THE USE OF PHOTOGRAPHS IN OPERATIONS MANAGEMENT RESEARCH

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ABSTRACT

This paper reports the use of photographs as primary sources of data in a study of the 5S in an organizational setting. Visual research, using photographic analysis as methodology and method, is discussed along with strategies for sampling, validity and credibility. Four types of photographic analysis are introduced. A pilot study using visual analysis in a manufacturing setting is reported and discussed. Data collection and analysis are predominantly qualitative, supported by quantitative analysis. Implications for operations management research are discussed in terms of methodological considerations and practical challenges in using visual research.

Keywords: Photograph, Visual Research, Methodology, Qualitative Analysis, 5S

INTRODUCTION

The overall aim of the research is to establish what differences exist between the espoused use, and the use in action, of a Japanese approach to management, the 5S concept (5S) in an Australian manufacturing workplace. The 5S concept has its origins in a Japanese acronym for *seiri (organization)*, *seiton (neatness)*, *seisō (cleaning)*, *seiketsu (standardization)* and *shitsuke (discipline)*, a philosophy that is embedded in Japanese everyday life.

This aim of this paper is not to provide a comprehensive discussion on 5S, but to introduce and discuss the use of photographs as primary sources of data in visual research. Visual research involves the use of visual data as method and the study of the modes in those data by which the lives of others are represented [36][42]. Visual research has been regarded as important in the natural sciences, but perceived as unusual or unscientific in social science research due to its language oriented approach [13][23]. In business research, marketing and communication studies have shown an increasing interest in the significance of visual research methods (e.g., [1][6][17]). However, there is a paucity of such evidence in management research and organizational studies in general, and operations management (OM) research in particular. Exemplars of relevant visual studies in management and organizational research, predominantly with the use of photographs, are few: Buchanan's study of a re-engineering process in a hospital [9][10], Harper's study of meaning and work [20], and Harper's study of technological changes in the agriculture industry [24].

Firstly, photo analysis method is discussed. Then a pilot study of photo analysis in a manufacturing setting is provided. Finally, implications for theory and operations management research are discussed.

THE USE OF PHOTOGRAPHS

Photographs have been used in research for almost for a century in sub disciplines of the social sciences, such as visual anthropology, visual ethnography and visual sociology [3][13][22]. Photography as a method to generate theory was pioneered by the work of Bateson and Mead [4] in *Balinese Character*, a study that examined the relationship between forms of social organization and types of character structure based on photographs and motion-picture film. Both authors faced the same problems in the representation of phenomena that has traditionally relied solely on words. Bateson and Mead [4] came up with an idea of using photographs as the primary data to generate a more 'precise' description. The significance of their work is that the use of visual materials assists researchers in forming the basis for alternative interpretation of lived experience.

Harper [23] suggests that photographs can be used in several ways including: studies of interaction; the presentation of emotion; the elicitation of information in interviews; and studies of material culture. Hurworth [27] provides seven conditions when visual materials become significant under study: (1) stakeholders are unable to participate in other forms of data collection, such as surveys or in-depth interviews (e.g., minors, physically or mentally handicapped participants, those for whom English is a second language, those who have low literacy levels, or with time/space restrictions); (2) some form of unobtrusive measure is required; (3) the objectives of a program are complex or abstract and are therefore difficult to articulate or measure; (4) the program is highly visual in itself; (5) the program may lead to change over long or short periods of time; (6) the physical/locational context of a program is particularly important (e.g., the way of using buildings, machines or a meeting room); and (7) carrying out interactive, empowering, participatory or collaborative evaluations (e.g., action research).

In relation to OM research, Buchanan's [9] sequential use of photographs is highly significant. The main objective of his study was to illustrate the complex and dynamic nature of the patient trail in a hospital. The steps in the patient trail were first documented photographically with other various data collection methods, such as interviews, observations and a questionnaire. According to Buchanan, approximately 150 photos were taken for the documentation purpose. A resultant slide presentation of a selection of those photographs was then shown to five groups of hospital staff to facilitate group interviews. After this study, Buchanan [10, p. 151] suggests that the use of photographs is beneficial in the following ways: [to] *develop a richer understanding of organizational processes; capture data not disclosed in interview; reveal to staff aspects of work in other sections of the organization with which they have little or no regular contact; offer a novel channel for respondent validation of data; and involve staff in debate concerning the implications of research findings for organization process redesign and improvement* [Italics added].

Despite the significance and power of photographs and other visual materials, "A common theme in general methodological textbooks appears to be an enthusiasm to describe the drawbacks and limitations of using images in a qualitative enquiry and an unwillingness to celebrate their strength" [37, p. 87]. Visual research has been "undervalued and under applied

by the orthodox qualitative research community" [37, p. 86]. This may limit researchers to actually apply visual research in management research and organization studies. The authors assert that the main reason for this low usage is due to a lack of a succinct understanding of visual analysis methods. In this paper the authors will emphasize several ways in which photographs can be employed by OM researchers.

PHOTO ANALYSIS METHODS

The term 'photo analysis' presented here refers to various visual research methods with the adoption of photographs. The review of the literature has depicted that incorporating a visual aspect into research using photographs is worthwhile in studies of highly abstract or complex phenomena either qualitatively or quantitatively, or both. This section outlines capabilities of photo analysis methods, including several types of photo analysis, as well as data collection and analysis methods that could assist OM researchers. Validity and reliability in photo analysis is also discussed.

Types of Photo Analysis

Methods in visual research are chiefly qualitative, but often involve *qualitative quantification* [2][8] or quantitative elements by design. In terms of photo analysis, some visual researchers have provided various approaches to the use and study of photographs [34][44][46]. According to those researchers, visual data such as photographs can be used for documentation, confirmation of textual reports, recording an evolving phenomenon, and other similar ways. Based on those classifications, the authors have proposed four types of photo analysis, see Table 1.

Table 1: Four types of photo analysis

	Role of the Researcher and Respondents	
Status of the photos	*Photos are taken by the researcher*	*Photos are taken by the respondents*
Photos as data or record *Direct mode of analysis*	**I : Direct photo analysis** The researcher takes the photos and analyses them	**II: Supplemental photo analysis** The researcher asks research participants to take photos, but analyses them on his or her own
Photos as elicitation *Participatory mode of analysis*	**III: Participatory photo analysis** The researcher takes the photos and discuss them with research participants	**IV: Collaborative photo analysis** The researcher ask the respondents to take photos and discuss them with research participants

(Source: [34][44][46])

Quadrant I: Direct photo analysis. The researcher takes photos and directly analyses them. Within this approach, photos can be used as the primary data or as supplements to other data [44]. Direct photo analysis is advantageous when the researcher is not in close proximity to the research subjects or experiences difficulty in interacting with the research objects [34]. This approach often employs *photo-documentation* [10] where the photographs serve as evidence. This technique is advantageous in describing or interpreting complex or highly abstract phenomena.

Quadrant II: Supplemental photo analysis. This approach requires the research participants to take the photos, but the researcher analyses and interprets them [34]. Visual anthropologists and visual ethnographers often employ this approach to attempt to provide rich description by adding a visual dimension [44]. Supplemental photo analysis is ideal when research participants have to explain a difficult context or conditions related to their lived experience. This approach often adopts either *photo-documentation* or *photo-narratives* (*visual narratives* [21]) technique, or a combination of both. Photo-narratives are often used to provoke emotion and insight into understanding individuals and cultures as illustrated in the picture [13].

Quadrant III: Participatory photo analysis. In this approach the researcher takes the photos. Research participants are invited to interpret the photos, then the researcher analyses both the visual data and the participants' interpretations [34]. This technique is often referred to as *photo-interviewing* [35] within an interpretive perspective, and *photo-elicitation* or *photo-voice* within a critical perspective [46]. Collier and Collier [13] first introduced the use of still photographs to facilitate interviews, as explained by Petersen and Østergaard [34, p. 233], "Within this context, 'elicitation' refers to drawing out what is latent – bringing out, extracting, or evoking a response from a person".

Quadrant IV: Collaborative photo analysis. The research participants are involved in both photo-taking (data collection) and interpretation of the photos (data analysis). Collaborative photo analysis uses techniques available in *photo-interviewing*, *photo-elicitation* or *photo-voice*, as well as *photo-narratives*. Many examples of this approach are seen in the form of action research in education and clinical research (e.g., [12][45]). This approach may require a *caveat* for some researchers because the degree of control by the researcher in the data collection and analysis phases is minimized whereas the research participants gain more initiatives in those phases. Although this approach gains the highest degree of self-representation and reflexivity, it does not lend itself to systematic collection and analysis of data [34]. Within this approach researchers are likely to have a more pragmatic perspective to respect for reflexivity of the research participants. Alternatively, the researcher can give the research participants clear instructions for a photo-taking activity, interpretation and analysis to maintain the rigor in a study [44].

Collection and Analysis of photographs

Sampling strategies for photo analysis are grounded in both quantitative and qualitative research. In addition to traditional random or purposive sampling techniques, photo analysis can consider the following strategies: *fixed time sampling*, *sampling across time*, *event-based sampling*, *dimensionally-based sampling*, *shadow sampling*, *snowball sampling*, and *theoretically informed sampling* [27, pp. 175-176]. The visual researcher may record the content of photographs in the *photo analysis worksheet* [43]. This option is suitable particularly when the collaborative photo analysis method was chosen. Within a collaborative approach, presenting photo-taking practice in a systematic way is crucial [40] as research participants tend to provide photographs and their narratives based on their preference unless they receive clear instructions or guidelines in advance [34].

In data analysis, the basic interpretation (transcription) of photographs can follow the 'reading' framework described by Wright [48]. Utilizing this framework, photographs can be read in three different ways: looking through the image to information internal to it; looking at the image to examine the way in which the content is presented; and looking behind the

image or examine the context, or the social and cultural relations that shape its production and interpretation. Photo analysis can then follow the principles of content analysis, semiotics, discourse analysis, psychoanalysis or other methods [42]. A relevant theory that supports a visual study can be informed by various theoretical perspectives including structuralism, phenomenology, symbolic interactionism, cognitive anthropology ethnomethodology and ethnoscience [2]. The use of 'thematic analysis' along with Schutz's (1899-1959) theory of social phenomenology is also ideal for photo analysis [7][14]. The use of 'artifact analysis' [26], often seen in archaeology and cultural studies, can be another option.

Assessing Validity and Reliability of Photo Analysis

Producing a robust study is essential to all types of studies, including visual research. Nonetheless, the traditional concepts of reliability and validity may or may not be applicable to the criteria for assessing the quality of visual studies [41]. With a qualitative strategy of inquiry, reliability and validity for visual research are expressed with different terms, such as *trustworthiness* [28] and *relevance* [19]. Simco and Warin [41, pp. 670-671] provide some assessment criteria for visual research, including: *completeness*, *adequacy of interpretation*, *transparency*, *self-reflection*, and *the aggregation of conflicting interpretation*. Despite many debates on the criteria for assessing the quality of research, the literature which proposes "how" researchers can satisfy the criteria for visual research is hardly seen. This section provides what evaluation criteria are considered in order to ensure the quality of visual research and how various approaches are used to satisfy those criteria, particularly for photo analysis. In this paper the authors will employ traditional terms, such as reliability and validity.

Reliability or dependability is concerned with the question of whether the results of a study are consistent and repeatable [8]. The Inter-observer or inter-coder reliability is particularly relevant for photo analysis with the use of content analysis. Some examples can be seen in the work of Goffman [17], and recently, Anderson and Imperia [1]. The use of a *photo analysis worksheet* [43] is also useful. Lincoln and Guba [28] propose *auditing* in qualitative research.

Validity or trustworthiness is concerned with the integration of the conclusions that are generated from a study [8]. A common approach to face validity is *member checking* [42]. Manning and Freimund [29] suggest the use of *verbal protocol analysis* that involves a questionnaire with agreed or disagreed statements. In their study those statements are: "I understood the questions that were asked", "The photographs realistically represent different levels of use at this area", "I was confused by the questions that asked me to choose between the photographs" and "It was very difficult to rate the acceptability of the photographs" [29, p. 569]. The adoption of multiple methods as way of overcoming the limitations of single method is also ideal to produce construct validity [37]. Within this context, the use of photographs can act to produce validity of another method and vice versa. In qualitative research, Prosser [37] proposes also to look at *contextual validity* that refers to the degree to which the research findings capture contextual information. For Prosser, "assessment of contextual validity is best made via reflexive accounts but also through representation" [37, p. 92].

PHOTO ANALYSIS IN PRACTICE

An Example: Use of Photographs in a Manufacturing Setting

The following example illustrates a current research project undertaken by one of the authors. This study adopted a case study strategy of inquiry, suggested by Yin [49]. The researcher has been investigating how the concept of '5S', a management approach, is understood and applied by a manufacturer in Queensland, Australia. Detailed information of 5S can mainly be seen in the work of Osada [31] and Hirano [25]. During the initial site visit and meetings, the researcher encountered limitations in the traditional forms of data collection methods. The researcher found that workers communicated mainly visually, not verbally, due to their particular work environment. The study environment also seemed to match some of the seven conditions suggested by Hurworth [27], such as (3) the objectives of a program are complex or abstract and therefore difficult to articulate or measure; and (4) the program is highly visual in itself. The case organization displayed various forms of visual information in their operations areas and meeting rooms, including indexes, tags and color-markings. Since the concept of 5S is strongly associated with the Japanese concept of *me-de-miru kanri* (visual management/control) [32], the examination of visual representations was carefully considered and deemed to be an appropriate research approach.

A combination of *direct photo analysis* and *supplemental photo analysis* methods was selected for the research (Table I). *Photo-documentation* and *photo-interviewing* techniques were adopted to collect visual data. Other data collection methods such as qualitative interviews, observations and documents were incorporated to establish the 'chain of evidence' in the case study, suggested by Yin [49]. A total of 202 photographs were collected from all twelve teams working in three small business units of the case organization. The researcher took 117 photos during observations and 85 photos were delivered by twelve team leaders and an operations manager. Each place to be photographed during observations was indicated by research participants as representing visual evidence of their 5S practice. The indication of places was based on the given themes in definitions of each element that comprises 5S (*seiri*, *seiton*, *seiso*, *seiketsu* and *shitsuke*) and an overall theme which represents 5S in a holistic manner. Analysis of data collected will have regard for the manifest and latent levels of *content analysis* to examine main themes and concepts, in the collection of photos from the case organization. The technique of *pattern matching* [49] will be incorporated to assess the presence or absence of evidence on photographs. The following stage of analysis is to be quantitative, using a *cross-tabulation* technique, supported by the *Chi-square* statistic, to examine the significance of difference.

A pilot study was conducted to assess the effectiveness of photo analysis methods, especially with interviews. The transcription of photographs taken by the researcher adopted the 'reading' framework described by Wright [48]. Other photos provided by research participants were used for photo-interviewing with twelve team leaders and the operations manager on site. The pilot study adopted a qualitative, descriptive analysis in order to develop qualitative *thematic analysis* from photo-interviewing. This framework was proposed by Felstead et al. [15] who conducted a study of workstations in the home. Photographs taken by the researcher ensured *contextual validity* [37] by contrasting with the photographs provided by the research participants as well as exemplars in the empirical literature [16][18].

The Result of a Pilot Study

The use of photographs in interviews seemed effective in the study environment that is often disrupted by the noise of machines and the movement of workers. This environment is quite common in the study of manufacturing organizations. The case organization was dealing with several incidents in operations during the site visit. The researcher had to pause to protect business confidentiality while the research participants were responding to his or her internal mobile phone. When those participants came back to the interview, the researcher noted that they were less likely to draw on their memory and were less fluent in their speech. Use of photographs assisted the research participants to track what they were talking about.

The significance of photographs suggested by Hurworth [27] was supported in the pilot study. The following criteria from the study environment were matched with Hurworth's conditions to use photographs under study: (1) stakeholders are unable to participate in other forms of data collection (e.g., those whom English is a second language, those who have low literacy levels, or with time/space restrictions); (3) the objectives of a program are abstract and therefore difficult to measure; (4) the program is highly visual in itself; (5) the program may lead to change over long or short periods of time; and (6) the physical/locational context of a program is particularly important (e.g., the way of using of building, machines, a meeting room). In addition, a couple of participants appeared to be nervous in interviews but photographs helped to construct his or her narratives.

Photographs linked to observations provided stronger visual evidence. The pilot study found some degree of inconsistency between a photograph brought by participants and another photograph of the same object taken by the researcher. However, in terms of *contextual validity* [37], this inconsistency between two photographs strengthened the evidence from interviews. For example, a team leader provided one photograph that shows the placement of boxes for storing equipment on a shelf. They were nicely arranged and signposted. During interviewing the leader commented, "We've done very well…Next challenge is 'sustaining'… (but it) is difficult". Another photograph of the same shelf taken by the researcher showed a piece of equipment being left out of a box. This finding supported the proposition that there was consistency between a comment from interviewing and photographs. Hence, photo-interviewing provides data triangulation.

The interpretation of photographs by participants uncovered subjective meaning of each component of 5S and the meaning of 5S as a whole. In order to understand how organizations work, researchers need to "understand the subjective experience of individuals" [11, p. 253]. According to Weick [47], people within an organization can experience the same reality but in different ways, construct meaning from the experience for those individuals, form shared perceptions that reconstruct reality, and finally constitute the basic building blocks of meaning for the organization. The use of photographs in interviews could assist the researcher in tracking the organizational processes of meaning construction not only in verbal form but also visually. For example, in the pilot study, the first S (*seiri*: organization) [31] was being translated as "sort and discard" within the case organization. However, each team had different representations and interpretations of the concept. Photographs showed that each team used different approaches to represent their actions for "sort and discard". One team used a red box, some used a red pallet, and others created an area with red line marking to represent a place to separate unneeded items from needed ones. Only the red color provided shared meaning for those members in the organization who used it to represent the concept of the first S of their 5S. This indicates that the "red-tag" strategy, as described in the

5S literature (e.g.[25][31]), was partly applied in the case organization in terms of "red", but not in terms of "tag".

IMPLICATIONS FOR OPERATIONS MANAGEMENT RESEACH

Methodological Contributions

For OM research, photo analysis is best suited in depicting highly abstract or complex phenomena, as seen in Buchanan's study of a re-engineering process in a hospital [9][10] and an example presented in this paper. Photo analysis can also be ideal for the examination and evaluation of a quality improvement program over time. Taking photographs from a fixed point over time could elicit the process and level of improvement, for example, in a *kaizen* (continuous improvement) programme [32]. Studies with experimental or quasi-experimental designs can incorporate photo analysis methods to increase the validity of research findings.

Photo analysis methods can also extend to the examination and evaluation of visual process management tools. Photo analysis allows the precise illustration and classification of those visual tools, particularly in lean production or within Toyota Production Systems, such as *kanban* (a card used for parts ordering), *andon* board (a light to give the current status and alert of the production system) and *poka-yoke* (mistake proofing) devices. For example, Parry and Turner [33] have examined this subject but neglected to provide construct validity. Photo analysis may overcome validity issues in conjunction with other research methods. Previous studies of visual process management tools [33] have focused merely on their technical aspects and therefore have been quantitatively or mathematically analyzed only. These studies have tended to ignore 'usability' aspects including "how it works" from an operators' viewpoint. Photo analysis methods add a visual dimension that enables an investigation of the usability issues.

The use of photographs in interviews is "ideal for use with people who, for whatever reason, are less able or reluctant to express themselves in a written or verbal form, or for exploring concepts that are inherently difficult to express in language" [46, p. 871]. The present study has supported the proposition of reluctance, as one team leader showed his or her nervousness in an interview before becoming noticeably more relaxed once photographs were introduced. This may expect the increased response rate of surveys and interviews by incorporation of photographs. Although it needs to be tested in relation to surveys, a result of the pilot study showed that most respondents in interviews seemed more enthusiastic about speaking once photographs were used. In the pilot study, each interview consisted of two parts. The first part of each interview was conducted without photos and the second part with photos. The second part obtained more than twice the overall informational content than the first part, suggesting that the introduction of photographs resulted in richer, more comprehensive data. Visual researchers with a critical perspective attempt to use those techniques to facilitate interviews to give voice to those who have traditionally been kept in silent [46]. Furthermore, the present study has indicated there are specific work environments and conditions in the operations of organizations that may or may not allow traditional data collection methods. The use of photographs can provide an alternative to traditional methods.

Challenges in Visual Research: Practical Issues

In common with other contemporary research methodologies, visual research also contains challenging issues. Firstly, the issue of *realism* must be directly addressed for visual researchers. Whilst 'objectivity' is the major criterion of adequacy in the positivist tradition, a commitment to 'realistic representation' is the main criteria for visual researchers with the realist tale. Some realist visual researchers often claim, "[An evidence by photographs] possess a credibility" [2, p. 16]. Those researchers believe that photographs "mirror" reality due to the mechanism of photo development process. However, advancement of technology now allows photographs to be altered (e.g. the use of extraneous processing and graphic-editing software). To overcome this issue, Becker [5] suggests including anthropological texts in the descriptions of photographs, such as persons may be "posed", artifacts "arranged" and activities "staged". Ball and Smith [2, p. 16] also propose that novice visual researchers should acquire "photographic literacy" (interpretation of photographs) based on the criteria of *content* (what is seen), *referent* (whatever the photograph is of) and *context* (where appears and the use made of it). This type of approach will improve the adequacy of the interpretation of non-verbal data [41]. Hurworth [27] adds the use of multiple methods or triangulation in order to improve the adequacy of interpretation of photographs.

Secondly, a researcher as a photographer may threaten validity, not by purposely unethical behavior, but by indirectly communicating desired findings to subjects. An option to overcome a common criticism that "only the best (and therefore atypical) pictures have been chosen" to illustrate a report is to include *galley proofs* or the index list of photographs being taken [27]. This then explicates that there were additional, similar photos from which to choose. In terms of external validity, *The Hawthorn effect* is a specific kind of reactivity that research participants might react differently during a study than they would in real life because they know they are under study [30]. This threat to external validity is also applicable to visual research. The presence of a researcher, as a photographer, may influence reactions of the research participants. In Hurworth's [27] study it was proved that increased presence of the researcher as a photographer is likely to lead to the acceptance of being photographed. "Indeed, after a while those being viewed come to ignore the equipment" [27, p. 176]. Taking several "dummy" shots prior to the actual photo-recording may also neutralize the likelihood of the Hawthorn effect.

Finally, ethical and privacy considerations are also a concern with visual research. Similar to participant observation, the role of the researcher with a photo-taking activity must clearly be explained with informed consent. Any selection bias imposed by the client, organization or the researcher's own convictions may result in the fewer number of photographs obtainable or acceptable for use than intended [27]. This would be a serious issue particularly when the possible exploitation of research participants occurs. One way to deal with such issue is to take photographs at an angle, a distance or any other non-identifiable way [27]. Another option is to conduct a participant briefing to gain an acceptance of which photographs can be included in the report. Asking the research participants to take and bring photographs (Quadrant II and IV in Table I) may also increase an acceptance rate and the number of photographs obtained, as seen in the work of Radley and Taylor [38][39] and the pilot study presented in this paper.

CONCLUSION

This study has discussed the use of photo analysis as a principle means of data generation and analysis. Different methods to manage photographs were discussed in relation to four approaches in photo analysis. Some of photo analysis methods and techniques were applied in a pilot study in a manufacturing setting to assess the effectiveness of using photographs with interviews under study. Findings from the pilot study included: photographs can assist retrospection of lived experiences by the research participants; the use of photographs is advantageous under certain conditions; combining photographs with other forms of data ensures contextual validity through a triangulation technique. The researchers also found that photo analysis provides an important means of collecting and analyzing data in a qualitative nature. Implications for theory and practice in OM research were that the use of photographs is beneficial: (a) in investigation of a mechanism and process in operations that is highly abstract or complex; (b) in examination and evaluation of visual or process management methods and tools; and (c) when the researcher directly interacts with a wide range of people in organizations. However, visual researchers need to be aware of issues on realism, validity and ethics. The significant advantage of using photographs was to clarify understanding and to provide a context in discussion with the research participants.

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