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Using Action Research as a Viable Alternative for Graduate Theses and Dissertations in Construction Management

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Due to the nature of graduate education in construction management, applied research questions have been more typical than basic research questions. Action research, as distinct from traditional scientific approaches to research, is discussed here as a means to provide structure to the applied research being completed by graduate students in this discipline. This discussion includes an overview of action research principles, a review of a case study involving an action research project which developed a computerized schedule control system and led to a Master's thesis, and a summary of limitations and benefits associated with this approach. Given appropriate levels of control in the selection of research hypotheses, the development of the problem solution, and the application of objective evaluation criteria, many of the limitations associated with applied research can be minimized. This process is demonstrated with numerous practical examples.

Key Words: Applied Research, Action Research, Graduate Education, Construction Management, Schedule Control

Introduction

Historically, research in the field of construction management has involved more *applied research* questions as opposed to *basic research* questions (Mouton & Killingsworth, 1995; Rounds, 1991; Segner, 1990; and others). Authors have noted at least two reasons for this tendency toward applied research topics.

The first reason is the nature of the field itself. Construction management education is fundamentally professional education (Robson & Bashford, 1995). "Construction education is a relatively new academic discipline, created to fill the need for *professionals* [emphasis added] with the specific knowledge and abilities required to manage construction field, office and business operations" (Mouton & Killingsworth, 1995, 45). Education in a profession differs from education in other academic disciplines in that professions are primarily "practice based" rather than "knowledge based." Education of the professional doctor, for instance, is based largely on the study of "what worked" in the past and is grounded in years of practical experience in internship and residency programs. This is not to say that medicine is not firmly rooted in the underlying science of biology and anatomy; in fact, an outstanding background in this "knowledge base" is typically required as a prerequisite to advanced study of the "practice." Because of this professional practice, research in the field of medicine -- as well as the field of construction management -- tends to be applied in nature: it addresses real problems being experienced by practitioners in the field and seeks to provide effective and efficient methodologies to solve these problems. While basic research in the sciences that support these

professions is essential for formulating theory and identifying new directions to search for solutions to problems, it ultimately falls to applied research to improve the daily practices of the profession. The goal of applied research is to expand the understanding of "what worked."

The second reason that applied research questions dominate study in the field of construction management is the relative immaturity of the field. Construction management as an academic discipline distinct from design has its origins in the post war era and, in most parts of the country, much later than that (Rounds, 1992). Research questions in "young" disciplines tend to be very practical in nature owing to the need to solve the immediate problems the field of study was developed to address. Engineering disciplines in the early 20th century concentrated on studies of hydrology, improved surveying techniques, and the distribution of electrical power. It has only been in recent years that *basic* research has begun to dominate the various fields of engineering. After decades of addressing immediate problems, these disciplines have begun to search for overriding theories to explain the relationships which were observed. Schools of Business still depend strongly on applied research in management as evidenced by a heavy reliance on the review of case studies (Poorvu, 1992). Likewise, at this stage in the development of the construction management discipline, researchable problems tend to be *applied* in nature - involving the search for improved management practices, more effective field procedures, and new products. The practical nature of research in this discipline was recently reflected in the "National Construction Goals" established by the Construction and Building subcommittee of the National Science and Technology Council (Badger and Magnell, 1995). These goals were established to define priorities for federally supported research and development and addressed the need for reductions in delivery times, operation and energy costs, and waste and pollution. The goals also called for increases in productivity and comfort, durability and flexibility of completed facilities, and workforce safety. Frequently, this applied research involves the modification of tools, materials, and procedures from other disciplines for use in construction. The discovery of overriding "theories" in the traditional sense, to explain and predict observed phenomena, is rare in the field of construction management.

This lack of reliance on basic research in construction management leaves educators in graduate programs in this discipline with an interesting challenge. How can our graduate students be encouraged to solve the very real problems addressed through *applied research* while maintaining the high standards for objectivity, statistical analysis, and rigor traditionally associated with *basic research*? Without an appropriate structure, applied research runs the risk of drawing conclusions which are not tested, cannot be replicated, and cannot be applied to a broader population. These research projects are little more than "book reports" which simply tell the story of something the author has observed. Clearly, our standards for graduate level research must be higher. One possible approach to this dilemma may be to follow the guidelines of action research to provide a structure to graduate studies in applied topics. In the following sections, the action research methodology is reviewed and an example of a graduate thesis prepared under these guidelines is described.

Overview of Action Research

Action research is widely used in the investigation of human behavior and the social world. It emerged as a new approach to research which is more directly relevant to the ongoing work of practitioners. The purposes of action research are to enable systematic investigation and solution of problems experienced by practitioners and their clients, to examine the effectiveness of their work practices, and to take methodical action to resolve those problems (Stringer, 1996).

Action research is distinct from traditional scientific approaches to research. The emphasis of action research is to "improve" while the emphasis of traditional scientific approaches to research is to "prove." Traditional scientific approaches to research seek to test theories that purport to explain why or how the world is as it is. The ultimate aim is to derive lawful statements that explain the nature of the world or the nature of reality. Instead, the goal of action research is to assist people in extending their understanding of their situation and thus resolve problems that confront them (Stringer, 1996).

This investigative approach is not without its critics and potential weaknesses. The literature reveals that there is some argument about the legitimacy of action research. Some academic researchers consider that action research lacks scientific rigor because its internal and external validity is weak. Its objective is situational, its sample is restricted and unrepresentative, and it has little control over independent variables. Hence, its findings, while useful within the practical dimensions of the situation, do not directly contribute to the general body of knowledge (Isaac & Michael, 1981). Others have accepted action research, when properly conducted and controlled, as a legitimate form of inquiry. Stringer (1996) explored issues related to action research and concluded that action research can be a legitimate, authentic, and rigorous approach to inquiry.

The procedures of action research can be simple or very complex. Although several different terms are used to describe the procedures of action research, the basic process is the same. Isaac & Michael (1981) outlined the procedure as a simple three-step sequence (Figure 1)

Figure1: Action Research – Three step sequence.

The procedure starts with setting up objectives. In this stage, the following steps are performed:

1. Gather information.
2. Analyze and describe the situation.
3. Define the problems.
4. Decide what objectives are to be accomplished.
5. Formulate testable hypotheses.

The next step is to determine what means will be taken to accomplish these objectives. In other words, what are the particular things the investigator will do in an attempt to accomplish his or her objectives?

The last step is to establish evaluation criteria, measurement techniques, and other means of acquiring useful feedback. The attainment of objectives will be evaluated by these criteria to determine whether they have been accomplished. It is frequently beneficial to adopt a set of outside standards as the evaluation criteria rather than depending on a list of measures developed by the investigator or even the investigator's client. By adopting these outside standards of evaluation (e.g., ISO 9000 standards, OSHA safety goals, or even results attained in previous research), the level of objectivity is increased and the criteria for success and failure are taken out of the hands of the researcher.

Although the procedures of action research have been described here as a linear sequence, it is typically an iterative set of activities. It can be viewed as a spiraling process or, to use the language of quality management, it seeks "continuous improvement."

This methodology described for action research can be adapted easily to the five step process typically associated with graduate research (i.e., corresponding to the standard five chapters of a thesis or dissertation):

1. *Formulation of Research Questions and Hypotheses* - This is common to all types of research and corresponds to the first step of Isaac & Michael's outline ("objectives") presented above. The only difference in action research is the nature and origin of the questions themselves. In this approach applied to construction management research, the questions are extremely practical and may have immediate impact on just a small group or even a single client company. The origin of the questions is from the clients who are experiencing the problem, not from the investigators themselves. As with most other forms of formal investigation, testable hypotheses are still necessary to guide the development of appropriate methodologies.

2. *Review of Literature* - The goals for the literature review are the same for all forms of research: what are the conclusions of other investigators which led one to the current set of research questions and the proposed methodologies to answer the questions? The primary difference in action research is to include in this review possible applications from other disciplines or other industries which may address the research questions presented by the client(s).

3. *Description of the Methodology* - In traditional research, this phase (corresponding to the "means" step in Isaac & Michael's model) describes the research methods used to test each one of the hypotheses identified in the question formulation stage above. In action research, however, this phase takes on a higher level of significance. Frequently, the primary result of action research is the *development* of something: a new procedure, a training module, a computer software application, etc. This development process is, in essence, part of the methodology of the research. Therefore, the goals of the action researcher in describing the investigation are twofold: one, to describe the process used to develop the solution to the stated problem and, secondly, to describe the solution itself. For instance, if the solution to a client-identified cost accounting problem turned out to be the development of new software, the investigator is obligated to describe the process used to develop the software (meetings held, interviews conducted, failed attempts, etc.)

as well as to describe the final version of the software itself. As with any research approach, the goal of this description of methodology is to permit other investigators to replicate both the process *and the product* of the research.

4. *Evaluation of Results* - This corresponds to the "measures" step of Isaac & Michael's model and traditionally is intended to report the results from each of the methods described in the previous phase. In action research, this phase is critical because this is where the investigator applies the evaluation criteria to test whether the solution developed to address the original problem as defined by the client actually worked. The fundamental test of the success of action research is to measure the effectiveness of the solution against a pre-defined set of criteria (preferably external). Without this evaluation step, all that was accomplished was product or process development; there was no research of testable hypotheses. While this objective evaluation of the effectiveness of the solution is critical, it is the lack of or poor quality of this process which leads some authors to question the legitimacy of action research.

5. *Conclusions and Recommendations* - This step is consistent for nearly all approaches to research. Conclusions about the importance or effectiveness of what was discovered are stated and directions for further areas of research are identified. In action research, a report of failure to solve the client-defined problem is typically accompanied by a listing of other possible solutions which were not included as part of the original research and which could be addressed in later studies.

In the following section, these research steps as they apply to action research are demonstrated through a review of the research conducted by a construction management Master's student.

Case Study of Action Research

Research was conducted in 1996-1997 by Chen (1997) which followed the basic procedures outlined for action research. The primary goal of this research was to address a company-specific problem identified by a regional office of a large national homebuilder. As is typical for action research, this problem was practical in nature, external to the investigator, and, while immediately applicable to the client in question, had potential for impact on a broader segment of the industry. The research proceeded as described in the following sections.

Formulation of Research Questions and Hypotheses

The idea for this research project originated in a required graduate course in Advanced Construction Management. Rather than a term paper based primarily on library research, students were asked to apply research methodology to actual, practical problems as identified by members of the Industry Advisory Committee. The response of committee members was solicited by the instructor of the course before the semester began (see Appendix). An executive with the regional office of a major national homebuilder asked, among other things, "Is centralized critical path scheduling feasible for a large homebuilding company?" This broad original question started an investigation of the problem to identify and narrow the scope of the

study. This homebuilder was constructing up to 200 homes at a time in fourteen ongoing subdivisions. Each home had about 80 identifiable activities which were being completed by about 16 subcontractors on each house. Some of these subcontractors were involved with many of the homes under construction and some were unique to individual houses.

An existing centralized scheduling system was updated in the main office based on weekly reports from field superintendents. This centralized schedule was developed using an Excel spreadsheet with critical activities identified beforehand using past experience rather that actual job performance. Predictions of completion dates assumed that noncritical activities would never be delayed enough to become critical activities. A simple linear logic relationship was used to calculate the finish dates of activities and individual projects. Average delays of critical activities were used to calculate "productivity ratings" for each project. In addition to numerous homes missing scheduled move-in dates, the following characteristics were noted as disadvantages of the existing scheduling system:

1. the current schedule control system was a time consuming process which could not respond quickly to changes in the field.
2. the current system could not accurately reflect actual project conditions.
3. the current system could not be used efficiently to predict resource requirements and resource allocation.
4. the current system could not evaluate and analyze schedule delays across the multiple projects. (Chen, 1997)

Following an initial meeting attended by key company personnel at which these problems were identified and discussed, this company requested that the researcher design and build a model schedule control system which would address the problems outlined above. It was determined that a demonstration model using just three homes would be developed to meet the initial requirements for this course and that the full model, capable of schedule and resource control for up to 200 homes at once, would be developed as part of the required thesis research.

All that remained in the first phase of this research was to specify a testable hypothesis which would guide the formulation of appropriate methodologies and provide the criteria for evaluation of the results. Based on these needs and the statement of problem, the hypothesis for this study became, "A model schedule control system for multiple projects using the same resources or overlapping resources can be developed which is perceived to be more effective and efficient and communicate better than the current system being used" (Chen, 1997, 7).

Description of the Methodology

As outlined above, the purpose of the description of methodology in action research is twofold: 1) to describe the process used to develop the solution to the stated problem and 2) to describe the solution itself.

In order to fully describe the process used, the researcher in this sample case recounted the investigation of the original problem, the selection of the scheduling software, and the selection of a model to describe the relationships among components of the schedule control system. The

initial problem investigation described the process of eight meetings or interviews held with different field supervisors and senior management personnel. In addition, the current schedule updating process was observed and all existing schedule update reports were obtained and reviewed. Numerous options for scheduling software were reviewed and considered. In the final analysis, the capacity to handle large numbers of activities was the main determinant for software selection. An estimated 16,000 to 20,000 activities would need to be scheduled for this study. Only Primavera Project Planner provided this capacity as well as 24 activity codes, 19 levels of sort, and 28 levels of selection criteria. Finally, a relatively simple model was developed to demonstrate the relationship between the master project schedule (containing all activities on all ongoing projects) and the subproject schedules (containing all activities for each house). While the model showed no external logic relationship between subprojects (houses), their inclusion in the master project schedule permitted the viewing of resource distribution across all projects and the analysis of the effects of changes on one project on all other projects. This model, and the defined use of numerous activity codes, would allow the master project planner in the regional office to produce a wide variety of standard and custom reports on a specific project, on several projects, or for the entire region. These reports could be produced by subcontractor, by subdivision, or by superintendent.

The remainder of the description of the methodology was a review of the software application developed to address the schedule control problems noted by the client. First, a master project was developed utilizing a standard project calendar, assigning values for four different activity codes to each activity, and assigning resources to each activity. This coding allowed for the various types of reports which would be possible when each of the individual subproject schedules were combined into one master project schedule. Secondly, a number of standard subproject schedules were developed to encompass each of the home styles currently under construction. At this stage, the durations and logic relationships were added for each of the activities following interviews with the project planner, director of construction, and superintendents. The resulting network diagrams were reviewed and modified according to their comments. Next, schedules for each of the projects under construction or currently under contract were created from one of the standard schedules and combined into a master project schedule representing all of the ongoing work of this regional office. Initially, a series of seven standard reports were developed which were intended to provide the senior project planner, the superintendents, and each of the subcontractors with the planning information they would need to better manage their responsibilities. Finally, a complete copy of the original schedule was created to serve as a “target plan”. As the projects progressed, the target plan could be used as a benchmark or baseline for comparing target dates, resources, and costs to those of the current schedule. At this point, the newly developed scheduling system was presented and demonstrated to the senior project planner and other management personnel for their evaluation of the final product as described in the next section.

Evaluation of Results

As stated above, this is a critical phase for action research projects because this is where the investigator applies the evaluation criteria to test the original hypotheses. In the case of this sample research study, the original hypothesis was that “a model schedule control system for multiple projects using the same resources or overlapping resources can be developed which is

perceived to be more effective and efficient and communicate better that the current system being used". This provided the basis for the evaluation criteria to be used in this case. For evaluation purposes, this hypothesis was divided into three sub-hypotheses:

1. The model schedule control system would be perceived to be more *effective* than the current system.
2. The model schedule control system would be perceived to be more *efficient* than the current system.
3. The model schedule control system would be perceived to provide *better communication* than the current system. (Chen, 1997, 44)

The researcher developed a questionnaire designed to test these sub-hypotheses which was completed by the management personnel who reviewed the demonstration of the new schedule control system. This evaluation instrument was divided into four parts. The first part contained 11 statements requiring a Likert type response designed to evaluate the *effectiveness* of the new system - defined as the ability to do more things and to do them better than the current scheduling system. The second part of the instrument included questions designed to evaluate the *efficiency* of the new system - defined as the ability to do the same job in less time and at less cost. These questions asked respondents to compare how long it would take to update and print out the weekly reports using the current system and the new schedule control system. They also asked for an estimate of the number of contracts lost during the past year due to houses delivered later than projected and how much of a penalty the company would pay the homeowner for each day a project was delivered behind schedule. This data would later be used to complete a cost-benefit analysis for the adoption of the new system. The third part of the instrument contained three statements designed to evaluate the communication improvements which might result from adopting the new system. The final part of the evaluation instrument contained an open ended question asking the respondents to list other perceived advantages and disadvantages associated with this new system.

The results from this evaluation instrument were described next. Prior to starting the evaluation process, a mean score of "4" or better on a five-point Likert scale was accepted to indicate support for each of the sub-hypotheses because a "4" was defined as "agree" in this study. The hypothesis related to *effectiveness* was well supported with a mean score of 4.485 for all respondents. Ten out of eleven statements were supported at or above the cut-off level. The hypothesis related to *efficiency* was evaluated through the use of a cost-benefit analysis. All costs associated with adopting the new schedule control system were estimated at $19,100. Benefits included time saved in preparing weekly reports and money saved from not losing contracts due to late delivery and not having to pay discounts due to late deliveries. The value of these benefits were estimated at $6417 per month. This resulted in a payback period of approximately three months which was taken as support for this hypothesis. The final hypothesis, related to *better communication*, was well supported with a mean score of 4.667 for all respondents. Three types of communication were evaluated: communication between the main office and the superintendents, communication between the superintendents and the subcontractors, and communication between the scheduling department and senior management. These results were summarized in the next section as described below.

Conclusions and Recommendations

The final section of this research report 1) summarized the research questions and hypotheses, 2) reviewed the methodology used to address the problem statement poised by the client and the outcome of this process, and 3) restated the results attained from the evaluation instrument. It was concluded from this evaluation process that support for each of the original hypotheses was demonstrated through the development and testing of this new centralized schedule control system. This computerized control system was the way in which the researcher addressed the client-defined problem and -- through the application of predefined evaluation criteria -- he was able to demonstrate the level of success in solving this problem. This conclusion reflects the "basics" of the action research process: 1) determine the *objectives* by listening to and investigating the problem(s) identified by the client, 2) develop a *means* (a tool or procedure) designed to address each problem, and 3) define and apply a set of *measures* or evaluation criteria to determine the level of success in solving the original problem (Isaac & Michael, 1981).

Finally, the researcher reviewed recommendations for future study. Due the applied nature of this study, these recommendations were related to the "next steps" required to benefit from the development of this schedule control system. Accordingly, these suggestions primarily were aimed at "implementation" problems. For example, it would be left to other investigators, or perhaps the management personnel themselves, to fully develop a standardized reporting system which would recognize current communication channels and the need for information among the individuals and departments related to the scheduling and control functions. Also, since this system was developed in an non-networked environment, other implementation options could be investigated if and when this homebuilder linked all field offices with the home office through the use of a networked computer system (Chen, 1997). These additional areas of study were beyond the scope of this original research but provided a foundation upon which other students could build a graduate research project.

Discussion

At the beginning of this decade, Ernest Boyer (1990) prepared a landmark text for The Carnegie Foundation for the Advancement of Teaching in which he attempted to redefine the traditional University view of "scholarship". Boyer contended that University scholarship consists of four components:

1. discovery - creating new knowledge
2. integration - synthesizing and interpreting knowledge
3. application - applying and disseminating knowledge
4. teaching - educating and motivating future scholars and practitioners

Boyer advocated that a healthy balance among all four types of scholarship is necessary; recognizing that the needs of different disciplines -- as well as different faculty at various times in their careers -- dictate varying emphasis on and reward for each type of scholarship.

Due to the nature of construction management education being primarily professional education -- and due to the relative immaturity of research in this field -- there is a need for a heavy emphasis on *applied* research in this discipline as opposed to *basic* research. However, there are some inherent difficulties associated with applied research such as a lack of scientific rigor, the inability to replicate the procedures, the challenge of application of the results to a wider population, and the lack of dissemination due to concerns about proprietary information. To build a successful program of research in construction management, which is truly meaningful to the industry being served, these problems associated with applied research must be overcome. To do this, a formal structure must be developed which would allow for the investigation of applied research questions while maintaining a high level of academic rigor and permitting the application of results to a wider audience. It is proposed here that the principles of action research provide one example of this structure.

However, action research has some pitfalls of its own which must be addressed whenever possible in the design of the research study (Stringer, 1996). First of all, these studies typically involve small sample sizes which may make the tools associated with statistical significance testing practically useless. While this problem may be unsolvable in many research designs, every effort should be made to increase sample size whenever possible. Secondly, extreme care should be exercised in the selection of the evaluation criteria. This is a critical step in successful action research and, whenever possible, it is best to find an "outside source" for these criteria. These outside sources might include standards from agencies or professional associations or recommendations from other published research. It is the value of these evaluation criteria which ultimately is the key to rigor and objectivity in the research study. Thirdly, since problems are defined not by the investigator but by an outside "client" for whom this study is not always a top priority, there is an inherent lack of control on the part of the researcher. There is a tendency for research questions to "drift" and a difficulty in simply arranging meetings and interviews with the appropriate parties. This problem can be addressed by establishing early in the process that this is not just about the development of a useful tool, it is also research which must demonstrate the usefulness of the tool. In the final analysis, the inability to control all the variables is the nature -- and the benefit -- of applied research. Finally, due to the practicality of the results, it is sometimes difficult to identify the "stopping point" for the research. For example, in the case study described above, the client may have reviewed the suggestions for further research and insist that the investigator continue with the implementation of the system he developed. This is why the research questions and the testable hypotheses must be well defined in the first step of the study. This defines the "scope of the work" and helps to identify the endpoint of the research (as well as provide future opportunities to other graduate students!).

One of the benefits of action research, as well as other approaches to applied research, is the opportunity it provides graduate students to "connect" with the problems they will be asked to solve as managers of construction companies. These graduate students will be hired by companies not to be just another project manager or estimator, but to be effective problem solvers who can identify the "real" problems and develop tested solutions rather than simply depend on past practices. The Construction Management program at Colorado State University is in the process of institutionalizing this part of the graduate students' education through the establishment of the Construction Management Applied Research Center (CMARC). This Center is intended to become a clearinghouse for applied, company specific problems that will be

addressed by teams of graduate research assistants and faculty. Some of these research questions -- which are originated by industry "clients" -- will become the basis for graduate theses and dissertations applying the guidelines of action research. The primary mission of the Center is to help solve the pragmatic problems facing the industry while demonstrating to graduate students the practical applications of research methodology.

Frequently, graduate students in construction management fail to see the relevance of research methodology to their future careers in the field. Education in research methods is something they endure so they can get through their theses and return to the challenge of managing companies. As graduate educators, one of the skill sets we should be providing graduate students is the ability to apply the techniques associated with academic research to the demands of the "real world". Because of the implied practicality of action research -- as well as its insistence on academic rigor and objectivity -- this is a tool that can be applied after graduate studies are finished. Too often in the "real world", untested solutions are adopted to solve ill-defined problems with disastrous results. It will be the responsibility of these graduate students to apply the practical tools of action research to avoid this outcome.

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Appendix

Sample Letter to Acquire Action Research Problems

July 19, 1996

RE: Problem Identification for Students in Advanced Construction Management

Dear Sir:

I am teaching the graduate course IS560 - Advanced Construction Management - in the Fall semester starting August 19. As this is the first time I am teaching this course, I am making several modifications to the course objectives. In addition to dealing with such topics as corporate organization, risk analysis, and project planning and execution, one of the objectives of this course will be **to demonstrate the practical use of research methodology to applied industry problems**. Each student will be asked to identify a researchable problem or question being faced by a local company and develop a reasoned analysis and solution to that problem. To that end, I am asking each of the members of the Advisory Committee to help in identifying actual problems being faced by your company or the industry for use as class assignments.

My plan is to have each student select one of these problems and apply the steps of standard research methodology - 1) problem identification, 2) hypotheses formation, 3) methods selection, 4) data collection, and 5) conclusions - to the solution of the problem. I hope the benefits will be twofold: first of all, you will be provided some "free" research time to investigate a problem you don't have time to look into yourself and, secondly, the students hopefully will see some applications of the dry, "academic" research methods to the realistic problems they will soon be asked to deal with as they continue their careers after school. Whether investigating questions of why one region is experiencing a lower Modification Rate than other regions or what are the market opportunities in the Pacific Northwest, these students must develop an objective, structured approach to problem solving.

Please keep in mind that this will be just a one semester assignment in addition to other course requirements and that the students will have varying levels of industry experience from limited to extensive. I do anticipate that some of these problems may be expanded into fuller research topics for the students' required theses. This is the same methodology they will use to develop their Master's theses and my goal for them is to select practical, applied topics. Your input will help focus their efforts.

If you have any questions about what I'm trying to accomplish, please don't hesitate to call me to discuss ideas. If you are already thinking of some possible problem areas, please jot them down and fax or send them to me at the above address. I look forward to working with you this fall as the graduate students help investigate these problems. Thank you for your continuing support of the Construction Management program.

Sincerely