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Application of a Case Study Methodology

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Abstract

In the preceding article (Tellis, 1997), the goals and objectives were presented and explained in detail. In this article, the methodology to accomplish those goals and objectives will be examined. The reader will become familiar with the specific techniques that are used in the current study, and supported by the literature that was reviewed in the previous article. That methodology will follow the recommendation of Yin (1994) and has four stages: Design the case study, Conduct the case study, Analyze the case study evidence, and Develop the conclusions, recommendations and implications. The article begins with an introduction, that includes some of the background information that is intended to inform the reader. Following that section, each step of the methodology will be explored in detail. Finally a summary will connect all the information in a concise manner.

Application of a Case Study Methodology
by
Winston Tellis[+]

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1. Design the case study,
2. Conduct the case study,
3. Analyze the case study evidence, and
4. Develop the conclusions, recommendations and implications.

The article begins with an introduction, that includes some of the background information that is intended to inform the reader. Following that section, each step of the methodology will be explored in detail. Finally a summary will connect all the information in a concise manner.

Introduction

Case study is an ideal methodology when a holistic, in-depth investigation is needed ([Feagin, Orum, & Sjoberg](#), 1991). Case studies have been used in varied investigations, particularly in sociological studies, but increasingly, in instruction. Yin, Stake, and others who have wide experience in this methodology have developed robust procedures. When these procedures are followed, the researcher will be following methods as well developed and tested as any in the scientific field. Whether the study is experimental or quasi-experimental, the data collection and analysis methods are known to hide some details ([Stake](#), 1995). Case studies, on the other hand, are designed to bring out the details from the viewpoint of the participants by using multiple sources of data.

[Yin](#) (1993) has identified some specific types of case studies: *Exploratory*, *Explanatory*, and *Descriptive*. [Stake](#) (1995) included three others: *Intrinsic* - when the researcher has an interest in the case; *Instrumental* - when the case is used to understand more than what is obvious to the observer; *Collective* - when a group of cases is studied. Exploratory cases are sometimes considered as a prelude to social research. Explanatory case studies may be used for doing causal investigations. Descriptive cases require a descriptive theory to be developed before starting the project. [Pyecha](#) (1988) used this methodology in a special education study, using a pattern-

matching procedure. In all of the above types of case studies, there can be single-case or multiple-case applications.

Case study research is not sampling research; that is a fact asserted by all the major researchers in the field, including Yin, Stake, Feagin and others. However, selecting cases must be done so as to maximize what can be learned in the period of time available for the study.

The unit of analysis is a critical factor in the case study. It is typically a system of action rather than an individual or group of individuals. Case studies tend to be selective, focusing on one or two issues that are fundamental to understanding the system being examined.

Case studies are multi-perspectival analyses. This means that the researcher considers not just the voice and perspective of the actors, but also of the relevant groups of actors and the interaction between them. This one aspect is a salient point in the characteristic that case studies possess. They give a voice to the powerless and voiceless. When sociological investigations present many studies of the homeless and powerless, they do so from the viewpoint of the "elite" (Feagin, Orum, & Sjoberg, 1991).

Case study is known as a triangulated research strategy. Snow and Anderson (cited in Feagin, Orum, & Sjoberg, 1991) asserted that triangulation can occur with data, investigators, theories, and even methodologies. Stake (1995) stated that the protocols that are used to ensure accuracy and alternative explanations are called triangulation. The need for triangulation arises from the ethical need to confirm the validity of the processes. In case studies, this could be done by using multiple sources of data (Yin, 1984). The problem in case studies is to establish meaning rather than location.

Denzin (1984) identified four types of triangulation: *Data source triangulation*, when the researcher looks for the data to remain the same in different contexts; *Investigator triangulation*, when several investigators examine the same phenomenon; *Theory triangulation*, when investigators with different view points interpret the same results; and *Methodological triangulation*, when one approach is followed by another, to increase confidence in the interpretation.

The issue of generalization has appeared in the literature with regularity. It is a frequent criticism of case study research that the results are not widely applicable in real life. Yin in particular refuted that criticism by presenting a well constructed explanation of the difference between analytic generalization and statistical generalization: "In analytic generalization, previously developed theory is used as a template against which to compare the empirical results of the case study" (Yin, 1984). The inappropriate manner of generalizing assumes that some *sample* of cases has been drawn from a larger universe of cases. Thus the incorrect terminology such as "small sample" arises, as though a single-case study were a single respondent.

Stake (1995) argued for another approach centered on a more intuitive, empirically-grounded generalization. He termed it "naturalistic" generalization. His argument was based on the harmonious relationship between the reader's experiences and the case study itself. He expected

that the data generated by case studies would often resonate experientially with a broad cross section of readers, thereby facilitating a greater understanding of the phenomenon.

Yin (1994) presented at least four applications for a case study model:

1. To explain complex causal links in real-life interventions
2. To describe the real-life context in which the intervention has occurred
3. To describe the intervention itself
4. To explore those situations in which the intervention being evaluated has no clear set of outcomes.

Information technologies involve all four of the above categories, but this study will only report on the last two. Since the Levy (1988) case study of the University of Arizona, there has been very little literature relating to the pace of acquisition of information technology at institutions of higher education. For this reason, Levy (1988) conducted a case study after consulting with experts in the field and with senior case researchers. Their recommendation was to conduct an in-depth study of the institution using the case methodology. This study replicates and extends that study and thereby adds to the body of knowledge on the nature of information technology acquisition at universities.

Levy (1988) used a single-case design for the study at the University of Arizona. Single cases may be used to confirm or challenge a theory, or to represent a unique or extreme case (Yin, 1994). Single-case studies are also ideal for revelatory cases where an observer may have access to a phenomenon that was previously inaccessible. These studies can be holistic or embedded, the latter occurring when the same case study involves more than one unit of analysis. Multiple-case studies follow a replication logic. This is not to be confused with sampling logic, where a selection is made out of a population, for inclusion in the study. This type of sample selection is improper in a case study. Each individual case study consists of a "whole" study, in which facts are gathered from various sources and conclusions drawn on those facts.

As in all research, consideration must be given to construct validity, internal validity, external validity, and reliability (Yin, 1989). Levy (1988) established construct validity using the single-case exploratory design, and internal validity using the single-case explanatory design. Yin (1994) suggested using multiple sources of evidence as the way to ensure construct validity. The current study used multiple sources of evidence ; survey instruments, interviews, and documents. The specification of the unit of analysis also provides the internal validity as the theories are developed and data collection and analysis test those theories. External validity is more difficult to attain in a single-case study. Yin (1994) provided the assertion that external validity could be achieved from theoretical relationships, and from these generalizations could be made. It is the development of a formal case study protocol that provides the reliability that is required of all research.

The design of this case study closely follows that of the Levy study. The methodology selected by Levy (1988) was based on the seminal work by Yin (1984) and confirmed by Feagin, Orum, and Sjoberg (1991). That single-case study methodology was used in the current study and is described below. Danziger (1985) has established the "context of use" as a mitigating factor in

the study of computing in organizations. The "pattern matching" (Yin, 1984) of acquisition and use established in other environments may be shown to be applicable in higher education. Yin (1994) listed six sources of evidence for data collection in the case study protocol: documentation, archival records, interviews, direct observation, participant observation, and physical artifacts. Not all need be used in every case study (Yin, 1994). In this study, the last three types of sources are not relevant, since they are related to direct sociological investigation, and are not used.

For this case study, the researcher replicated Levy's (1988) study, but also adds to the field by examining aspects of client/server computing, the Internet, and the WWW. It is based on a modification of the methodology devised by Yin (1984). Each stage of the methodology will consist of a discussion of procedures recommended in the literature, followed by a discussion of the application of those procedures in the proposed study:

1. Design the case study protocol:
   a. determine the required skills
   b. develop and review the protocol
2. Conduct the case study:
   a. prepare for data collection
   b. distribute questionnaire
   c. conduct interviews
3. Analyze case study evidence:
   a. analytic strategy
4. Develop conclusions, recommendations, and implications based on the evidence

The following sections expand on each of the stages listed above, in the order in which they are executed in the current study. Each section begins with the procedures recommended in the literature, followed by the application of the recommended procedure in the current study.

Design the Case Study Protocol

The first stage in the case study methodology recommended by Yin (1994) is the development of the case study protocol. This stage is composed of two subheadings: *Determine the Required Skills* and *Develop and Review the Protocol*. These are presented in the following discussion.

Determine the Required Skills

Recommended Procedures

Yin (1994) suggested that the researcher must possess or acquire the following skills: the ability to ask good questions and to interpret the responses, be a good listener, be adaptive and flexible so as to react to various situations, have a firm grasp of issues being studied, and be unbiased by preconceived notions. The investigator must be able to function as a "senior" investigator (Feagin, Orum, & Sjoberg, 1991).

Application of Recommended Procedures

This researcher has had thirty years of experience in both academic and administrative computing and was adequately prepared for the investigation. This researcher's training in systems analysis is adequate preparation for the project.

< Recommended Protocol the Review and>

A draft of the protocol will be developed by the researcher. This follows extensive relevant readings on the topic which would help in developing the draft questions. Yin (1994) recommended that this be conducted in a seminar format if there are multiple investigators. The purpose of the seminar or review, in the case of a single investigator, is to discover problems in the plans or any phase of the study design. If there is a team of investigators, the seminar format would perhaps highlight team-member incompatibilities and perhaps potentially productive partnerships amongst the members. If there are unreasonable or unattainable deadlines in the plan, this will most likely be discovered by the team.

Some of the early criticism of the case study as a research methodology was that it was unscientific in nature, and because replication was not possible. The literature contains major refutations by Yin, Stake, Feagin, and others whose work resulted in a suggested outline for what a case study protocol could include. Yin (1994) reminded the researcher that there is more to a protocol than the instrument. He asserted that the development of the rules and procedures contained in the protocol enhance the reliability of case study research. While it is desirable to have a protocol for all studies, Yin (1994) stated that it is essential in a multiple-case study. The protocol should include the following sections:

- **An overview of the case study project** - this will include project objectives, case study issues, and presentations about the topic under study
- **Field procedures** - reminders about procedures, credentials for access to data sources, location of those sources
- **Case study questions** - the questions that the investigator must keep in mind during data collection
- **A guide for the case study report** - the outline and format for the report.

The discipline imposed on the investigator by the protocol is important to the overall progress and reliability of the study. It helps keep the investigator's focus on the main tasks and goals, while the process of development brings out problems that would only be faced during the actual investigation. The overview of the project is a useful way to communicate with the investigator, while the field procedures are indispensable during data collection. The case study questions are those under study, not those contained in the survey instrument. Each question should also have a list of probable sources.

The guide for the case study report is often omitted from case study plans, since investigators view the reporting phase as being far in the future. Yin (1994) proposed that the report be planned at the start. Case studies do not have a widely accepted reporting format - hence the experience of the investigator is a key factor. Some researchers have used a journal format (Feagin, Orum, Sjoberg, 1991) which was suitable for their work, but not necessarily for other studies. Indeed the case study at Fairfield University is not served by such a format, nor was the

Levy (1988) study before it. The reason for the absence of a fixed reporting format is that each case study is unique. The data collection, research questions and indeed the unit of analysis cannot be placed into a fixed mold as in experimental research.

Application of Recommended Procedures

Yin (1984) presented three conditions for the design of case studies: a) the type of research question posed, b) the extent of control an investigator has over actual behavioral events, and c) the degree of focus on contemporary events. In the Levy (1988) study and this study, there are several "what" questions. This type of research question justifies an exploratory study. Examples of such questions include:

- What patterns of acquisition emerge from the current computing environment and the perceived needs for computing?
- What patterns are revealed from historical inventory records?
- Was there any change in the perceived needs related to the Internet and the WWW?
- What characteristics of the categories of computing use contribute to the patterns of acquisition?
- What managerial issues arise from the rapid acquisition of information technology and how important have those technologies become to the organization?
- Since replacement and enhancement of information technologies are projected to increase, what economic impact will that have on the planning and budgeting of the university?
- Was there any particular budgetary and/or systematic preparation for the implementation of client/server computing?
- What was the level of managerial commitment to information technology?
- What was the level of faculty commitment to information technology?
- What was the degree of decentralization/decentralization of information technologies?
- What resources were or will be needed for conversion to a client/server environment?
- What additional resources will be needed now and in the future for university community access to the WWW?

The existence of several "how" questions in the questionnaires make the study explanatory as well, which is not uncommon (Yin, 1994). Examples of such questions include:

- How do the respondents view the availability of computing resources in comparison to peer institutions?
- How are information technology resources allocated?
- How are information technology resources financed?
- How will the institution balance the need for technological changes with the need to continue the accomplishment of routine tasks?
- How does Fairfield University plan to meet current demand for service while preparing for strategic long term goals?
- How does the university evaluate the cost-benefit of its computing environment?

The researcher had no control over the behavioral events, which is a characteristic of case studies. The third condition, that was present in the Levy (1988) study and is evident in the current study, is that the events being examined are contemporary, although historic information was used.

An empirical investigation of a contemporary phenomenon within its real-life context is one situation in which case study methodology is applicable. Yin (1994) cautioned that case study designs are not variants of other research designs. Yin (1994) proposed five components of case studies:

1. A study's questions,
2. Its propositions, if any,
3. Its unit(s) of analysis,
4. The logic linking the data to the propositions, and
5. The criteria for interpreting the findings (Yin, 1994, p. 20).

The research questions framed as "who", "what", "where", "how", and "why" determine the relevant strategy to be used. In the Levy (1988) study and the current study, the nature of the questions lead to an explanatory-exploratory case study. The Levy (1988) study and this proposed study, both being exploratory, need not, and do not have a proposition (Yin, 1994). The unit of analysis in a case study could be "an individual, a community, an organization, a nation-state, an empire, or a civilization" (Sjoberg, Williams, Vaughan, & Sjoberg, 1991). The Levy (1988) study used the case study organization as the unit of analysis. The linking of the data to the propositions and the criteria for interpretation of the findings are not well developed in case studies. However they are represented in the data analysis and report.

Levy (1988) established the single-case explanatory- exploratory methodology as the most suitable choice for the investigation of information technology. The explanatory strategy came from the need to determine the extent to which the patterns of acquisition and use that were established in other environments were applicable to higher education environment also. The exploratory strategy was used to examine the economic aspects of information technologies. As a replication of the Levy study, this study also followed that methodology.

Conduct the Case Study, Preparation for Data Collection, Distribution of the Questionnaire, and Conducting interviews

Recommended Procedures

The second stage of the methodology recommended by Yin (1994) and which were used in the current study, is the Conduct of the case study. There are three tasks in this stage that must be carried out for a successful project: *Preparation for Data Collection*, *Distribution of the Questionnaire*, and *Conducting Interviews*. These stages are presented together in the following section, since they are interrelated. Once the protocol has been developed and tested, it puts the project into the second phase - the actual execution of the plan. In this phase the primary activity is that of data collection. The protocol described above addresses the types of evidence that are available in the case organization. In case studies, data collection should be treated as a design

issue that will enhance the construct and internal validity of the study, as well as the external validity and reliability (Yin, 1994). Most of the field methods described in the literature treat data collection in isolation from the other aspects of the research process (Yin, 1994), but that would not be productive in case study research.

Yin (1994) identified six primary sources of evidence for case study research. The use of each of these might require different skills from the researcher. Not all sources are essential in every case study, but the importance of multiple sources of data to the reliability of the study is well established (Stake, 1995; Yin, 1994). The six sources identified by Yin (1994) are:

- documentation,
- archival records,
- interviews,
- direct observation,
- participant observation, and
- physical artifacts.

No single source has a complete advantage over the others; rather, they might be complementary and could be used in tandem. Thus a case study should use as many sources as are relevant to the study. Table 1 indicates the strengths and weaknesses of each type:

Table 1
Types of Evidence

Source of Evidence	Strengths	Weaknesses
Documentation	- stable - repeated review - unobtrusive - exist prior to case study - exact - names etc. - broad coverage - extended time span	- retrievability - difficult - biased selectivity - reporting bias - reflects author bias - access - may be blocked
Archival Records	- Same as above - precise and quantitative	- Same as above - privacy might inhibit access
Interviews	- targeted - focuses on case study topic - insightful - provides perceived causal inferences	- bias due to poor questions - response bias - incomplete recollection - reflexivity - interviewee expresses what interviewer wants to hear
Direct Observation	reality - covers events in real time	- time-consuming - selectivity - might miss facts

	• contextual - covers event context	• reflexivity - observer's presence might cause change • cost - observers need time
Participant Observation	• Same as above • insightful into interpersonal behavior	• Same as above • bias due to investigator's actions
Physical Artifacts	• insightful into cultural features • insightful into technical operations	• selectivity • availability

(Yin, 1994, p. 80)

Documents could be letters, memoranda, agendas, study reports, or any items that could add to the data base. The validity of the documents should be carefully reviewed so as to avoid incorrect data being included in the data base. One of the most important uses of documents is to corroborate evidence gathered from other sources. The potential for over-reliance on document as evidence in case studies has been criticized. There could be a danger of this occurrence if the investigator is inexperienced and mistakes some types of documents for unmitigated truth (Yin, 1994).

Archival records could be useful in some studies since they include service records, maps, charts, lists of names, survey data, and even personal records such as diaries. The investigator must be meticulous in determining the origin of the records and their accuracy.

Interviews are one of the most important sources of case study information. The interview could take one of several forms: open-ended, focused, or structured. In an open-ended interview, the researcher could ask for the informant's opinion on events or facts. This could serve to corroborate previously gathered data. In a focused interview, the respondent is interviewed for only a short time, and the questions asked could have come from the case study protocol. The structured interview is particularly useful in studies of neighborhoods where a formal survey is required. The use of tape recorders during the interviews is left to the discretion of the parties involved.

Direct observation in a case study occurs when the investigator makes a site visit to gather data. The observations could be formal or casual activities, but the reliability of the observation is the main concern. Using multiple observers is one way to guard against this problem.

Participant observation is a unique mode of observation in which the researcher may actually participate in the events being studied. This technique could be used in studies of neighborhoods or organizations, and frequently in anthropological studies. The main concern is the potential

bias of the researcher as an active participant. While the information may not be available in any other way, the drawbacks should be carefully considered by the researcher.

Physical artifacts could be any physical evidence that might be gathered during a site visit. That might include tools, art works, notebooks, computer output, and other such physical evidence.

Yin (1994) suggested three principles of data collection for case studies:

1. Use multiple sources of data
2. Create a case study database
3. Maintain a chain of evidence

The rationale for using multiple sources of data is the triangulation of evidence. Triangulation increases the reliability of the data and the process of gathering it. In the context of data collection, triangulation serves to corroborate the data gathered from other sources. The cost of using multiple sources and the investigator's ability to carry out the task, should be taken into account prior to deciding on the use of this technique.

The data that are collected during this phase need to be organized and documented just as it is in experimental studies. The two types of databases that might be required are the data and the report of the investigator. The design of the databases should be such that other researchers would be able to use the material based on the descriptions contained in the documentation. All types of relevant documents should be added to the database, as well as tabular materials, narratives, and other notes.

In recommending that a chain of evidence be maintained, Yin (1994) was providing an avenue for the researcher to increase the reliability of the study. The procedure is to have an external observer follow the derivation of evidence from initial research questions to ultimate case study conclusions. The case study report would have citations to the case study database where the actual evidence is to be found.

Application of Recommended Procedures

This study used the methodology established by Levy (1988) in his investigation of the impacts of information technology at the University of Arizona. The methodology recommended by Yin (1984) and others was adapted for use at Fairfield University.

The questionnaire developed by Levy (1988) was modified for use at Fairfield University. The modifications were approved by Levy (1988). The modified instruments reflect both the current case organization and the technology environment under study. The modified instruments were tested on a group of individuals from the administration and from the faculty at Fairfield University, the case organization. The results from the test group indicated that changes to the instruments would be beneficial, and these changes were made. The remodified instruments were reviewed by Levy. King and Kraemer (1985) provided the logical categories for context of use in computing environments and were adapted by Levy in the 1988 study: *technological development*, *structural arrangements*, *socio-technical interface*, *political/economic*

environment, and *benefits/problems*. Specific questionnaire items cover these areas. These categories were also employed in the analysis.

The primary data gathering was accomplished using the "Administrator Assessment of Computing" and the "Faculty Assessment of Computing" questionnaires developed for the Levy study, appropriately modified to reflect recent developments and concerns specific to Fairfield University. The purpose of the modifications to the instruments was to gather data on the client/server aspects of the computing environment, as well as the use of the Internet and the WWW. Permission to use the questionnaires from Levy's study was obtained.

Some of the items in the instruments that relate to each of the categories above are:

- Technological Development:
    o There is considerable support for the acquisition of PC networks within my department/unit
    o More local area networks
    o Access to the Internet and WWW
    o Access to networked CD's from classroom
    o Ability to create class material for use on the WWW
    o Video Conference capability
    o Microcomputer classrooms for instruction only
    o More classrooms connected to networks
    o More instructional software
    o Support for WWW/Multimedia course development
    o Ability to transfer large files with sound, images, etc.
- Structural Arrangements:
    o University policy has provided effective guidelines for computing use in the university
    o The university's central administration has been equitable in allocating available resources for computing
    o Satisfied with our level of computing decisions
- Socio-Technical Interface:
    o Hands-on workshops designed specifically for faculty and research uses of information technology tools would be useful for me
    o Current support programs
    o Sufficient data communications capabilities
    o Access to Internet, WWW, E-mail, from the Office
    o Access to Internet, WWW, E-mail, from the Classroom
    o Access to Internet, WWW, E-mail, from the Home
    o Use the services of an Instructional Computing group to help faculty use computing for instruction
    o Use the services of a Research Computing group to help faculty use computing for instruction
- Political/Economic Environment:
    o All students should have access to computing, regardless of the course in which they are enrolled

- o Faculty positions
- o Support positions
- o Plant and Equipment maintenance
- o Current instructional programs
- o There is sufficient support for instructional computing in my department
- Benefits/Problems:
  - o The scope of the work I am able to undertake is directly increased by the use if computing
  - o Attracting undergraduate students
  - o Attracting faculty
  - o Able to adequately discuss needs with mainframe support staff
  - o Satisfied with system response time
  - o Satisfied with institutional data sets available for analysis

The questionnaires were distributed through the office of the Academic Vice President (AVP) to all full-time faculty and academic administrators, and specific others recommended by the deans and the AVP. This data gathering activity was co-sponsored by the Education Technology committee. The questionnaire for faculty was also distributed to the permanent faculty of the School of Engineering, although they are not full-time faculty. They are heavy users of technology and their views were considered valuable. Including part-time faculty other than the School of Engineering, carried the risk of including several hundred instructors who teach in the School of Continuing Education and whose access to computing resources is limited. They are adjunct lecturers who could be classified as part-time instructors. Their number is too large to warrant the potential distortion in the results. The completed questionnaires were returned to the office of the Academic Vice President.

A reminder notice was sent to all faculty and administrators one week after the original contact, so as to encourage participation. This action increased the response rate. The Educational Technology Committee made phone calls to colleagues to encourage participation.

Levy (1988) used open-ended interviews as recommended by Yin (1984) to expand the depth of data gathering, and to increase the number of sources of information. In this study the researcher used the same interview questions and protocol that were used in the Levy study. As in the Levy study, the survey was enhanced by interviews of key individuals so as to acquire information that might not have become available through the questionnaire. The interviews were conducted according to the interviewee's schedule and availability, as suggested by Feagin, Orum, and Sjoberg (1991). The list of those to be interviewed included the Academic Vice President, the Vice President of Administration, the Director of Telecommunications, the Deans of Arts and Sciences, Business, and Engineering, and the Chair of the academic Educational Technology committee. The interview protocol used by Levy (1988) was free form and followed the recommendations of Yin (1984). It was ideal for the case organization under study. The researcher is well qualified to conduct this form of inquiry. The interview questions are contained in Appendix E.

The source of the quantitative data was various university records in the public domain. The historic financial information, Financial Statements, 1989-1995 (Fairfield University Controller,

[1995](#)) was available through the appropriate university officers. Permission was obtained from the Fairfield University Controller, for use of the documents. [The Long Range Planning Committee Report](#) (1993) and the [Computer User Group Report](#) (1993) were the primary sources of information on future projections. Both the documents were available in the university Library. The academic Educational Technology Committee minutes would have been very informative for some of the historic and anecdotal issues, but were unavailable for non-committee use.

Analyze Case Study Evidence

Analytic Strategy

Recommended Procedure

The following discussion will present the *Analytic Strategy* that should be followed in the course of evaluating data gathered in the previous stage of the study. There are various viewpoints relating to this phase of the study, and one of them is that statistical robustness is not an absolute necessity in all case studies. This researcher will present the specific statistical techniques that will be used in this study later in the section.

"Data analysis consists of examining, categorizing, tabulating, or otherwise recombining the evidence to address the initial propositions of a study" ([Yin](#), 1994). The analysis of case study is one of the least developed aspects of the case study methodology. The researcher needs to rely on experience and the literature to present the evidence in various ways, using various interpretations. This becomes necessary because statistical analysis is not necessarily used in all case studies. This case study employs a series of statistical tests to help in the presentation of the data to the reader. However not all case studies lend themselves to statistical analysis, and in fact the attempt to make the study conducive to such analysis could inhibit the development of other aspects of the study. [Miles and Huberman](#) (1984) have suggested alternative analytic techniques of analysis in such situations, such as using arrays to display the data, creating displays, tabulating the frequency of events, ordering the information, and other methods. This must be done in a way that will not bias the results.

[Yin](#) (1994) suggested that every investigation should have a general analytic strategy, so as to guide the decision regarding what will be analyzed and for what reason. He presented some possible analytic techniques: *pattern-matching*, *explanation-building*, and *time-series analysis*. In general, the analysis will rely on the theoretical propositions that led to the case study. If theoretical propositions are not present, then the researcher could consider developing a descriptive framework around which the case study is organized.

[Trochim](#) (1989) considered pattern-matching as one of the most desirable strategies for analysis. This technique compares an empirically based pattern with a predicted one. If the patterns match, the internal reliability of the study is enhanced. The actual comparison between the predicted and actual pattern might not have any quantitative criteria. The discretion of the researcher is therefore required for interpretations.

Explanation-building is considered a form of pattern-matching, in which the analysis of the case study is carried out by building an explanation of the case. This implies that it is most useful in explanatory case studies, but it is possible to use it for exploratory cases as well as part of a hypothesis-generating process. Explanation-building is an iterative process that begins with a theoretical statement, refines it, revises the proposition, and repeating this process from the beginning. This is known to be a technique that is fraught with problems for the investigator. One of those problems is a loss of focus, although keeping this in mind protects the investigator from those problems.

Time-series analysis is a well-known technique in experimental and quasi-experimental analysis. It is possible that a single dependent or independent variable could make this simpler than pattern-matching, but sometimes there are multiple changes in a variable, making starting and ending points unclear.

There are some things that the researcher must be careful to review to ensure that the analysis will be of high quality, including: showing that all relevant evidence was used, that all rival explanations were used, that the analysis addressed the most significant aspect of the case study, and that the researchers knowledge and experience are used to maximum advantage in the study.

Application of Recommended Procedure

The data analysis for the current case study follows the logical categories used in the Levy (1988) study, and was adapted from the categories developed by King and Kraemer (1985). The categories are:

1. Technological development
2. Structural arrangements
3. Socio-technical interface
4. Political economic environment, and
5. Benefits/problems.

Those categories were supported by the selection of indicators that were "functionally equivalent" items for each concept (King & Kraemer, 1985). Functional equivalence means that the same variable may be measured by a variety of different indicators, all of which have some bearing on the concept.

This researcher modified the Levy questionnaires to reflect current technology developments and items of interest to Fairfield University. All references to the University of Arizona were replaced by references to Fairfield University. Several items were added to gather data concerning the Internet and the WWW. A factor analysis was executed to determine if the current case population produced the same groupings as in the Levy study. Loehlin (1992) recommended an exploratory factor analysis for the type of data that was gathered in this study.

Some of the items added to the original instrument include:

- Current use / could use / would enhance future use

- o Internet resources (Gopher, FTP etc.)
- o World Wide Web (WWW) resources (Netscape, etc.)
- o Networked PC access from classroom
- The following contribute to the effectiveness of my work
  - o Access to the Internet, WWW, Email from the office, classroom, and home
- These developments could be important in five years
  - o Access to the Internet and WWW
  - o Access to networked CD's from classroom
  - o Ability to create class material for use on WWW
- High priority should be placed on the following
  - o More powerful network servers
  - o Microcomputer/Multimedia classrooms for instruction only
  - o More classrooms connected to the network
  - o Support for WWW/Multimedia course development
  - o More instructional software
  - o Ability to transfer large files with sound, images etc.
  - o Ability to scan and store documents on WWW for instruction
- Table adding up to one hundred percent
  - o Use of the Internet for: Instruction, Research, Professional Interest, Email, and Personal Interest/Surfing.

Aczel (1996) recommended cross tabulations to explore a hypothesis such as that relating to differences between faculty and administration within the King and Kraemer (1985) categories. The hypothesis was that there is no significant difference between the responses of the two groups of respondents with regard to the factors relating to the rate of technology acquisition. Cross tabulations were used to explore the differences in responses of the faculty by school. Cross tabulations and the chi- square were computed to determine if the differences that appeared among the sub groups of the university community such as faculty and administrators, were significant. A contingency coefficient for each cross tabulation indicated the strength of the relationship (Reynolds, 1977).

The Likert-type variables were analyzed using frequency distributions. The ordinal items in the questionnaires were analyzed using the mean and median. The results will be presented in subsequent article in this journal.

For those items in the questionnaires that are common to the Levy study (University of Arizona) and the current case organization (Fairfield University), a paired comparison of the sample populations was run. The statistical tests were the Cross tabulation and Chi square, so that inferences may be drawn about the comparison of the two very different institutions. Those inferences could lead to grounded theory regarding the aspects of information technology at universities of different sizes. The Chi-square was used to assess whether the differences that emerged were significant (Aczel, 1996).

All analyses were carried out using SPSSx version 7.1 on an IBM Pentium 75 megahertz PC compatible running Windows 95. These resources were available to the researcher at Fairfield University. The data capture was carried out on a DEC Vax 6430 using Accent R, creating a

database and screen driven programs. The researcher created the programs to validate the data as it was entered so as to minimize data entry errors.

There are hundreds of private colleges that are about the same size as Fairfield University. By applying the case study to this type of institution, the analytic generalizations could be informative to other similar institutions. The literature has pointed to increasing costs and declining revenues (Blumenstyk, 1994; Deitch, 1994; DeLoughry, 1994; DePalma, 1991; Evangelauf, 1992). Those are issues that many higher education institutions face.

Develop Conclusions, Recommendations, and Implications Based on the Evidence

Recommended Procedure

The reporting aspect of a case study is perhaps most important from the user perspective. It is the contact point between the user and the researcher. A well designed research project that is not well explained to the reader, will cause the research report to fall into disuse. In this section, the researcher must refrain from technical jargon and resort to clear explanations. Those explanations are necessary to help the user understand the implications of the findings.

Application of Recommended Procedure

The results of this study will be presented in a future article in this publication, and will include a detailed description of procedures and the results derived from the statistical tests. These results are presented not exclusively as statistical results, but with accompanying explanations of the meaning of those test results. In that way both the technical requirements and the informational needs are met.

Summary

The case study methodology has been subjected to scrutiny and criticism at various times since the 1930's. As a research tool, it has not been a choice that is listed in the major research texts in the social sciences. However, as this researcher has shown in this article and in the preceding article in this journal, case study is a reliable methodology when executed with due care. The literature, while not extensive, contains specific guidelines for researchers to follow in carrying out case studies. Yin and Stake have designed protocols for conducting the case study, which enhance the reliability and validity of the investigation.

The current study followed the design used by Levy (1988) in his case study of the impacts of information technology at the University of Arizona. The survey instruments used by Levy (1988) were modified for use at Fairfield University. The modifications included replacing "Fairfield University" for references to the "University of Arizona", deleting environmental references not appropriate for Fairfield University, and adding items to the instruments for the purpose of gathering data on the client/server computing, the Internet, and the World Wide Web.

Once the instruments were modified and the testing completed, the surveys were distributed to the full-time faculty and educational administrators. One week after the initial distribution, a reminder was sent to the groups so as to encourage participation.

The analysis followed conventional analytic techniques using statistical as well as anecdotal analysis. Differences between the responses of the administrators and faculty were explored using cross tabulations. These differences were examined within the categories described by King and Kraemer (1985) and adapted for use by Levy (1988) in a case study of the University of Arizona. For the Likert-type variables frequency distributions were used to analyze the data. For those items where the original Levy (1988) instruments and the current instruments were identical, a cross tabulation and chi-square were executed to examine the significance of the differences, if any, between the groups. All these tests were run at Fairfield University using SPSSX version 7.1 on an IBM Pentium 75 megahertz PC compatible running Windows 95.

The goals and objectives of the study were presented in the previous article by this author (Tellis, 1997). This article has presented the methodology that was used to conduct the current study. In a future edition of this journal, the results will be presented in accord with the goals and objectives of the study so as to confirm that what was proposed was in fact executed. The conclusions will also be presented in the subsequent article, and will once again follow the goals and objectives outlined in the introductory article and confirm that what was proposed was in fact accomplished.

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