WISDOM OF A DESIGN RESEARCH NINJA:
LESSONS LEARNED FROM FIELDWORK

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ABSTRACT

Although the designers' work can be driven by research historically they have not lead research investigations. Recently, designers have begun to combine their experience and knowledge with research abilities to increase the credibility of their work. The current paper focuses on fieldwork studies as a strategic approach to inquiry. Fieldwork studies have high ecological validity since they provide data, which has limited intervention by the researcher. Connections between strategic choices and the practical nuances of conducting an investigation are explored. The goal of this paper is to introduce some of the concealed challenges, which naturally manifest during fieldwork studies. Using a case study, the pre-work, fieldwork and post-work phases of field research are detailed. The analogy of a ninja is made to create an ideal persona of the design researcher that works in the field. The paper concludes by sharing 'wisdom' that a designer researcher might seek in order to deal with fieldwork challenges.

Keywords: Design Research, Fieldwork, Lessons Learned, Design Methods, Case Study.

1 INTRODUCTION

The perception of an industrial designer seems to be associated with stylist, decorist, form-builder or an aesthetic manager of a product. The designer has been seen as a creative person who uses personal experience and knowledge to generate beautiful forms. Previously, designers were rarely involved in research; however, their work is actually determined by the research data. The market; however, has begun to seek measurable outcomes from creative services. Companies and clients prefer designers, who can assure the success of their creative work (Laurel, 2003; Visocky O'Grady & Visocky O'Grady, 2006). Also, the problems that a designer addresses these days have become extremely complex, and the solutions require a holistic approach and multi-disciplinary knowledge. With such complexity, designers may not be the masters of all the aspects of the problem; therefore, it is important that they reach out to and work with the real masters and learn from them. In addition to the changing demands on the designer owing to problem complexity, the market has acknowledged that positive user experiences are key to success. However, even this key does not assure the success. The negative user experience on the other hand guarantees the failure of the solution; better understanding of users appear to be an efficient way to begin designing solutions (Kuniavsky, 2003). The work and the role of a designer have shifted beyond the form builder of a product; therefore, the personal experiences of a designer are no longer enough to generate meaningful solutions. The consistent success of design consultancy companies, which have utilized research methods in the design process, underscore the importance of human-centered design approach, and have become the motivation for research based solutions. Hence, designers have begun to combine their experience and knowledge with research abilities to increase the credibility of their work. Design consultancies have begun to offer research services, and the universities offering design education, have begun including design research courses in their curriculum. As a result, design research now appears to be a necessary skill for industrial designers.

1.1 PHILOSOPHICAL PERSPECTIVES ON DESIGN RESEARCH

Design Research is now conducted in the studio class, in labs, conference rooms, offices, retail centers, public venues, manufacturing environments, garages, over the Internet, in any field and every situation that design involves. Before addressing the objectives of this paper and introduce the lessons learned in the fieldwork

studies, it is essential to clarify some of the terminology used in the paper about Design Research, specifically for fieldwork studies. First, the term 'research' is used to refer to any systematic inquiry that seeks new conclusions about the problem (Groat & Wang, 2002). Thus, in this paper, Design Research refers to a type of 'research' conducted in the field of Industrial Design. Each system of inquiry is based on assumptions about the nature and the source of the knowledge. Though many researchers might miss the gravity of their method selection reflecting on their philosophical perspective, there is a strong connection between method of inquiry, assumptions and world view. More specifically, a first assumption is an epistemological issue referring to the relationship between knower and what can be known. A second is an ontological assumption addressing the nature of reality about what can be known, and the third is a methodological assumption referring to a process of how the knower goes about finding out whatever he or she believes can be known (Guba & Lincoln, 1998; Patton, 2002). Thus an investigation should not be reduced to just a question of methods when it indicates the strategies of an inquiry. Here strategy refers to overall plan and structure of the research, which includes tactics, techniques or methods including data collection formats, procedures, and archival treatments etc. (see Figure 1). Strategy is the design of the research as an action plan which defines the road map between the research question and desired knowledge (Groat & Wang, 2002).

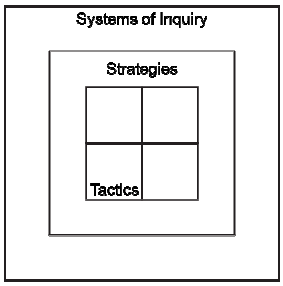

Figure 1: The structure of systems of inquiry. Adapted from Groat and Wang (2002).

For instance, the Cartesian system of inquiry suggests isolating the mind from the world as a source of knowledge, whereas another system of inquiry, ecological psychology, considers the interaction between the mind and world as the source of the knowledge. Similarly yet different, another system of inquiry, constructivism, proposes that the source of the knowledge is the mind which is socially formed. Strategies are generated within the limits of the assumptions of each systems of inquiry. However, tactical level commonalties across the systems of inquires and the strategies can be seen. At the tactical level, studies can be divided in two groups. Groat and Wang (2002) state that "quantitative research depends on the manipulation of the phenomena that can be measured by numbers; whereas qualitative research depends on non-numerical evidence, whether verbal, experiential or artifactual." A research strategy under certain systems of inquiry may oblige the researcher to use multiple tactics providing quantitative, qualitative or both types of data in order to answer a research question.

1.2 FIELDWORK ASSUMPTIONS AND PERSPECTIVE

The current paper focuses on fieldwork studies, which are positioned under the strategic level in the structure of systems of inquiries (see Figure 1). At the strategic level, the environment in which the study will be conducted can be considered. A study conducted in a controlled environment, such as the studio, laboratory, and in some cases over the Internet, affords the researcher control over many variables associated with the problem being studied. This allows the researcher to dissemble the problem into its variables, focus on certain aspects of the problem, and evaluate accordingly. The controlled environment approach, also known as experimental studies, allow the researcher to understand the cause and effect relationships between two variables when controlling others carefully. This approach generally follows well-defined procedures so that it can be repeated, and if the results are obtained across repeated studies then leads to generalizable outcomes. However, the cost of such control is paid by relinquishing validity due to the simulated nature of the tasks performed. The controlled environment is a simulation of the problem; therefore, the results may not necessarily reflect what would happen in real life. In other words, it lacks ecological validity which becomes a problem when participants describe a behavior that is not representative of their actual behaviors. Participants understand the structure of the controlled situation and provide results that may inflate or misrepresent their real-life performance. A researcher may inadvertently influence the participant with their interpersonal interaction during the experiment. Additionally,

participants in the lab may not represent the target group. Therefore, behavior in the controlled situation may provide limited information about the problem of interest. In contrast, conducting the research in the field (e.g. in natural settings such as conference rooms, offices, retail centers and other public venues) may minimize some of the disadvantages of controlled environments. Fieldwork studies, or field research, refer to a strategy in which a researcher engages participants in their own environment. Fieldwork requires researchers to collect data on location where participants perform tasks in context. The main goal of the fieldwork studies is to understand the natural behaviors of the participants. Fieldwork studies have high ecological validity since they provide data, which has limited intervention by the researcher. Also, participants in fieldwork studies provide representative behaviors when performing the real life task. Thus, researchers can collect detailed data (both quantitative and qualitative) about a problem that may not be necessarily possible in a controlled environment due to its restricted nature (Guba & Lincoln, 1998; Guba, 1981; Krauss, 2005). However, fieldwork studies also have disadvantages. First, they cannot be repeated; therefore, results are not easily validated. A second issue arises due to the interpretative nature of qualitative data. Often the proportion of the qualitative data collected in field studies is higher than controlled environment studies and may therefore result in reliability issues. Fieldwork studies may not provide direct results between causes and effects. While fieldwork studies are also time-consuming, expensive and hard to manage, they provide large, rich data sets and a holistic view about the topic. On the tactical level, fieldwork studies generally involve intensive data collection (Courage & Baxter, 2005). Therefore, fieldwork may not be a good strategy when researcher needs to sample large numbers of participants.

A fieldwork study can be conducted at the beginning of the design process where the problem should be deeply understood, reframed and synthesized. If the study is conducted in the field, it provides a holistic view, generating theories about the problem. It can be used to understand participants' needs, goals, motivations, behaviors, and desires as well as the nature of the problem. Fieldwork studies may be preferred when the prototype of the solution is mature enough to be tested by users. They also can be the part of the iterative prototype generation, evaluation and refinement. Controlled studies, on the other hand, can be used to check if each individual proposed solution fulfills participants' requirements about the problem. The controlled studies provide understanding of cause and effect relationships (e.g. in size, texture, dimensions, material) when testing mock-ups or initial prototypes. Control studies may be also preferred when testing the mature prototype to assure the quality of the product or its parts or evaluating the behavior of the product under certain conditions (weather, under water, and under loads etc.).

Both field and controlled approaches use similar tactics such as observations, focus group activities, interviews (structured, semi-structured, and unstructured), dyads, apprenticeship, online or conventional surveys, journals, field notes and other ethnographical techniques depending on what the research question and strategy entail. Each tactic has its own advantages and disadvantages. Each tactic may be used simultaneously or by themselves in multiple phases of the industrial design process, and each tactic requires certain types of analysis, which will then have their own challenges. Many publications can be found in design fields introducing the use of diverse types of tactics – methods. Some publications organizes these methods according to their use in the phases of design process (Kumar, 2013; Martin & Hanington, 2012). Others present them as a design process (Visocky O'Grady & Visocky O'Grady, 2006). Some introduce them through the case studies (Laurel, 2003), whereas other present each tactic as a tool and provide particular technical information about them (Courage & Baxter, 2005). Although the number of publications on tactics and methods in the field of design is increasing, there are a few sources that consider the challenges of fieldwork at the strategic level of inquiry. The goal of this paper is to introduce some of the concealed challenges which naturally manifest during fieldwork studies. The paper then concludes by sharing 'wisdom' that a designer researcher might seek in order to deal with fieldwork challenges.

2 CHALLENGES IN FIELDWORK

There are many challenges in each phase of field research, which may result in increased time and effort (and project costs). Since clients may not accept a fieldwork proposal due to cost and time constrains, it is important to educate the decision makers and project stakeholders involved in the research project as to the benefits of fieldwork (Courage & Baxter, 2005). Once the agreement on a fieldwork strategy is reached, a comprehensive preparatory phase should be anticipated before conducting the study in the field. The 'pre-work phase' involves preparations and practice — pilot work. Then the 'fieldwork phase' begins in which the data gathering occurs, and finally in the 'post-work phase' data is analyzed and reports or presentations are generated. There is no sharp

distinction between these phases in most cases. Some challenges introduced in the paper are at the tactical (method-specific) level; however, such specifics will help this paper provide pragmatic recommendations rather than simply an esoteric discussion of research theories and paradigms.

2.1 PRE-WORK: THE PREPARATION PHASE

The description of the term research suggests that it is a 'systematic and planned' investigation. The first step for the researcher is revisit why the study is conducted and how the results might be implemented. Considering both the why and the how, the research can develop a set of research questions including main and sub-questions. In a practical way, the researcher can imagine the type of the data and knowledge that is needed to answer the main and sub-questions when making tactical decisions. Research experience aids this process and the awareness of literature on research tactics and methods helps shorten this phase. Depending on the topic, a researcher may use previous procedures (sets of questions for participants, observation points, list of interesting topics, and methods that gathers the information) or come up with a new procedure to achieve the broad goal of the study. In most cases researchers adapt existing procedures to their study. This avoids the necessity to test the validity of new methods. Methods research is time consuming to conduct, obtain peer review, and have accepted in the research community. Method modifications include translating tools into other languages or modifying the language to make more understandable for participants. Regardless of whether it is an established or a new procedure, researchers should test procedures before using them in the field. The researcher should also consider the data collection instruments (such as video and audio recording devices, computers and iPads, pressure pads, scales, anthropometers, motion trackers, accelerometers, EMG, EEG, and vital sign systems etc.) and the requirements for these instruments (power, tolerance for vibration/changes in temperature, humidity, natural light and electrical/magnetic interference). Instruments and their condition become vital when data collection relies heavily on instrument based measurements. Recruitment and location selection is also important for fieldwork studies. When working with clients, it is common that they suggest and open one of their facilities for the study and recruit their employees for participation. However, this is not always the case; researchers should consider possible ways of recruiting participants and finding a location. Location selection also becomes important considering cultural, gender and age differences of the participants. The location selected may also impact data collection due to regional weather or workforce culture. For example, beyond making a data collection session unpleasant, temperature and humidity may influence data collection instruments. The safety requirements of the workspace should be always respected and reinforced; violation of the safety rules by your participants or a researcher should halt data collection until the issue is resolved. Workspace floor plans, maps or space constraints can be useful in understanding the juxtaposition of the participant and their tools and the researcher and their data collection equipment. Such pre-planning may resolve whether a wide angle or telephoto lens is needed to collect video or image data. If there is insufficient space for the researcher and equipment, there is no reason to head to the field to collect insufficient or meaningless data.

Once the research question is set and the procedures are ready, the researcher should submit for their project to their organization's (or institutions) Institutional Review Board for the Protection of Human Subjects in Research (IRB) for review and approval. This is very important when working with human subjects in order to protect the rights and welfare of the participants and to assure compliance with policies and regulations. Although the IRB approval is enough to start for the study; a researcher should always consider a pilot study before conducting the main study in the field. Pilot studies are at the core of the successful fieldwork studies. They are a simulation of work and methods to be used to collect data in the field allowing the researcher to test procedures and instruments, and anticipate the challenges waiting in the field study. In other words, pilot studies are the prototypes of the main data collection session conducted in the field. This is where researchers identify: "What works and what does not in the procedure?", "What might go wrong and what might we do when it is the case?", "How long the study took and what took so long?", "How might we shorten the time used?", or "How might we make the data collection process easier for us?" The answers to these questions might change the procedure of the study or require other instruments to use to collect data. In this is the case than researcher should make the appropriate changes and re-submit the IRB forms to have approval on the updated procedures. It is essential to mention that pilot studies are iterative and might require an allocation of considerable time.

Case Study: A study conducted this year with a heavy equipment vehicle manufacturer provides an excellent example of the challenges of fieldwork. The goal of the study was to assess usability issues of four brands of driver's seats that were being considered for use in their new vehicle. The fieldwork study was conducted to collect information about pressure distributions on the seats, driver posture, and driver perception of comfort.

Each participant would drive the vehicle for four hours using each of the four seats. The study was designed to allow two data collection sessions per day in the field. The researcher was to ride in the cab of the vehicle with the participant while they were driving in order to collect the pressure distribution, posture and subjective data at different intervals. While the research question was straight forward, the pre-work phase of this project conducted at the client's local research test facility and in the lab was interesting.

An assessment of the cab of the vehicle at the client's local research test facility highlighted several challenges including layout restrictions, awkward camera mounting locations and obstructions of line of sight for posture assessment. Based on the limited space, rough driving conditions, difficult mounting locations, and the need to remotely activate the cameras, GoPro cameras were selected to document driver posture. The simulated study created in our lab allowed testing of some of the challenges providing methods refinement. This included the generation of specialized posture markers (to address the anticipated changes in lighting as the vehicle was driven across fields in natural light - see Figure 2) and evaluation of power alternatives for the new set of GoPro Cameras, laptops and iPads. The GoPro batteries lasted less than an hour, the computer battery last ~ 3 hours, and the power for the iPad (to control the GoPros) lasted more than 4 hours which was not an issue. The client indicated that they had tested their new GoPros and that their engineer would hack the vehicle's charging unit to power them from the vehicle. Though the client was to provide all GoPro cameras, mounts, and power; we packed our own as back-ups along with redundant laptops, iPads, and iPhones. A tasks checklist was designed to keep the researcher on time and maintain the order of the data collection tasks. Since the farm was in a remote part of the country, we created a data collection first aid kit (including extra computers and ipads with the same software, extra cameras, extra camera mounts/joints, memory cards, cords, charging units, and materials such as velcro, tapes, glues, scissors etc.) in case of instrument or attachment failure. Along with the data collection equipment and first aid kit, consent forms, procedure guides, and data collection forms were printed and packed for the 492 mile trip to the 150,000 acre farm. Flight, rental car and hotel arrangements were confirmed. Pre-work includes planning for study contingencies (including local office supply and hardware stores) and also planning for the researchers, for example, safety gear, appropriate clothing, breaks and arranging meals.

2.2 IN THE FIELD: FIELDWORK PHASE

In this phase the researcher engages with participants in the study and gathers data that will be used in the analysis. This phase begins with another pilot study as well. The researcher; therefore, should go to the field early, set up the instruments and test them. The pilot study double checks whether preparations and the lessons learned in the lab study apply to the field. The researcher should identify probable failures and problems, and generate solutions as fast as possible. Practical, rapid problem solving within the limits of time and budget, along with rapid building are important skills for a researcher regardless of the problem. The immediate solution created in the field should be tested before the main fieldwork study in case it causes additional problems.

To continue with our example of seat assessment for a heavy equipment vehicle manufacturer, once on location at the client's farm in Georgia, a day was spent testing the equipment that had been transported and piloting data collection. During this time, the conditions of the field were identified, the space in the test vehicle was experienced, and power limitations within the vehicle were evaluated and mounting of seat pan pressure distribution pads were defined. The client's solution, powering the GoPro cameras using USB cable connections to the vehicles power system, did not work. That day many solutions were generated and tested; ultimately it was necessary to turn on and off the cameras and use them when only a measurement needed to be taken (using a photo) rather than recording posture continuously (with video). While this is the most reasonable solution given the power constraints, it required extra attention from the researcher during the data collection session. As anticipated from the lab simulation, there were many tasks that researcher must accomplish which required the use of a computer, an iPad and a clipboard for the protocol checklist, subjective data collection and notes. What was not anticipated was that the jump seat on which the researcher would sit provided no shock absorption; therefore, in addition to the researcher being bounced around the equipment being held for 2-4 hours sessions each day was being slid and bounced and needed to be secured. After the route for the driving sessions was tested, maps of the farm and route were printed. Since there were changes to the procedure, the checklist was updated to aid the researcher during the data collection sessions. In the first session with the participant, the pressure pad created an issue when slipping on the seat due to long driving time and bumps in the trail; it was secured to the seat using materials from the first-aid kit prepared in the lab. The first-aid kit helped to solve many set up issues in the field. While some problems could be solved (such as securing the pressure distribution pad to the seat) some could not, in those cases the data could not be collected. For instance, in the case study we were

not be able to take a posture measurement from one angle, as was proposed, due to the spatial constraints of the equipment cab (see Figure 3). Another adjustment in data collection was a shift in the timing of the measurements since sampling when the participant passed another vehicle (on the road between two fields in the farm) which created safety issues. Therefore, measurements were collected right after or before this type of situation occurred.

While it is important to have a well-managed data collection methodology, the well-being and interpersonal skill of the researcher in the field cannot be overlooked. In our case study, as previously mentioned each day the researcher rode in the cab with 2 participants during the 4 hours sessions (a total eight hours/day) and was seated in an instructor seat which did not have shock absorbers or good cushioning resulting in an uncomfortable and at times seemingly unbearable experience due to the long driving time and bumps. In order to make the study more natural in the confines of the cab, the researcher was armed with ice breaking topics and conversation points to keep participants' motivation high and make the study more natural. As with all studies, the researcher expressed appreciation and thanked participants in an effort to leave positive impression. These engagements during data collection can be considered as an investment for the future studies since the participant might join in the pool of future participants. The motivation of the participants should be held high but not at a level that unnecessarily affects the participants' behavior; however, simply participating in a study can affect participants' behavior (the Hawthorne Effect). Regardless of the care taken by the researcher to explain the project methods during participant recruitment, some participants may choose to discontinue their participation before the study is completed. In that case, a participant may receive full or partial compensation; the level of compensation for partial participation should be made clear in advance of an individual agreeing to participate. This is one of the many details outlined in the informed consent form approved by an institution's IRB.

Figure 2: The body markers designed used the case study.

Figure 3: Due to spatial limitation, the camera did not provide required angle and allow seeing the body marker to take measurements.

In addition to interacting with the study participants, one of the major roles of the researcher in the fieldwork study is to check the data recordings to identify if there are any problems in the data. It is important to emphasize that data is what researcher seeks. Especially in the fieldwork studies, if the data is poor or lost there are rarely way to reconstruct it. This is becomes especially challenging when multiple data collection instruments are used in a single data collection session. In our case study, the researcher took multiple measurements in case noise, glare, or vehicle movement resulted in unusable points in the data. Backing up the data in secure space, such as encrypted cloud services, is recommended to prevent the loss of collected data.

2.3 POST-WORK: ANALYSIS PHASE

The post-work phase includes the analysis of the data, generating interpretations, drawing conclusions and reporting the findings. The analysis phase may overlap the fieldwork phase when data can be reviewed and initially process shortly after it is collected. The researcher might code, enter and analyze the data when time is available during the fieldwork phase (breaks between participants, during engineering repairs, or in the evening).

This saves large amount of time during the subsequent phases and provides immediate feedback if something in the data is missing, meaningless, or wrong. When the data collection session ends, the researcher should collect the instruments and leave the fieldwork area as it was before the research team arrived. It is also important to reach out to the participants and express appreciation for their involvement. This transition between data collection and analysis is an opportunity to connect with the client and other stakeholders to provide an update about the study. Having selecting the right tools and methods for the analysis of the data is vital to the efficient, accurate completion of this phase of the study. The researcher should be aware of tactics and methods used and their required analysis methods.

In the case study, the pressure distribution data, participant posture and subjective measurements about each seat types were collected. The pressure pad system used in the study provides peak and average pressure data points and the contact areas, which change over time. The posture data was analyzed using video processing techniques, which allow tracking of the angular changes between selected body markers (see Figure 4). Finally, the likert-scale measurements were used to gather subjective opinions about the experience of each participant about each seat. All the methods used allow descriptive (and multivariate) statistics to identify significant differences between data points.
If data points were missing from one data set or were confusing, concerns could be addressed or results interpreted if there was some redundancy within the data collected (e.g. additional samples, video in addition to photos, etc). Choosing a variety of data collection methods supporting modest redundancy when designing a study can avoid being held hostage by a single piece of equipment or data collection method. Admittedly, this runs contrary to the notion of being efficient in data collection so that multiple pieces of equipment are not transported. While modest redundancy may make the logistics of data collection a bit more complicated, it may ultimately be a study lifeline that is only appreciated once it is needed.

Figure 4: Video processing tool used in analysis of posture change of the participant.

3 WISDOM OF A DESIGN RESEARCH NINJA

The analogy of a ninja is made to create an ideal persona of the design researcher that works in the field. The wisdom a researcher earns from the fieldwork is the value gained from pilot work. In the case study, almost a month was spent preparing and learning for the eight days of data collection in the field. During the pilot studies many ideas about protocols, measurements, and instrument issues changed and evolved. We learned about the environment, participants, and the company we were working with, the resources we needed, and problems we might have. The critical pilot work in the case study was that conducted in the field immediately before the collection of data in the field study. This seemingly last minute pilot work helped prove or disprove our assumptions generated from previous lab studies. The problems that might occur in the field can be estimated and foreseen through pilot studies and through previous experiences of the researcher. The ability to imagine the future, prepare for it and consider the consequences of the decision made is the wisdom a researcher should seek.

The researchers' effort is expended to gather meaningful, useful data points for the research. The data is the temple of the truth that research ninja seeks to reach, and participants are the tough masters of this temple who have the true knowledge based on their experience; data collection is the key to the temple of truth. Hence, the researcher, as a humble apprentice ninja, should understand the participants, address their concerns about the study, and keep their motivation high. A repository of ice breaking activities or conversion topics, the timing of a smile to make each participant feel assured, comfortable and safe, and expressing gratitude are concealed strategies that a research ninja should develop.

The researcher should have the senses of a ninja; the researcher should be able to use what is available at that moment in the reachable environment in order to solve the problems. This requires pre-work to learn about the environment. The field should be considered not only as where the research takes in place but where all the sources, tools, events, activities and interactions occur. Studying the culture of participants, understanding dynamics of the company, learning legal issues in the specific area etc. are all parts of the data collection context and environment. The researcher; therefore, must wear different hats, be open-minded and be engaging on an inter-personal level.

Creativity, flexibility, and agility become vital components of the wisdom that a research ninja should deploy in the field. When problems occur in the field, the fast and feasible solution must be found rapidly. Mastering the procedures, tactics, inter-personal skills, and the abilities such as solution-driven and creative thinking, problem solving, making and building, testing and re-testing are the strategies or abilities that researcher need. Autonomy as a by-product of researcher's wisdom is necessary to make decisions in the field. The decisions made by the researcher must take into account not only the limited resource at hand but also the effects on the participant(s) and the data collected. Ultimately, the researcher's must make decisions so that the data is collectable but does not hinder their ability to process the data, interpret the results and ultimately answer the research questions. The decisions need to be made quickly, precisely and in a manner that with be respectful of the participants. If the wrong decision is made, the data collection session will be wasted or the truth mis-represented. The research ninja is always aware that their decisions will impact their reputation and their relationships with the project stakeholders. The ability to make wise decisions, be self-observation, have high situation awareness, be experienced and able to document problems are skills of a successful researcher. The understanding of the trade-offs of decisions and having foresight of the consequences is the wisdom a researcher seeks. Consequently, researchers should:

- Have a clear vision of which data are answering which research questions (understand if a question is being answered with multiple data sets)
- Understand the priority of the questions being answered so that if tough choices have to be made and not all data sets can be collected, there is a clear understanding which questions/data sets are least important
- Know who the decision makers are if the project is funded — who to call to halt data collection
- Understand how the data will be processed after it is collected so that the impact of choices made in the field are understood (you don't want to make a choice that will triple you data processing time)
- Plan for failure in the field: bring extra equipment, batteries, generators, sensors, instruments, computers, thumb drives, printers, data collection forms, food/snacks, cash/change/credit cards, phones, and simple tools and office supplies
- Document any change in methods and why decisions were made (you will forget your rational once you are in your office or studio and things have calmed down)
- Document new research questions that arise in the middle of fieldwork
- Plan time after the data collection session for a debrief and to strategize how to move forward (either affirming the existing plan or identifying necessary changes to the plan and timeline)
- Add to researcher's wisdom by adopting a policy of transparent documentation and dissemination of your experiences, not just your results (be honest about turning water into wine or diamonds into dust)

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