are conducted in the design of a card sorting exercise and present a potential basis for future studies that expand on this study of card sorting methods. These categories are critical considerations for successful design of a card sorting exercise. The analysis of the methods discovered within these categories is beyond the Limitations of this research and as such, no properties are assigned within these categories.

Discussion of Category # 9: How to Define Target Audiences

The definition of the target audience is generally considered essential to a successful design of a card sorting exercise. Fuccella and Pizzolato (1998), Fuccella (1997), Martin (1999), and Hahsler and Simon (2001) specifically list Audience Definition as the first step in their card sorting design process.

Practitioner Perspectives on Target Audience Definition

- "An audience description should include all the qualities that pertain to their interest in the site" (Martin, 1999). *See Table 1, analysis 11.*
- **"**The ability to create usable and useful web site designs is highly dependent on the availability of a crisp audience definition" (Fuccella & Pizzolato, 1998). *See Table 1, analysis 2.*

Survey as a Method for Defining Target Audiences

- "The easiest and most cost-effective means for collecting audience definition data is to conduct a survey" (Fuccella & Pizzolato, 1998). *See Table 1, analysis 2.* This concept is reinforced by Fuccella (1997).
- "As a first step, the target groups of the information system have to be defined …the project team might use existing customer information [however] only a precise knowledge of user needs enables the development of web sites with high user value. To obtain this kind of information, market research data can be extended by user surveys…" (Hahsler & Simon, 2001). *See Table 1, analysis 13.*

Other authors imply that the audience definition already exists or is easily determined, such as in the redesign or design of an internal Intranet or audience specific portal. In these references, the selection of participants and content for the card sort exercise are directly tied to this audience definition (Faiks & Hyland, 2000) (Akerelrea & Zimmerman, 2004) (Kidwell & Martin, 2001) (Nielsen & Sano, 1994) (Robertson, 2002).

Discussion of Category # 10: How to Select Participants

The selection of participants shows substantial interrelation to the target audience definition and as such, evaluating Category # 9 – How to Define Target Audiences should precede this analysis. This analysis elucidates the interrelationships between the target audience definition and the selection of participants.

Selection of Participants – Relationship to Targeted Audiences

- "The participants should reflect the breadth in abilities, jobs, and environments of the targeted user community" (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*
- "The most important aspect of selecting participants is that they come from and are representative of your user group. If you have multiple user groups, it is important to include a representative sample from each group" (Mauer and Warfel, 2004). *See Table 1, analysis 9.*
- "The attendees at the card sorting session must be the actual end-users of the system you are building" (Robertson, 2002). *See Table 1, analysis 14.*

Other statements within the literature also suggest that random or casual selection of participants is not widely practiced and that the participant selection, although the selection may be randomized within target audiences, it is intended to reflect the target audience. This inference is suggested by the relatively precise definition of the participants selected in the following case report excerpts.

- "The target audience was identified as all employees … [those] employees who had assisted in the collection and characterization of the planned content were disqualified [as participants]… thirty [participants] were selected, including representatives of each of the company's office divisions" (McGeorge & Rugg, 2003). *See Table 1, analysis* 4.
- "Because the [information resource] is intended for all users of the university population, the committee chose a random sample from the academic community ... both experienced and novice … users were welcome. The study populations consisted of [undergraduate and graduate students, faculty, and staff members]" (Faiks & Hyland, 2000). *See Table 1, analysis 6.*
- "Fourteen experienced UNIX users … participated in the study" (Dearholt et al., 1986). *See Table 1, analysis 8.*
- Deaton (2002) reports that in the literature reviewed, participants were selected randomly from a directory, recruiting co-workers, and recruiting from a corporate database (Deaton, 2002). *See Table 1, analysis 10.*

Discussion of Category # 11: Content Selection Process

A wide range of seemingly disparate information items may become potential candidates for inclusion in an information resource, in particular, a web site. The identification of current and

potential content and the labels that are applied to the cards are important considerations in the design of the card sorting exercise. Below are listed a few content items that demonstrate the range of "objects" that have been included in card sorts.

Content Object Definitions

Fuccella and Pizzolato (1998) provide these examples of "content objects" to be included on software marketing website (Fuccella & Pizzolato, 1998). *See Table 1, analysis 2.*

- White papers
- FAQ's
- Downloadable code
- Call-in support numbers
- Success stories

Robertson (2002) suggests looking to these sources for generating a list of content. (Robertson, 2002) *See Table 1, analysis 14.*

- Existing online content
- Descriptions of business groups and processes
- Planned applications and processes
- Potential future content

Ahlstrom and Allendoerfer (2004) include these information items in their description of content considered in the design of an employee portal (Ahlstrom & Allendoerfer, 2004). *See Table 1, analysis 5.*

- Existing employee intranet

- Several human resource systems
- Employee directory
- Accounting and tracking systems
- Management information systems
- Email and collaboration systems
- Library card catalog

Other practitioners have suggested various methods for identifying content to include in a card sorting exercise.

Methods for Content Identification

Hahsler and Simon (2001) suggest these methods for identifying content (Hahsler & Simon, 2001). *See Table 1, analysis 13.*

- **Web server log file analysis**.
    - Advantages - "convenient and inexpensive"
    - Disadvantages - "can only consider existing objects" and "may be misleading [for a number of technical reasons]"
- **Analysis of search engine queries**.
    - Advantages - "helps identify the most frequently requested keywords"
- **User survey.**
    - Advantages - "a reliable method for identifying the most important web objects"
    - Disadvantages – "very expensive"

Fuccella and Pizzolato (1998) outline a number of "Requirements and Task Gathering" processes for the identification of content for a web site (Fuccella & Pizzolato, 1998). *See Table 1, analysis 2.*

- **Focus group.**
    - Advantages – "can collect large amounts of data in a short period of time"
    - Disadvantages - "costly, usually requires a professional facilitator or moderator"
- **Iterative survey** – a first survey of open-ended questions reveals similarities in requirements. A second survey compiles the results and survey participants then rank them in importance.
    - Advantages – remote participation (electronic surveys), large sample sizes do not significantly increase cost or data analysis.
    - Disadvantages – time consuming, expensive
- **Exploratory Surveys – "**ask the users to list the specific content they would like to have on the site."
    - Advantages – inexpensive and simple and it is easy to "survey a large sample in a relatively short time"
    - Disadvantages – data is difficult to analyze
- **Scenario Building Exercises**
    - Advantages – inexpensive and simple, users can more easily identify tasks
    - Disadvantages – one on one research is time consuming
- **Competitive Review**

- Advantages – inexpensive and simple
- Disadvantages – time consuming

Nielson and Sano (1994) suggest the development team was responsible for identifying content (Nielsen & Sano, 1994). *See Table 1, analysis 12.*

- **Brainstorming.** The development group discussed and agreed on the content.

Discussion of Category # 12: Term for Content Selected

This category is not specifically related to the design of a card sorting exercise but is included for the semantic value of the terminology used to depict the content defined and the labeling of the cards sorted in the exercise. Practitioners consider a large array of information that may be included within the information domain. Specifying a name for the cards is in itself a daunting semantic task. Below is the list of conceptual terms that practitioners use to describe the content on the cards:

- Idea units
- Content objects
- Elements
- Information items
- Concepts
- Web site objects
- Commands
- Content labels
- Objects

- Content
- Web objects
- Topics

The term "object" occurs most frequently in the description of the cards (4 times), followed by "content" (three times). All other terms only appear once. Accordingly, this researcher chooses "content object" (Fuccella & Pizzolato, 1998) as the most descriptive definition of the cards sorted.

CHAPTER V – CONCLUSIONS

Summative Reflections of the Researcher

The complexities of Usability, Human Computer Interaction, and Information Architecture are both greatly removed from and intricately intertwined with the complexities of electronic information systems. Over the years, as a veteran of the technical end of electronic information systems I have become frustrated with supporting systems that were designed according to the interests and perspectives of the technology experts, rather than the interests and perspectives of users or needs of an organization. After years of cacophonous complaints about various system designs, I happened across a brief description of card sorting, presented as a "deceptively simple" (Boorman & Arabie, 1972) method of gaining insight into user preferences for the design of an information system. My reaction was, what could be easier or more intuitive than writing labels that represent content or tasks on a stack of recipe cards and asking users to sort them any way they saw fit? It brought to mind a favorite quote of Albert Einstein, who aptly stated, "Any intelligent fool can make things bigger and more complex …it takes a touch of genius – and a lot of courage to move in the opposite direction" (Einstein, n.d.). With no prior experience in card sorting beyond a ten-minute exercise in a University of Minnesota workshop and a brief assignment using the online tool CardZort® in a graduate Taxonomy course at the University of Oregon, I approached this study with limited knowledge, experience, and no preconceived notion of how to design, conduct, or analyze a card sort.

The primary intent of this research is to provide practitioners with a global overview of card sorting methods as described in the literature under review. This overview is presented as a table of criteria for practitioners to consider when designing a card sorting exercise. Discussion of the criteria presented in *Chapter IV - Analysis of Data* should not be interpreted as either conclusive or inclusive. As a preliminary study, considerable potential exists for the further identification of categories and for the addition of properties to existing categories. Thus, the reader is highly encouraged to study these resources to make their own determination on the validity of constructs used by this researcher for the classification and assignment of properties to the characteristics.

Observations on Grounded Theory and the Constant Comparative Method

The constant comparison method (Glaser and Strauss, 1967) demonstrates considerable advantages when applied to this type of study. *Chapter IV – Analysis of Data* represents the author's interpretation of the data and is "concerned with generating and plausibly suggesting (but not provisionally testing) many categories, properties, and hypotheses about general problems" (Glaser & Strauss, 1967, p. 104). This study proposes a method to categorize the characteristics of a card sorting method and to identify the properties of those categories. No attempt is made to test the reliability or validity of the card sorting methods.

In *Chapter III – Method* the researcher states that "this study does not draw conclusions from the data". The reasoning behind this claim is that grounded theory research seeks to discover themes and patterns that emerge from unstructured verbal or written data – interviews, books, literature, field notes, observations, and other sources (Glaser & Strauss, 1967). The

categorization and assignment of properties to a phenomenon may lead the researcher to the formulation of a theory – a hypothesis - a research question. Grounded theory research does not seek test a hypothesis (Glaser & Strauss, 1967). Thus, the conclusions of this research are represented by the outcome of this study - a prototype tool – a method – a decision support system intended to assist practitioners with the design of a card sorting exercise. This study does not propose what that design should be.

Speculations on the Tool

The capability of the hypertext table (*see* Table 1: Twelve Categories of Card Sorting Characteristics) may be approaching practical limits for presenting the data gleaned from the hybrid conceptual analysis and constant comparative process. As further categories and properties are defined and additional literature or practitioner data are added, the need to scroll up and down or left and right becomes cumbersome and frustrating, making cognitive absorption problematic. Because of the limitations inherent in the spreadsheet table, a proposal is made for the development of a type of expert system (an extensible database) designed for comparing card sorting methods. In this system, qualified practitioners would complete an extensive online survey on card sorting methods, assigning Likert scale ratings to selected properties of the categories and elaborating with free text comments that semantically reinforce their concepts and ratings. By assigning tangible properties to categories of quantitative and qualitative card sorting characteristics, structured queries could filter the data. The results of the query would be presented in a condensed form on a web page or as a downloadable table or document. Practitioners could then review the filtered data to assist

them with the design of a card sorting exercise "based on the collective wisdom of the industry-wide community of UCD [user centered design] practitioners" (Carey, et al. 2002).

Conclusion

Card sorting is a research method, often applied in one form or another in the social sciences, that seeks to increase our understanding of human thought and behavior. Coxon (1999) contends that sorting and categorization is "the most fundamental operation of thinking and language" (Coxon, 1999). In many ways, this study evolved in a self-reflexive manner – one intrinsically about itself - because it applied a social science research methodology to the analysis of a research methodology used in social science. Using the cognitive power of sorting to further our understanding of sorting may help us gain insight into our own mental models. Although quantitative statistical methods may be necessary to aggregate results from card sorts with a large number of participants and cards, the transformation of any card sorting analysis into a final design requires a measure of insight and intuition, a process described by Mauer and Warfel (2004) as "part science, part magic" (Mauer & Warfel, 2004). Researchers should continually strive to objectively improve research design and analysis methods, keeping in mind the thoughts of Deaton (2002) who concludes, "Regardless of how you analyze your data, the design decisions you reach should still be guided by your experience as a design professional" (Deaton, 2002).

APPENDIX A

Definitions

Card sorting. "[The] sorting [of] a series of cards, each labeled with a piece of content or functionality, into groups that make sense to users or participants" (Mauer & Warfel, 2002, p.2).

Category or classification. "Putting a number of things into a smaller number of groups and giving a rule by which such allocation is made" (Coxon, 1999). "A category stands by itself as a conceptual element of theory, [categories] are concepts indicated by the data and not the data itself" (Glaser and Strauss, 1967, p.36).

Characteristic. "A definable or measurable feature of a process, product, or variable" (Six Sigma Qualtec, 2005). "A distinctive mark, trait, or feature; a distinguishing or essential peculiarity or quality" (Oxford English Dictionary, 2005a).

Closed sorting. "[A card sorting methodology] in which the groupings are defined by the researcher and the subject is putting object cards into the defined groups" (Deaton, 2002, p.4).

Conceptual analysis. "Traditionally, content analysis has most often been thought of in terms of conceptual analysis. In conceptual analysis, a concept is chosen for examination, and the analysis involves quantifying and tallying its presence … The focus is on looking at the occurrence of selected terms within a text or texts, although the terms may be implicit as well as explicit. While explicit terms obviously are easy to identify, coding for implicit terms and deciding their level of implication is complicated by the need to base judgments on a somewhat subjective system. To attempt to limit

the subjectivity, then (as well as to limit problems of reliability and validity), coding such implicit terms usually involves the use of either a specialized dictionary or contextual translation rules" (Palmquist, et al. 2005).

Constant comparative method. "[A research methodology that utilizes] joint coding and analysis [to] generate theory systematically [by] using explicit coding and analytic procedures" (Glaser and Strauss, 1967, p. 102).

Existence or Frequency. "This is a key question in the coding process. The researcher must decide if he/she is going to count a concept only once, for existence, no matter how many times it appears, or if he/she will count it each time it occurs. For example, 'damn' could be counted once, even though it appears 50 times, or it could be counted all 50 times. The latter measurement may be interested in how many times it occurs and what that indicates, whereas the former may simply looking for existence, period" (Palmquist, et. al, 2005).

Frame of Reference. "A set of standards, beliefs, or assumptions governing perceptual or logical evaluation or social behaviour" (Oxford English Dictionary, 2005b)

Open sorting. "[A card sorting methodology] in which subjects can determine their own groupings by first sorting the cards and then labeling the resulting piles" (Deaton, 2002, p.4).

Information architecture. "[Information architecture is] the combination of organization, labeling, and navigation schemes within an information system" (Morville & Rosenfeld, 2001, p.4).

Interactive Concept Choice. "One must determine whether to code only from a pre-defined set of concepts and categories, or if one will develop some or all of these during the coding process. For example, using a predefined set, Horton would code only for profane language. But, if Horton coded interactively, she may have decided to half-way through the process that the text warranted coding for profane gestures, as well" (Palmquist, et. al, 2005).

Irrelevant Information. "One must decide what to do with the information in the text that is not coded. One's options include either deleting or skipping over unwanted material, or viewing all information as relevant and important and using it to reexamine, reassess and perhaps even alter the one's coding scheme" (Palmquist, et. al, 2005).

Level of Generalization. "A researcher must decide whether concepts are to be coded exactly as they appear, or if they can be recorded in some altered or collapsed form. Using Horton as an example again, she could code profanity individually and code 'damn' and 'dammit' as two separate concepts. Or, by generalizing their meaning, i.e. they both express the same idea, she could group them together as one item, i.e. 'damn words"' (Palmquist, et. al, 2005).

Likert Scale. "A Likert scale is used to measure attitudes, preferences, and subjective reactions. In software evaluation, we can often objectively measure efficiency and effectiveness with performance metrics such as time taken or errors made. Likert scales and other attitudinal scales help get at the emotional and preferential responses people have to the design" (Usability First, n.d.).

Practitioner. In the context of this study, the term practitioner (s) is used as an inclusive term that collectively describes information architects, usability specialists, usability engineers, website designers, human computer interaction specialists, and other persons or roles whose interests or responsibilities include the design and/or testing of information architectures. Although not specifically defined in the literature, the term practitioner is commonly used in the literature reviewed in this study (Hannah, 2005).

Property. "[A property is] a conceptual aspect or element of a category. [Properties] are concepts indicated by the data, and not the data itself" (Glaser and Strauss, 1967, p.36).

Level of Analysis. "Chosen by determining which word, set of words, or phrases will constitute a concept. According to Carley, 100-500 concepts is generally sufficient when coding for a specific topic, but this number of course varies on a case by case basis" (Palmquist, et. al, 2005).

Mental Model. "A group or network of interrelated concepts that reflect conscious or subconscious perceptions of reality. These internal mental networks of meaning are constructed as people draw inferences and gather information about the world" (Palmquist, et. al, 2005).

Qualitative Data. "…Qualitative researchers tend to select a few participants who can best shed light on the phenomenon under investigation. Both verbal data (interview comments, documents, field notes) and nonverbal data (drawings, photographs, videotapes) may be collected" (Leedy & Ormrod, 2001, p. 102).

Quantitative Data. "Quantitative researchers identify one or a few variables that they intend to study and then collect data specifically related to those variables. Specific methods of measuring each variable are identified and developed, with attention to the validity and reliability of the measurement instruments. Data are collected from a population, or from one or more large samples that represent the population, in a form that is easily converted to numerical indices" (Leedy & Ormrod, 2001, p. 102).

Selective Reduction. "The central idea of content analysis. Text is reduced to categories consisting of a word, set of words or phrases, on which the researcher can focus. Specific words or patterns are indicative of the research question and determine levels of analysis and generalization" (Palmquist, et. al, 2005).

Translation Rules. "If one decides to generalize concepts during coding, then one must develop a set of rules by which less general concepts will be translated into more general ones. This doesn't involve simple generalization, for example, as with 'damn' and 'dammit' but requires one to determine, from a given set of concepts, what concepts are missing. When dealing with the idea of profanity, one must decide what to do with the concept 'dang it,' which is generally thought to imply 'damn it.' The researcher must make this distinction, i.e. make this implicit concept explicit, and then code for the frequency of its occurrence. This decision results in the construction of a translation rule, which instructs the researcher to code for the concept 'dang it' in a certain way" (Palmquist, et. al, 2005).

Theoretical sampling. "The process of data collection for generating theory whereby the analyst jointly collects, codes, and analyzes … data and decides what data to collect

next and where to find them, in order to develop … theory as it emerges" (Glaser & Strauss, 1967, p. 45)

User Centered Design (UCD). "In broad terms, user-centered design (UCD) is a design philosophy in which the needs, wants and limitations of the end user of a computer product or computer interface are given extensive attention at each stage of the design process. User-centered design can be characterized as a multi-stage problem solving process that not only requires designers to analyze and foresee how users are likely to use an interface, but to test the validity of their assumptions with regards to user behavior in real life" (Wikopedia, 2005a).

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