Cycles of Research

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ABSTRACT

Research is an essential component of academic life. As a result, in addition to performing research on discipline specific subjects, the processes by which we conduct research is an area of significant interest. Researchers focused on the built environment have displayed an increasing interest in methodological research issues. Recently there have been special issues and plenary sessions that have explored these issues.

Scholars in the field have suggested that this indicates an increasing maturity in the field and the emergence of foundational theory. However, there is little evidence of the emergence of an underlying theory in project organizations. In fact, there is more evidence of a broadening of the field and tension in approaches to research.

This paper suggests a context that is inclusive of all ideas, theories and methodologies. It builds on a view of research as an iterative process that focuses on the development and testing of descriptive and normative theory. This cycle of theory development welcomes all questions and approaches. In addition, it suggests a trajectory that can unify diverse research streams.

Lastly, it examines the research published in the last seven years from the EPOC proceedings and classifies these papers according to context, technique and outcome. An analysis of these findings suggests that more effort needs to be placed on developing a trajectory that moves towards improving practice.

KEYWORDS

Research

INTRODUCTION

Research is an essential component of academic life. As a result, in addition to performing research on discipline specific subjects, the processes by which we conduct research is an area of significant interest. Researchers focused on the built environment have displayed an increasing interest in methodological research issues. The Journal of Construction Engineering and Management produced a special issue on “Research Methodologies in Construction Engineering and Management” (Taylor and Jaselskis, 2010). The Engineering Project Organization Society sponsored a Plenary session on innovative research methods at the 2016 EPOC.

Scholars in the field have suggested that this indicates an increasing maturity in the field where “… research into research…signifies that an underlying theory about the discipline is starting to evolve. (Betts and Lansley, 1993, p.222). However, there is little evidence of the emergence of an underlying theory. In fact, there is more evidence of a broadening of the field and tension in approaches to research. (Seymour et al, 1997; Chau et al, 1998; Harty and Dainty, 2016)
This paper suggests an alternative context that is inclusive of all ideas, theories and methodologies. It builds on a view of research as an iterative process that focuses on the development and testing of descriptive and normative theory. (Carlile and Christenson, 2005; Puddicombe and Johnson, 2011). This cycle of theory development welcomes all questions and approaches. In addition, it suggests a trajectory that can unify diverse research streams.

The paper first reviews the current state of research on research within this community. It then introduces the cycle of theory development and suggests how this approach which focuses on the macro intent (Descriptive or Normative) can synthesize competing’ research regimes. The paper then analyzes the papers that have been presented at previous EPO conferences and organizes them both in terms of methodological approach and macro intent. Lastly it examines several major research streams and suggests how this approach could describe linkages and offer guidance to future research.

RESEARCH ON RESEARCH

Seymour, Crook & Rooke, (1997) called for a debate on the theoretical basis for construction management research and by extension the methodologies used to conduct that research. They argued that the ‘rationalist paradigm’ limited the focus as well as the methodologies of research. In its place they suggested alternative ‘interpretative methods’ that would be employed to ‘make sense of the world’. Chau, Raferty & Walker (1998) argued that this interpretive approach narrowed the scope of research by limiting the methods employed. They argue for methodological pluralism, that the research approach should be dependent on the nature of the problem.

The JCEM (2010) special issue would seem to imply that methodological pluralism has won out. While their review of papers published from 1993-2007 indicate a dominance for the ‘rationalist paradigm’ the papers published within the issue were balanced between qualitative and quantitative approaches. In addition, there were three papers that were ‘cross cutting’ in their approach.

Since the publication of special issue there have been a number of calls to move away from a rationalist paradigm. Monson etal (2016) argue “that new research strategies are necessary to investigate the complex collaborative environments and work practices of integrated AEC teams.’ Hartman and Dewulf (2011) call into question the appropriateness of a pluralistic approach. They argue that the positivist approach ‘diminishes the practicality and legitimacy’ of much CM research. Harty and Dainty (2016) go further and question whether this approach has ‘has even had significant effects on the cost and quality of the built environment’. They call for a foundational change in the locus on built environment research, away from efficiency of the delivery process and towards a view of built environment as the ‘centre of societal interaction’ they advocate for a sociological imagination that calls for a radical reconceptualization of research. Quoting Mills they argue:

- ‘Be a good craftsman…avoid the fetishism of method and technique.’
- ‘Stand for the primacy of the individual scholar, stand opposed to the ascendency of research teams of technicians.'
• ‘Do not give up your moral and political autonomy by accepting in somebody else’s terms the illiberal practicality of the bureaucratic ethos, or the liberal practically of the moral scatter.’

• ‘Know that the problems of social science, when adequately formulated, must include both troubles and issues, both biography and history’

An important point that emerges from the discussion of research is the relationship between research question and research method. It appears that Seymour et al and Harty & Dainty see a linkage between question and method that goes beyond the efficacy of the method. This is in contrast to Chau et al (1998) who note the research approach should be based on the question asked and the context of the research. This division becomes increasingly important when one considers the totality of the built environment. The 2014 EPOC plenary session drew on a distinguished panel of scholars to synthesize a vision statement focusing on the Grand Challenges in Engineering Project Organization (Taylor et al, 2014). Figure 1 presents a consolidated view of the breadth of issues identified that relate to both practice and research.

The Grand Challenge framework suggests that no single approach to research can address all the Grand Challenges. In the next section we introduce a model that is agnostic to the research method and directs us to examine the macro intent of the research. Classifying research by intent creates an understanding of the trajectory of and linkages between research. As a byproduct it has the potential to inform our

Figure 1: Grand Challenges
understanding of the efficacy of various methodological regimes as they relate to the intent of the research.

CYCLES OF THEORY DEVELOPMENT

Carlile and Christensen (2005) divide research into two broad categories. The first category, which is focused on increasing knowledge, encompasses descriptive research. The second category, which focuses on improving practice, encompasses normative research. Descriptive research provides the foundation for normative research. One does not advance without the other. The crucial vehicle to advance research in both these domains is both the development of and testing of theories.

“To do this well, we need to design our research so that it provides an intimate understanding of the practical problems facing the profession. Equally important, we need to appreciate and strengthen our skills in developing good theory so that research conducted about these problems will advance the knowledge that is relevant to both the discipline and the profession. Lewin’s (1945) statement that ‘nothing is so practical as a good theory’ captures a theme that is as important today as it was in Lewin’s time. Good theory is practical precisely because it advances knowledge in a scientific discipline, guides research towards crucial questions, and enlightens the profession of management” (Van de Ven, 1989, p. 486)

This catholic view of theory drives the model. Theory is relevant to both the (academic) discipline and the profession, the knowledge is both intimate and practical. Research can focus on either descriptive or a normative outcome and the approach taken should reflect the efficacy of an approach to an outcome

In the Carlile and Christensen model theory building is seen as constantly iterating between three steps: Observation, Classification, and Definition. Theory that is built from observation is what Popper (1965) refers to as empirical theory and Glaser and Strauss (1967) refer to it as grounded theory. As observation progresses, researchers can begin to develop constructs. These constructs are ‘abstractions that help us rise above the messy detail to understand the essence of what phenomena are and how they operate” (Carlile and Christensen, 2005 p.3). Descriptive research progresses to normative research and an iterative process of theory building can begin. In Figure 2 this process is shown.
It is important to emphasize the difference between this model and others such as the 5-point classification of research (Insights, Model Fitting, Model Building, System Building, Theory Building) proposed by Betts and Lansley (1993). Seymour et al. (1997) argue that the 5-point classification produces a ‘hierarchy of contribution to the discipline’ and limits theory development to a single stage. In contrast, the Cycle Model recognizes and values the process of theory development and testing in all context.

**APPLICATIONS OF CYCLES**

Puddicombe and Johnson (2011) described a broad perspective on a research stream that serves as an example of how the cycles model could be applied to construction management. A recap of that discussion follows. Within the built environment it has been observed that a significant number of projects result in litigation. Two major constructs have developed to describe the parties’ propensity to litigate: are they collaborative or adversarial. Case studies have explored issues related to litigation and provide important validation for the constructs and aid in further theory development. Building on these observations researchers can now begin to classify the phenomena. In the early stages of theory development, the attributes of the phenomena will define the classifications. The primary litigants are often the constructor and the owner. Classifications of the constructors would include General Contractors, Construction Managers, and Design Builders. Owners could be classified in terms of whether they are private or public and whether or not they are the end user. These classifications help us to generalize and rise above the specificity that is an artifact of case studies.

The latter stage involves the definition of correlations between constructs and classification systems. These are the models of association. A theory may propose that **General Contractors are more adversarial (or less collaborative) than Construction Managers.** Growing from this an additional theory that - **General**
Contractors have a greater propensity to resort to litigation than Construction Managers - could be proposed.

These theories have several important characteristics. The first is that they lend themselves to falsification, which is a key consideration for the development of scientific theories (Popper, 1965). They can be tested using techniques such as correlation or regression analysis. The second is that it can begin a cycle of iteration that develops a more complete description of the phenomena. If the theory is not supported (technically we cannot reject the null hypothesis that there is no association between General Contractors and adversarial positions) the research could begin a new cycle of studies to further clarify the phenomena via additional constructs or classifications.

The initial theory was developed by the inductive method but as the researcher cycles back down to develop new constructs the researcher can apply deductive reasoning to predict what the outcomes of further studies should be. This deductive reasoning often focuses on identifying anomalies that explain why the initial theory did not hold. These anomalies modify the old theory and allow a new inductive process that produces richer theories that again are subject to scientific validation. In the research stream the researcher may deduce that the nature of the project is an important factor. The researcher may look for evidence of this in others case studies and develop a new set of attributes and a model that theorizes that **General Contractors will be more adversarial than Construction Managers on complex projects and therefore more prone to litigation.** This new model is much richer due to the fact that it describes limitations.

When a descriptive theory is supported it is important to recognize that we are speaking only about the average outcome. A specific owner of a specific project cannot know that hiring a Construction Manager will lead to a more collaborative relationship. “The ability to know what actions will lead to desired results for a specific company in a specific situation awaits the development of normative theory…” (Carlile and Christensen, 2006: 4) focusing on that specific situation.

The primary ingredient in the movement from descriptive to normative theory is the addition of causality. The researcher needs to theorize why general contractors will be more adversarial and therefore litigious than construction managers on complex projects. In developing normative theories causality needs to be supported by a logical deductive process. The strength of theory is tied to the strength of the logic as well as the empirical evidence. The strength of the logic is enhanced by the use of reference disciplines.

In developing a statement of causality relative to construction and litigation the researcher would have recognized, as part of the development of descriptive theory, that the actors are joined by contracts. The major reference disciplines that deal with contracts are law and economics and these research streams offer a significant body of work that the construction management researcher can build on. Macneil’s (1974) work on relational contract law and Williamson’s (1985) work on transaction cost economics lay out highly developed causal theories that could be applied to the descriptive theory. Based on this work a researcher could argue that **General**
Contractors will be more adversarial and litigious than Construction Managers on complex projects because of increased asset specificity.

From this broad theoretical statement, the researcher will need to develop specific falsifiable hypotheses. The development of testable hypotheses requires that the researcher cycle to the observation step of normative theory. Here the researcher will begin to develop constructs that describe how to measure the phenomena. The researcher must operationalize, in the context of the construction industry, the concepts that have been laid out in the theory. The researcher would need to quantify complexity, adversarial and collaborative tendencies, and asset specificity. The validity and reliability of the research rest on this foundation. From a practical perspective this can be an extremely challenging step.

Assuming that the theory and its hypotheses have been successfully operationalized the researcher can now begin to test the theory via efforts to falsify the hypotheses. In this process it is highly likely that anomalies will be uncovered. The theory may be brought into question if the hypothesis is rejected (not statistically significant) or there is low practical significance (statistically significant with a very low R²). The researcher can engage in another round of deductive reasoning and resort to other reference discipline or revisit the categorization stage. Assuming that the initial logic still stands up to scrutiny and that the operationalization of the constructs was successful, categorization is the preferred alternative. Here we will be looking to categorize the circumstances as opposed to the phenomena. This is reflective of the goal of normative theory in that we wish to understand what actions will lead to what results in what circumstances. The reality is that few theories will apply in all circumstances.

In categorizing the circumstances that could affect this theory we can again gain insight by reverting to the descriptive stage. In our categorization of the phenomena it was noted that owners could be either public or private. Given that public projects often operate under a different set of rules than private projects owner type could explain some of the anomalies observed in our attempt to develop normative theory. Our theory could now be modified to state: General contractors will be more adversarial and litigious than construction managers on complex, publicly funded projects, because of increased asset specificity associated with the general contractor’s involvement with the project. This theory would then be the basis for further hypothesis testing.

If the theory is supported, we would have the beginning of normative theory and could begin to improve the practice of construction management. However, this would not be the end of the process. If owner type was seen to be significant a new process of descriptive theory building around this construct would need to begin. In addition, descriptive theory focused on the litigation process and its outcomes would need to be initiated.

CURRENT RESEARCH

The research described here falls within the domain of Descriptive Theory development. The overarching research issue involves understanding descriptive and normative research in the built environment. Addressing this issue in total is beyond the pale of a single research project. However, I can address some specific questions given that I have a convenience sample of built environment research: The EPOC
proceedings from 2010-2016. While I could conduct an intensive analysis of all the research I am choosing to take a less intimate approach and will quantitatively address the context, the technique and the outcome of the research. My choice of a quantitative methods is a function of the efficacy of this approach as well as my experience and expertise. The efficacy is function of both my personal context and the specific questions I am asking.

In planning this research I had originally intended to use the classification scheme from the JCEM (2010) special issue, however as I reviewed the articles it became evident that this was trying to fit a square peg into a round hole. My classification therefore evolved as I interacted with data. The context of the research refers to the type of contact that occurred between the researcher and the subject. In cases where there were multiple contexts that approach which was dominate was coded.

- Archival research referred to situations where secondary resources were the primary source of data.
- Case research referred to situations where the data source was direct or participant observation (Yin, 1989)
- Experimental research includes both experimental and quasi experimental designs (Campbell and Stanley, 1963)
- Interview research included both structured and unstructured discussion with the actors
- Literature referred to work that synthesized the literature for themes and ideas.
- Survey research referred to written responses from the actors and included both structured and opened ended questions.
- Model research referred to any quantitative approach that employed or attempted to develop a mathematical representation of the phenomena of interest.

Technique was broadly classified as qualitative or quantitative. Quantitative was limited to mathematical and statistical approaches. Qualitative included all other approaches, including simple descriptive classification as well structured qualitative approaches such as qualitative comparative analysis (QCA).

Outcome was classified based upon the goal of the research. Research was coded as normative if it explicitly sought to identify improvements in practice, performance was often a keyword. It was coded as descriptive if it sought to bring a greater understanding of the phenomena without regard to performance. Research was coded theory if the purpose of the research was to develop new propositions and theories for future research.

The research attempted to answer three questions:

- What is the quantity of contexts, techniques and outcomes on a yearly basis?
- Have the quantities changed over time, is there a trend?
- What is the relationship between context, technique and outcome?

**RESULTS**

Table 1 shows the quantities for each variable broken down by year. Case research (89) is the most frequently encountered context, followed by Literature (45), Survey (38),
Archival (30), Experiment (26), Interview (26) and Model (12). In Figure 3 it can be seen that with the exception of the decline in model research there are no trends in research context.

Table 1 also shows that qualitative research (162) has been the preferred approach over quantitative (104). Figure 4 shows that there is no trend in technique.

Table 1 shows descriptive research (144) dominating normative (93) and theory (27) as the outcome. Figure 5 shows there is no trend in output.

Table 1: Consolidated Results

<table>
<thead>
<tr>
<th>Year</th>
<th>Archival</th>
<th>Case</th>
<th>Experiment</th>
<th>Interview</th>
<th>Literature</th>
<th>Survey</th>
<th>Model</th>
<th>Qualitative</th>
<th>Quantitative</th>
<th>Descriptive</th>
<th>Normative</th>
<th>Theory</th>
</tr>
</thead>
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<tr>
<td>2010</td>
<td>9</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>6</td>
<td>2</td>
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<td>21</td>
<td>11</td>
<td>18</td>
<td>18</td>
<td>13</td>
</tr>
<tr>
<td>2011</td>
<td>4</td>
<td>7</td>
<td>5</td>
<td>4</td>
<td>2</td>
<td>5</td>
<td>2</td>
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<td>2</td>
</tr>
<tr>
<td>2012</td>
<td>2</td>
<td>16</td>
<td>5</td>
<td>2</td>
<td>14</td>
<td>8</td>
<td>3</td>
<td>19</td>
<td>19</td>
<td>27</td>
<td>18</td>
<td>9</td>
</tr>
<tr>
<td>2013</td>
<td>5</td>
<td>20</td>
<td>4</td>
<td>2</td>
<td>6</td>
<td>7</td>
<td>1</td>
<td>29</td>
<td>16</td>
<td>29</td>
<td>13</td>
<td>3</td>
</tr>
<tr>
<td>2014</td>
<td>3</td>
<td>14</td>
<td>5</td>
<td>2</td>
<td>4</td>
<td>2</td>
<td>1</td>
<td>19</td>
<td>12</td>
<td>21</td>
<td>7</td>
<td>3</td>
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<tr>
<td>2015</td>
<td>3</td>
<td>14</td>
<td>1</td>
<td>8</td>
<td>7</td>
<td>8</td>
<td>1</td>
<td>23</td>
<td>19</td>
<td>21</td>
<td>15</td>
<td>4</td>
</tr>
<tr>
<td>2016</td>
<td>4</td>
<td>13</td>
<td>4</td>
<td>4</td>
<td>6</td>
<td>6</td>
<td>0</td>
<td>21</td>
<td>16</td>
<td>21</td>
<td>13</td>
<td>3</td>
</tr>
</tbody>
</table>

| 2010 | 30       | 89   | 26         | 26        | 45         | 38     | 12    | 162         | 104          | 144         | 93       | 27     |

Figure 3: Context Percentage per Year
Tables 2, 3 and 4 compare the cross tabulation between context, technique and outcome. In the tables the first number shows the observed frequency and the second shows the expected frequency from chance. For example, in comparing cases and qualitative research (qual) 76 occurrence were observed and 54.7 would be expected by chance. Pearson $\chi^2$ is employed to determine if there is a statistically significant relationship between the variables.
- Table 2 shows a significant relationship \((p<.000)\) between the context and the technique employed to analyze the data.
- Table 3 shows a significant relationship \((p<.000)\) between the context and the outcome associated with the analysis.
- Table 4 shows a significant relationship \((p<.000)\) between the technique employed to analyze the data and the outcome.

Table 2: Context and Technique

<table>
<thead>
<tr>
<th>Context</th>
<th>Tech</th>
<th>Qual</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Quant</td>
<td>Qual</td>
<td></td>
</tr>
<tr>
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<td>case</td>
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<td>76</td>
<td>90</td>
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<td></td>
<td>35.3</td>
<td>54.7</td>
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<tr>
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<td>18</td>
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<td>27</td>
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<tr>
<td></td>
<td>10.6</td>
<td>16.4</td>
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</tr>
<tr>
<td>interview</td>
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<td>26</td>
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<td></td>
<td>10.2</td>
<td>15.8</td>
<td>26.0</td>
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<td>literature</td>
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<td>37</td>
<td>44</td>
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<tr>
<td></td>
<td>17.2</td>
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<tr>
<td>model</td>
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<td>13</td>
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<tr>
<td></td>
<td>5.1</td>
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<tr>
<td>survey</td>
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<tr>
<td></td>
<td>14.9</td>
<td>23.1</td>
<td>38.0</td>
</tr>
<tr>
<td>Total</td>
<td>105</td>
<td>163</td>
<td>268</td>
</tr>
<tr>
<td></td>
<td>105.0</td>
<td>163.0</td>
<td>268.0</td>
</tr>
</tbody>
</table>

Pearson chi2(6) = 107.7338 \( \text{Pr} = 0.000 \)
### Table 3: Context and Outcome

<table>
<thead>
<tr>
<th>Context</th>
<th>Desc</th>
<th>Norm</th>
<th>Theory</th>
<th>Total</th>
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<td>survey</td>
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<tr>
<td>Total</td>
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<td>147.0</td>
<td>28.0</td>
<td>268.0</td>
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</table>

Pearson chi2(12) = 148.8052  Pr = 0.000

### Table 4: Technique and Outcome

<table>
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<th>Desc</th>
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<th>Theory</th>
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<td>163.0</td>
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<tr>
<td>Total</td>
<td>147</td>
<td>93</td>
<td>28</td>
<td>268.0</td>
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</table>

Pearson chi2(2) = 23.0986  Pr = 0.000

### ANALYSIS

The seven years of data examined does not show any consistent trends in research context with the exception of model based research which has declined steadily over this period. Case study research which is clearly the dominant research context increased from 2010 – 2014 then dropped in 2015 and remained even for 2016. The balance of the contexts fluctuated within a narrow range.

When categorized as qualitative and quantitative there again is no significant trend. Qualitative research is consistently dominant although the spread decreased from 2013 – 2015 it has widened slightly in 2016.
The outcome of the research has been dominated by descriptive and dominant with theory consistently being in the 10% range. While normative research dominated for one year (2011) descriptive research has been the dominant outcome. Again there are no consistent trends.

Interpreting the individual contrasts with a cross tabulation is not generally encouraged. However, with that caveat that statistical issues exist there are trends that deserve comment. In table 2 This is not surprising given the nature of the data involved with these techniques. Likewise, case analysis tends to employ qualitative techniques. Interestingly research contexts focused on archival, interviews and literature reviews also took a predominantly qualitative approach. The data that would result from these contexts could be argued to lend itself to either technique yet there was a clear propensity to employ qualitative techniques.

Employing the same caveat discussed above, certain trends are evident in the relationship between the context and the outcome (table 3). Unsurprisingly the literature reviews were dominant in theory development. Experimental, model and survey research contexts all show a tendency to focus on normative outcomes and case contexts tend to focus on descriptive outcomes. Archival, and interviews also produced more descriptive outcomes and again it could be argued that the data that would result from these contexts could lend itself to either outcome.

In reviewing the connection between technique and outcome there is (unsurprisingly) a very strong relationship between qualitative research and descriptive outcomes. The theory based outcomes were also largely driven by qualitative research. Quantitative research had a stronger connection to normative outcomes (and a weaker connection to descriptive research) than predicted by chance. However, they were fairly close with quantitative research producing 44% descriptive and 51% normative outcomes. This is in contrast to qualitative research that produced 62% descriptive and 24% normative outcomes.

**DISCUSSION**

The examination of the context, the techniques and the outcomes associated with EPOC research suggests that there do not appear to have been any significant changes over the life of the study. If one is concerned with the efficacy of our research efforts, then one needs to ask: Is this mix of approaches appropriate given the “Grand Challenges” facing engineering project organizations.

In considering efficacy one is required to define the purpose of our research. The ‘cycles of research model’ provides a structured and nuanced model for considering the evolution of our research. By recognize the value and connection between theory, descriptive and normative outcomes without regard to context or technique one is able to describe a general trajectory for research. The end result of these efforts should be to improve practice, with practice defined very broadly to encompass all the constituents of the built environment.

Our present research has a strong bias towards descriptive theory. This could be a result of the stage of development in our research in which case we should eventually start to see a shift towards more normative theory. However, this could also be an artifact of the academy. As described earlier there appears to be a trend for research to
become a philosophical statement (Hartman and Dewulf, 2011) as opposed to the practical exercise Lewin (1945). If it becomes a philosophy that rejects a pluralistic approach, then movement along a trajectory that eventually improves practice becomes increasingly difficult.

The dominance of descriptive theory could also be an artifact of the use of qualitative research techniques. As could be seen in the analysis there is a significant connection between qualitative research and descriptive outcomes, and qualitative research is the preferred method even when the research context could have produced quantitative data. So why is qualitative research so popular (it is even a specific keyword in EPOS submittals and quantitative is not)? I would suggest that part of it is our training. I was trained as an applied statistician and my research reflects that. If others are trained in qualitative techniques, their research will reflect that. If I have a hammer the entire world looks like a nail.

CONCLUSION

While the present research is purely descriptive in nature the discussion and the cycle of theory development suggest that considering how this work might contribute to future research is not only appropriate but necessary. Movement towards improved practice requires a trajectory that eventually proceeds to normative theory. Normative theory requires as a basis the rich, nuanced understanding that comes from descriptive theory. However, it does not require a complete foundation, rather an iterative process that cycles back and forth is needed. This iterative process requires thoughtful planning that recognizes what went before and how the work we are doing now will pave the way for future work.

REFERENCES


