Need for Indices to Assess Health of the Construction Industry

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ABSTRACT

The Architectural/Engineering/Construction (AEC) industry comprises a large portion of the global economy, contributing significantly to gross domestic product (GDP) and employment. Entangled with crucial upstream and downstream industries, the AEC also plays an important role in the global supply chain; and monitoring the trajectory of the industry is therefore important for the individuals who are directly or indirectly involved in the industry. Nevertheless, analysts are deprived of tools specifically devised to evaluate the health of what we will now refer to generally as the construction industry. The available indices are essentially finance-driven and generic, disregarding the specific characteristics of the construction industry. Construction is known as a high risk, capital and asset intensive industry, involving large-scale projects with longer payback periods.

This paper reports on the preliminary results of ongoing research at Purdue University, which would lead to the development of specific construction industry health indices. This research investigates the existing indices applied within the industry to identify gaps in the current literature and, most importantly, proposes a multi-dimensional definition of health for the industry. The interim outcome of the research is a methodological prototype that can be applied by decision-makers to develop indices that indicate current health of the industry. The final developed prototype could be applied to enhance protocols for strategic planning.

KEYWORDS

Industry Health, Construction Industry, Trend Analysis, Indexing, Strategy Development

INTRODUCTION

The construction industry has faced rapidly changing dynamics in recent decades. The real estate market crisis and substantial changes in renewable energy policies in the U.S. are among multiple examples of the fluctuations in the market dynamics of the construction sector. These swift changes have significantly challenged the development of strategies and plans within the industry. On the other hand, the construction industry is a key part of the U.S. economy. The U.S. Bureau of Economic Analysis (BEA) estimated the gross output of the U.S. construction industry as $1,091 billion for fiscal year 2009, which is approximately 7.7% of the U.S. GDP

(BEA, 2011). Further, the U.S. Bureau of Labor Statistics (BLS) stated that the construction industry is one of the largest contributors to employment in the U.S., with 7.2 million wage and salary jobs and 1.8 million self-employed and unpaid family workers in 2008 (BLS, 2011a). The importance of the industry in the overall economy in terms of revenue and employment has put the construction industry at the focal point of economic recovery policies. Therefore, monitoring the trajectory of its health is crucial for policy-makers and strategy developers at the national and global levels.

Index analysis can provide a structured approach to promptly monitor the trajectory of the health of an industry and identify trends, performances, and bottlenecks. Multiple indices are commonly used in the construction industry to gauge the course of the dynamics within the industry. The most common implication of index analysis is the application of financial ratios, which are used extensively in different industries. For instance, many construction companies check their asset ratios to examine their financial performance and efficiency.

In general, many of the common indices are either financial market ratios or are heavily based on financial performance. Although important, financial ratios (e.g., financial leverage ratio) do not reflect the comprehensive multi-dimensional image of construction industry dynamics because it has unique inherent characteristics. Many accountants, for instance, who work for construction companies often indicate cases where companies may be facing challenges despite being in good standing in terms of financial ratios. Likewise, the majority of other common indices that heavily rely on the financial performance of the industry cannot provide an all-inclusive picture of the dynamics. For example, many companies apply the income per full time equivalent (FTE) to gauge their status, while ignoring the health of the process behind the output. Indices developed for financial markets or other industries therefore may not apply to the construction industry due to its unique characteristics. In contrast to other industries, construction is essentially a highly competitive industry with long payback periods, involving products that are unique and often requiring substantial asset and capital investment. These characteristics differentiate construction from other industries and necessitate application of benchmarks specifically designed for construction.

This study aims to frame a multi-dimensional prototype for developing indices to monitor the trajectory of the health of the construction industry. It is based on an extensive literature review on trend analysis within the construction industry, a survey of 45 top managerial construction experts, and a select number of open-format interviews. The following topics were addressed: i) the current trend analysis approaches in construction and ii) the definition of health and its perception in the industry. From this extensive input, a trend analysis prototype for the construction industry is recommended.

First, this paper briefly presents a structured overview of the studied indices that are commonly used in construction (a mixture of the survey results on existing tools, the literature review, and the open format interviews). Then the results of the second part of the survey are presented as a brainstorming on the definition of "health in the construction industry," as well as a review of the last part of the survey, which is a structured survey on the proposed framework of a prototype. Finally, a multi-dimensional prototype is proposed as a foundation for development of indices for the trajectory of the health of the industry.

BACKGROUND: APPLICATION OF INDICES IN THE CONSTRUCTION INDUSTRY

Research on indices has ranged from development of benchmarks for performance assessment and productivity to identifying indices that aim to capture trajectories and trends. In

general, indices are tools devised to provide quick and easy to understand insights into dynamics and complex phenomena. These tools are commonly used in decision-making settings that require comparison of different firms, sectors, industries, or geographical divisions. Besides, indices are practical instruments to monitor long-term fluctuations of any given phenomenon. Table 1 is a sampling of some economic, cost, and social-related indices used within the industry, as well as their publishers and a related description. These indices will be discussed at three levels of analysis: construction projects, construction companies, and the industry.

Table 1. Example of indices applied in construction industry

Index	Publisher	Description
Economic Indices		
S&P Select Industry Indices	McGraw-Hill	Performance of selected industries (Incl. Construction)
The Dodge Index of New Construction Starts	McGraw-Hill	New construction starts
Architecture Billings Index	American Institute of Architects	Lead index for construction volume based on architects work
ENR-Construction Industry Confidence Index	McGraw-Hill	Confidence index for near future of costruction industry
Pending Home Sales Index	National Asspciation of Realtor (NAR)	Pending home sales on Multiple Listing Services (MLS)
Non-Manufacturing Managers Index	Institute for Supply Management	Gauges economic activity of non-manufacturing sector
Expansion Index	Reed Construction Data	Lead index for construction volume based on architects work
CIRT Sentiment Index	FMI-Construction Industry Round Table	Confidence index of economy and cost in construction industry
Wright Fuel Index	Wright Express Corp.	Growth based on fuel consumption by construction companies
Cost Indices		
ENR Cost Indices	McGraw-Hill	Price fluctuations of construction, labor, and materials
Construction Equipement Revenue Trends Index	Association of Equipement Manufacturers	Unit index and value index as average prices
Employment Cost Index	Bureau of Labor Statistics	Changes in the cost of labor
Turner Building Cost Index	Turner Construction	Cost in nonresidential building construction in the US
Housing Price Index	S&P/Case-Schiller	Price fluctuations of residential real estate value
Housing Price Index	Federal Housing Finance Agency	Measure of movement of single house family price
Social Indices		
Experience Modification Rate (EMR)	Rating Bureaus or NCCI	Injury rate compare to industry average
Total Recordable Incident Rate (TRIR)	Self calculated/Bureau of Labor Statistics	Measure of recordable workplace injuries
Lost Time Incident Rate (LTIR)	Self calculated/Bureau of Labor Statistics	Measure of lost time injuries

Construction Projects Level: At the most reductionist level of analysis (i.e., construction projects), benchmarking is used to monitor its dynamics. Benchmarking in the construction industry is essentially based on four basic metrics of construction projects (cost, time, safety, and quality). Likewise, multiple tools have been proposed for project level assessment, such as key performance indicators (KPI) (Chan and Chan, 2004). KPI include a set of indicators that holistically assess the performance of the project. The core idea of KPI is to assess the health of construction projects according to their performance. Some studies have focused solely on productivity as a measure of health; and Park et al. (2005) developed a framework for measuring the productivity of project activities. They proposed a set of construction productivity metrics, corresponding definitions, and a framework to report on productivity. The framework was developed based on heavy construction projects, but it is applicable to other specialties within the industry. Finally, there are indices that focus on measuring safety at the project, firm, and industry levels. The most commonly used indices are the total recordable incident rate (TRIR) and lost time incident rate (LTIR), which are benchmarked against the industry averages published by BLS (2011b).

Organizational Level (firm level): Moving higher in the analysis level (i.e., firms and organizations), the focus would be on financial ratios to observe dynamics and trends. Since financial performance is one of the key objectives of firms in any industry, they are considered as the most common trend analysis tools among different industries. These ratios are usually at the firm level and look into different aspects of the financial status of an organization. A common approach to these ratios is to develop an industry average as a benchmark for firms

(shift from firm to industry level). The construction industry has a similar approach since many companies refer to averages within their specialty area to gauge their financial health. For example, a company that works on residential buildings in the Midwest will look into the average "under-billings to equity" ratio in the region as well as the industry as a whole for their financial planning. However, construction firms randomly deal with non-repetitive projects, which reduces the reliability of the all-inclusiveness of the industry averages. As a result, isolated application of these ratios may not be advantageous. This gap, along with the importance of the industry, has resulted in numerous research efforts being directed to develop indices specific to the construction industry.

Industry Level: The top level of analysis in monitoring the trajectory of dynamics (i.e., industry level) involves numerous indices that reflect on different dimensions of the industry. Apart from indices that compare project and firm level indices with the industry averages (e.g. safety indices and financial ratios); industry level indices may include economic indices. Generally, managers and strategy developers are cautious about national and global economic indicators and stock market fluctuations and the consequent impact on their business. Major sources for data can be the U.S. Department of Commerce (DOC) and its entities, such as the U.S. Census Bureau, BLS, or BEA. These generic data can be a proxy for the dynamics of the industry, for example, population growth may serve as a generic proxy for the housing sector growth of any region. BEA provides industry-level indices such as the input-output account between different industries (including construction industry) as well as the contribution of each industry to GDP (BEA, 2011). BLS offers indices that include the Producer's Price Index (PPI), which is an index of the price fluctuations that producers ask for their outputs, and the Consumer Price Index (CPI), which address the price fluctuations of a basket of goods (BLS 2011c).

More specific to construction, *Engineering News Record* (ENR) publishes the trends in the cost of major construction materials. Some sub-industries also are heavily dependent on the trends of commodity prices, either as a major resource (e.g., steel for a steel structure contractor) or a major industry drive (e.g., oil in petroleum-related construction). Therefore, indices such as the Baltic Dry Index, which is a lead index for commodity prices, may be applied by these industries to approximate the dynamics of the market. As labor is an important portion of the cost structure in construction, indices such as the ENR labor indices are monitored closely for labor cost fluctuations. Generic indices may be helpful as well in this regard, including the Employment Cost Index (ECI) published by BLS, as well as the PayScale Index, which provides a picture of the fluctuations in labor costs.

More deliberate planners refer to specific economic indices for the construction industry, such as Standard & Poor's (S&P) select industry indices (Table 1), which measure the performance of industries and include the Building and Construction that includes six sub-industries. S&P select industry indices are developed based on a minimum of 35 stock data from each industry and sub-industry (S&P, 2011). The "McGraw-Hill Dodge construction starts" is another important index for residential building, non-residential building, and non-building construction project start-ups. Confidence indices, such as the Construction Industry Confidence Index (CICI), published by ENR, and the Construction Industry Round Table (CIRT) Sentiment Index, measure the confidence level of the industry in future performance. These indicators are developed based on the systematic surveying of executives within the construction industry to measure their confidence about the future economic performance of the industry. Lead indicators can be also applied to benchmark future dynamics. Examples of lead indicators in construction

involves Architecture Billing Index (ABI) and the Expansion Index, which surveys the volume of architecture work as a lead index for future market size of the housing construction (Table 1).

As observed above, many of the indices are financially driven and lack the specific characteristics of the construction industry. Although financial performance is a necessary indicator to discerning any economic concern's health, it is not sufficient to reflect the multi-dimensional aspects of the construction industry. An extensive study by McKinsey indicated that focusing solely on performance, though important for securing short-term achievements, may not guarantee sustainable success (De Smet et al., 2007). The study argued that a combination of performance and health is vital to secure the long-term success of organizations.

DEFINITION OF HEALTH OF THE CONSTRUCTION INDUSTRY

Substantial literature exists concerning the debate on the importance of firm level factors versus industry level factors on the performance of the firms, such as McNamara et al. (2005), Hawawini et al. (2005), Short et al. (2007), and Phua (2006). Several studies have argued that industry health has a significant effect on the profitability of corporations (Schmalensee, 1985 and McGahan 1997). Other studies have emphasized the business-unit as the major determinant of profitability, while considering the industry as a relatively significant variable (Rumelt, 1991). Tracing the debate from its origin, it may be argued that researchers have converged at the fact that, although firm level factors are essential to ensure success, the industry as a context is critical to guaranteeing the outcomes of the firm level efforts. Phua (2006) supports this argument, stating that rather than focusing on any side of the dichotomy, firms need to find which firm level or industry level factors are important in their specific case. Hawawini et al. (2005) argue that industry level factors matter for an average body of firms within the industry, while firm-related indicators matter most for overperformers or underperformers. This current paper discusses the development of a prototype that defines the health of the construction industry for the following reasons: 1) construction is a key industry in the global supply chain; 2) construction is a unique industry; and 3) the health of the construction industry is vital for both the firms involved in the industry and the overall economy.

Table 2. Sample properties: Position of respondents

Position	Pctg.
Owner/President Emeritus/President/CEO/Chairman/Vice President	56%
Senior Project Manager/Project Manager/Regional Managing Principal	14%
Human Relation Manager/Group Manager/Project Control Manager/Design Manager/Director of Training	22%
Chief Estimator/Field Engineer	8%

The health of the construction industry involves the perceptions of different actors, which may differ widely. These actors include the work force of the industry (individuals or unions), contractors, owners, and governing organizations. A comprehensive prototype to develop indices for the trajectory of the construction industry's health must reflect the perceptions of all these groups.

The basis of this paper includes the structured literature review discussed in the previous section, the survey on the health of the construction industry, and a few open-format interviews with selected participants. The survey and its results are discussed in this section. This survey involved participants from the top management of contracting firms and owners in the construction industry and consisted of three major sections: i) review of the existing indices, ii) an open-ended question regarding perception of the health of the construction industry, and iii)

structured questions based on the discussed literature and development of a hypothetical prototype. There were 45 responses to the survey and included individuals with diverse positions in the construction industry, with the emphasis on top-management (Tab. 2). The diversity of the respondents enabled capturing broader opinions while the focus on top-management personnel reflected the nature of our research on industry-level dynamics. Among the respondents, 80% chose to provide their profile information, which was an optional choice. Company sizes ranged from top U.S. contractors that are active internationally to small sub-contractors. The correlation of position and decision-making impact may depend on the company size.

The survey began with an open-ended question on how the respondents define the health of the construction industry while enumerating important dimensions of a healthy construction industry. According to Fowler (1995), open-ended questions encourage genuine choice to identify properties of a phenomenon, and thereby eliminate transfer of any restraints from the research group to the respondent. However, this type of question suffers from difficulty in analysis of responses, which necessitates coding of the responses (Fowler, 1995). Therefore, we coded the responses to the open-ended question using a list of factors to provide an overall understanding of the pool of the ideas. In order to code the responses, a list of mutually exclusive factors that might be potentially important for the health of the industry was developed, and the final group included 38 factors. The aim was to capture all the factors mentioned in the definitions provided by the respondents as a starting point on brainstorming how the industry perceives its overall health. Tab. 3 provides the structured result of the responses on the most important topics that industry perceives about its health. The second column of the table refers to the number of respondents indicating a certain factor in their definition, and column three shows the percentage of those respondents in the overall sample.

As observed, the factors related to the financial performance of the industry made the top of the list regarding a definition of health, including: backlog volume, new investments and projects, competitiveness, profitability, growth trajectory, etc. The remainder of the suggested factors on the list pertained to the social health of the industry (e.g., safety), development of the industry (e.g., academic education/non-academic training (expertise)), and quality (e.g., owner's and user's satisfaction, quality of work). The results of this survey show that, although the industry (specifically, contractors) is over-emphasizing the importance of financial performance, there exists a slight awareness about the other dimensions of its health. The McKinsey Study (De Smet et al. 2007) strongly suggests that performance, although necessary for success, must be accompanied by the health of the enterprise to ensure success in the long term.

HEALTH ASSESSMENT PROTOTYPE FOR THE CONSTRUCTION INDUSTRY

Some studies have focused on the competitiveness of the market as an indicator of health (e.g., Momaya and Selby, 2009), while other research in construction has focused on performance (e.g., Qingbin et al., 2010). However, as discussed in this paper, the health of the construction industry is multi-dimensional, beyond the financial performance. It is undoubtedly a high-risk, highly competitive, and complex industry that is significantly labor-intensive and requires substantial initial capital investment. Cheah et al. (2004) suggested the use of a dynamic, open-format assessment model of strategic performance to reflect the diverse characteristics of firms. They argue that there is no particular formula for success (ie., it is rather a combination of different dimensions). Therefore, a generic prototype for developing indices for the health of the construction industry may need to be a multi-dimensional framework reflecting the specific characteristics of the industry (as a non-manufacturing industry).

Table 3. Health factors for construction as perceived by the industry

Healthy Construction Factors	No.	Pctg.
Backlog Volume	23	53%
New investments	17	40%
Competitiveness	16	37%
Profitability	16	37%
Growth Trajectory	14	33%
Employment/Layoff rate	10	23%
Diversity of projects	5	12%
Market willingness to pay	3	7%
Safety	3	7%
Academic education/Non-academic training	4	9%
Average payback period	2	5%
Availability of financing	2	5%
Quality of work	2	5%
Owner's Satisfaction	2	5%
User's Satisfaction	2	5%
Business activity in the industry	2	5%
Union workers	1	2%
Dependencies	1	2%
Changes and modifications	1	2%
Development	1	2%
Contribution to GDP	1	2%
Number of disputes	1	2%

The proposed prototype is essentially shaped to answer this question: "How healthy is the construction industry at the current moment?" Analogous to the health of an individual, the prototype will need to provide a basis for developing indicators that collectively describe the current status of the health of the industry. The proposed prototype was developed based on the refined definition from the extensive literature review, as well as the open-format interviews with construction experts and further refined with the responses to the survey. The conclusion was the following five-folded definition that describes the construction industry as healthy, if:

- The industry indicates positive economic and financial performance.
- The industry is stable and is resilient to internal/external shocks.
- The industry produces high quality products for its users.
- The industry applies the best of the expertise, science, and technology in the production process.
- The industry provides a pleasant working environment for individuals involved within the industry.

The open-ended responses to the survey asserted these dimensions, but the degree of significance varied. The economy of the construction industry was the most important (and most highlighted) sign as to its health since revenue generation is the foremost purpose of the involved individuals and entities. A higher-level dimension of the health of the industry is its resilience to any deviations due to external and internal conditions. An industry with buffered resilience to external shocks is more predictable for future planning and provides security for business activities. On the other hand, the industry has to offer a desirable working atmosphere for its

workforce. The social interactions and job satisfaction of individuals define a higher level of the industry's health. Furthermore, sustainable development of the industry in terms of proficiency in performing business activities and tasks is another dimension of the health of the industry in terms of human resources, such as academic and professional education (i.e., expertise of human resources). Utilizing innovative technologies and science within the industry is another indicator; and research and development (R&D) investment can be an indicator of this dimension of the industry. Finally, the quality of the outcomes (e.g., projects, plans, designs, etc.) comprises another dimension of the health of the industry since the industry is known by its outcomes. The satisfaction of the users with its output will bring respect and future success to the industry. Changes and deviations in this indicator may also result in changes in the economy of the industry in the longer term; and, conversely, identifying the changes in this trend will help the construction industry to avoid adverse consequences in the future.

Based on the discussed philosophy of health for the construction industry, a prototype was devised for the development of indices to determine a trajectory of the health of the construction industry. This prototype involves five dimensions that collectively address the health of the construction industry: i) economic dynamism, ii) stability (resilience), iii) quality, iv) sustainable development, and v) social dynamism.

In order to gauge the perception of the industry, the second section of the survey asked the respondents to rate the above five dimension on a five-point-scale of: *very high importance; high importance; medium importance; low importance; no importance*. As expected, economic dynamism was rated as the most important dimension, followed by stability, which was rated as a high important dimension. Quality was ranked as a relatively important dimension, while development was rated as a medium important dimension. Social dynamism was rated as a medium to low important dimension; note that it may be argued that social dynamism ranked the lowest as the sample of respondents was dominated by top-management in the industry. Complementary surveys of unions and owners will further increase the multi-perspective nature of the ranking for the industry.

The survey also questioned the factors that are significant in each dimension and their degree of importance. A list of factors was prepared for the respondents, which were to be rated on a scale of 0 to 10. Table 4 presents the survey results of the question, thereby indicating the important factors to be addressed for each dimension of the prototype. The scope of this research also includes development of the indices and appropriate data collection that will be reported in subsequent publications upon completion. The data collected through the questionnaire survey will assist in creating indices that would add the most value to the construction industry.

CONCLUSION

The construction industry has distinctive characteristics that differentiate it from manufacturing. As a significant contributor to GDP and employment, it is also a significant actor in the global economy. This paper discussed a prototype for development of indices, as benchmarking tools, for the health of the construction industry. Arguing that the health of the construction industry is a multi-dimensional phenomenon beyond financial performance, a survey has been conducted on contractors and owners within the industry to provide a coherent definition of health. On the basis of the survey results, a prototype is proposed based on the core philosophy of the health of the industry as a foundation to develop indices to gauge its health. It should be noted that this paper is one part of the survey; and the future papers will cover the perception of health among other groups in the industry as well as a study of the historical data

on the correlations of these dimensions with the health of the industry. This paper focused on industry-level analysis as a general prototype, and it will further extend the prototype, in future work, to sub-industries to consider the diversity of the construction industry. Finally, further ex-post analysis of the extent of the impact of these dimensions is required, as well as ex-ante application to assess the prototype's practicality.

Table 4. Important factors within each dimension

Criteria	Score
Economic Dynamism	
New Investments	8.14
Market Willingness to pay for Projects	8.09
Backlog Volume	7.91
Growth Trajectory	7.81
Average RoR	7.60
Stability	
Diversification	7.41
Governance Consistency	7.41
Employment or layoff rate	7.14
Rate of Bankruptcies	7.12
Quality	
Owner's Satisfaction	8.45
Users' Satisfaction	7.82
Changes and Modifications	7.00
Sustainable Development	
Innovation	8.02
Availability of Expertise	7.91
Application of new technologies and methodologies	7.09
Social Dynamism	
Safety related Incidents	7.96
Job Security	7.56
Average Level of Salaries	7.27
Benefits (Healthcare, etc.)	7.02

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