Key Issues in Workforce Planning and Adaptation Strategies for BIM Implementation in Construction Industry

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ABSTRACT

Building Information Modeling (BIM) and its implementation have been continuously reshaping the construction industry. Fundamental changes are taking place to address the dual challenges of BIM in technology utilization and business operation. The lack of competent BIM talent has been identified as a major obstacle in BIM transformation. However, there has been little published research on the impacts of BIM on future workforce and how companies can adapt to BIM-driven business transitions with appropriate workforce planning and talent acquisition. This paper discussed key issues in workforce planning and adaptation strategies for companies that are looking into BIM adoption. The paper reviewed and identified the unique skill set requirements of BIM and desired changes in current talent planning and acquisition practices. A preliminary Workforce Planning/Succession Model was proposed to facilitate industry adaptation to BIM at the company level. The model outlined the procedures that companies could follow to align workforce analysis with their strategic goals oriented to BIM business, identify competency and skill gaps in existing workforce, create and implement development plans, and monitor, assess and continuously improve workforce plans. A case study was performed to verify the model. Results of this research provide valuable insights into intellectual preparation in companies who are at the early stage of BIM adoption and implementation.

INTRODUCTION

The lack of adequately trained personnel has been identified by professionals (e.g. Smith and Tardiff 2009) and scholars (e.g. Sacks and Barak 2010, Becerik et al 2011) as a major hindrance to the adoption and implementation of building information modeling (BIM). Meanwhile, McGraw-Hill Construction (2012a) reported an industry-wide workforce (broadly refers to the labor pool in employment) shortage, especially the skilled workers. In this context, it is important for companies who have started to engage in BIM use and aspire to expand in BIM business to consider workforce planning for the future. BIM sets new skill set requirements on construction workers (Hardin 2009) and necessitates a closer scrutiny at the procedures and approaches that companies take in planning and acquiring competent BIM talent. This paper investigates the key issues in workforce planning driven by BIM implementation. A Workforce Planning/Succession Model is developed based upon existing best practices and survey results conducted among the BIM-engaged

industry professionals. The model suggests adaptation strategies that companies may find beneficial to facilitate intellectual preparation for the BIM transformation. A case study is conducted as a proof of concept for the proposed model.

BACKGROUND

Workforce planning – definition, trend and application in construction industry

Workforce planning is defined as the systematic process for identifying and addressing the gaps between the workforce of today and the human capital needs of tomorrow. An essential function of workforce planning is to align workforce requirements directly with organizations' strategic goals or business objectives. The fundamental principle of workforce planning is to "put the right people in the right place, at the right time to accomplish the mission of the agency" (IFMA 2002). Significant benefits of strategic workforce planning include: facilitating the prioritizing, developing and funding of workforce initiatives; and informing decisions on better structuring organization to deploy the workforce to overcome identified internal or external barriers to accomplishing strategic workforce goals (OPM 2005).

Recent development of workforce planning reflects the increasing awareness of the linkage between organization strategy and all human capital strategic planning. Approaches to workforce planning must be flexible enough to keep pace with emerging trends. Forces such as technology, globalization, deregulation, stakeholder power, and the movement toward free agency have combined to change the social contract between the employee and the organization. These forces shape workforce allocation, the flow of people, and work efficiency (IPMA 2002).

Workforce planning in the construction industry has not been as diligent in its implementation as other industries in the United States (Brandenburg et al. 2006). Among a very few published studies, Ferris et al. (1990) investigated and found that construction firms with higher level of strategic workforce planning tended to achieve higher organizational performance, e.g. higher productivity, better cost effectiveness and overall efficiencies. However, Maloney (1997) revealed that in most construction companies, the strategies that received the least formalized consideration were those involving human resources or workforce. More recently, Srour et al. (2006) identified the absence of human resource management for construction workers at the project, corporate, regional or industry level. Brandenburg et al. (2006) concurred and remarked that human resource management had typically been an emergent rather than a strategic/deliberate process in the construction industry, which resulted in the infrequent use of comprehensive workforce planning and management strategies in this industry. As the rate of change in external environments of the construction industry accelerates, featured by rapid technology transformation and an increasingly volatile global economy, more attention needs to be paid to strategic planning for workforce management (Maloney 1997, Tucker et al. 1999, Srour et al. 2006).

Skilled workforce crisis in construction industry – the big picture

The supply/demand equation for the global construction industry workforce has been imbalanced. Crisis of skilled workforce shortages is commonly perceived in leading economies such as the US, and UK. Labor research suggested main contributing factors including the aging workforce, low attraction of construction as a

profession to youth, lack of craftsman skills among younger generation, and evolved skill set requirements associated with new technology implementation (Tucker et al. 1999, Mackenzie et al. 2000, Dainty et al. 2005, Whyte and Greene 2008, McGraw-Hill Construction 2012a). In the US, data from Bureau of Labor Statistics (BLS) (cited in Russo 2013) reveal that workers at age 45 or older currently make up 38% of the construction workforce. McGraw-Hill Construction (2012a) reported an estimate of 62% of senior staff in the construction industry are retiring, which directly causes that as much as 69% of Architecture, Engineering and Construction (AEC) firms are expecting workforce shortage in the next three years. The aging workforce and the shortage of younger generation in the pipeline become a major challenge facing the industry.

Technology has been playing an increasingly vital role in the construction industry. Most recent industry trends including green building and BIM have initiated paradigm shift in technology implementation. Before long, the industry realizes there are significant gaps between the new skill set requirements and current workforce training and education programs, which aggravates the crisis of skilled workforce shortage. On the other hand, new technology may also bring opportunities to future workforce development. It attracts nonconventional or even non-construction audiences to pursue a career in this field because they are passionate about the new technology implementation and embrace the new career options generated. As McGraw-Hill Construction (2012a) reported, green building and green technology implementation have helped cultivate the new generation of workforce in the construction industry and across various closely related industry sectors. Given time, a similar trend will grow gradually and steadily in the case of BIM. According to Uddin and Khanzode (2013) and Wu and Issa (2013a), BIM is enhancing careers of existing professionals while creating new career paths for young professionals.

BIM adoption – impacts on construction workforce

In a time when the construction industry in general is struggling, BIM uptake has been proliferating. In North America, industry-wide BIM adoption has surged from 28% in 2007 to 71% in 2012 (McGraw-Hill Construction 2012b). In the UK, National Building Specification (NBS) (2012) reported that between year 2010 and 2011, construction professionals using BIM were more than doubled, bouncing from 13% to 31%. Increased profits and proved positive return-on-investment (ROI) encourage non-BIM users to start exploring its business potential, while current users are planning on enhancing their BIM investment.

Conceivably, rapid BIM uptake in companies will eventually rely on employees that are knowledgeable and skillful in BIM, who may not be readily available. In a typical technology-driven market transformation cycle, the intellectual preparation is often lagging behind, which reflected in the labor market is the drastic off-balance between workforce supply and demand. Smith and Tardif (2009) anticipated that BIM-savvy people would be in high demand, and the projected supply/demand equation could place acute pressure on the industry to acquire or cultivate competent BIM talent to increase knowledge-worker productivity across the industry to meet the rising demand.

As a transformative industry trend, BIM prefers more collaborative project delivery method such as integrated project delivery (IPD), in which the roles and

responsibilities of project team members are reconfigured, and new skill sets other than those of traditional positions are also expected (Hardin 2009). This pressing demand is likely to urge the industry to rethink the skill sets a worker has to offer (McGraw-Hill Construction 2012a). New job titles prefixed with "BIM", e.g. "BIM Manager" and "BIM Coordinator", and the advent of new organizational function units such as "BIM/VDC department" reflect the impetus to rethink the profiling and planning of workforce oriented to BIM tasks. Barison and Santos (2010) conducted an overview of "BIM specialists", which provided a preliminary outline of the areas of responsibilities, and contributed to better defining the professional skills required to perform BIM related functions in construction companies.

Traditionally, crafts training and education have proved to be effective means in promoting recruiting. For many, BIM training begins in academia. Education, especially college education, is where the ability to create new mind sets and exposure to new media is most effective (Hardin 2009). BIM education is expected as a solution to quicken the BIM learning curve thus companies can recruit ready-made BIM talent when the students graduate (McGraw-Hill Construction 2008). However, in the short term, institutions of higher learning will not be able to satisfy the workforce demand of BIM (Hardin 2009, Wu and Issa 2013a). As a result, employers will have to rapidly develop BIM and IPD skills internally. Some companies chose to rely on conventional wisdom of their "CAD managers" to perform the job function as "BIM managers". This practice is criticized by Kiker (2009) as risky, who argued that despite the few commonalities, the two job titles "are fundamentally different" in terms of the desired qualification, responsibilities and expectations.

Research questions and scope of work

Skilled workforce shortage coexists with the thriving BIM adoption in today's construction industry. It is also evident that BIM, similar to green building, is bringing new career opportunities while reshaping the profile of the construction workforce. The dual challenges faced by construction companies are to deal with the workforce shortage yet to meet the business needs of investing in BIM or enhancing such investments. "Just-in-time" training or continuing education within the organization may offer temporary solutions. Yet from a longer term standpoint, a more systematic and strategic workforce planning/succession approach is desirable.

In both scenarios, it is a high priority for construction companies engaged in BIM to align human resources with organizational development challenges, to understand the need for BIM talent, finding it and then placing employees properly within the existing system (Joseph 2011). This is where workforce planning comes into play. Accordingly, the research intends to investigate: 1) what are the key issues in BIM workforce planning and succession; and 2) what adaptation strategies construction companies may adopt to streamline BIM implementation in their business operation. The scope of work includes: 1) proposing a Workforce Planning/Succession Model to address the research questions; and 2) conducting a case study to prove the concept of formulating adaptation strategies for construction companies by utilizing the proposed model.

METHODOLOGY

Workforce planning/succession model development

A rich literature of workforce planning models is available in the public sectors as well as individual industry sectors. Despite slight differences among these models, a workforce planning model typically consists of these generic cyclical phases: strategic direction, supply/demand analysis, gap analysis, action plan, and execute/monitor/revise. BIM is a new paradigm, and its body of knowledge stays evolving. To accommodate such uncertainties and dynamic changes, it is meaningful to nest a "succession planning" sub-process within the gap analysis phase, which makes it a Workforce Planning/Succession Model (see Figure 1). Succession planning is a subset of workforce planning in which critical positions are targeted, and qualifications and skill sets are developed for the targeted positions.

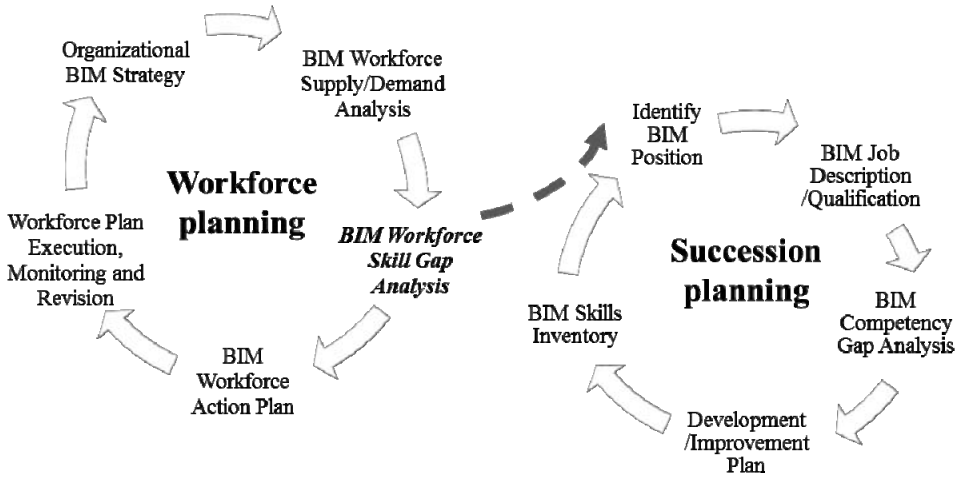

Figure 1. Framework of proposed workforce planning/succession model

Supplemental survey

A workforce planning model typically relies on compiling and analyzing factual labor market statistics (e.g. employment, layoff and establishment) in conjunction with organizational business operation data (e.g. revenue, ROI, and employment turnover). The proposed Workforce Planning/Succession Model, however, inspects construction workforce in general and aims to provide companies with generic guidance. Current published statistics regarding BIM workforce and employment are limited at both the industry and organization levels. Consequently, this research made a compromise to use the data from an anonymous industry survey conducted in a previously published research (Wu and Issa 2013b). These data served as references to support the overall Workforce Planning/Succession Model development. It is expected that such an approach has conceivable limitations due to data-related subjectivity, incomplete coverage and other statistical biases.

The major investigations and findings relevant to this research in the Wu and Issa (2013b) survey are summarized below:

Identify BIM workforce demand: the survey confirmed pressing demand of BIM workforce in the market with evidence in companies' historical hiring statistics,

the rising frequency of companies' participation in BIM mandated projects, the contribution of BIM to their annual revenues and budgeted BIM positions companies planned to recruit.

Identify BIM job titles and desired qualifications: the survey identified most popular BIM job titles to include BIM coordinator, CAD/BIM/VDC manager, and BIM director, etc. The most valuable BIM knowledge is about BIM workflow, strategic plan and execution. The most desired BIM skills are technical and functional skills. There is still no consensus on Knowledge, Skills and Abilities (KSAs) for BIM.

Identify BIM talent pool: the survey confirmed the most popular BIM talent pool to be companies' internal employees through training and continuation. Recruiting from college students is increasing but not yet the priority.

Identify BIM talent retention and management strategies: the survey found that BIM talent could be best retained through organizational learning and knowledge management. Most companies expect their BIM talent to assume both conventional and BIM-specific roles and responsibilities.

Case study

A case study was conducted as a proof of concept for companies to utilize the proposed Workforce Planning/Succession Model as adaptation strategies to guide BIM adoption and implementation. Company and employee identity data were removed due to confidentiality concerns. The case study outlines the various steps the selected company is undergoing in BIM workforce planning and succession. Information presented in the case study is relevant to companies who intend to perform in-house BIM workforce planning to survive in BIM transformation process.

DEVELOP THE WORKFORCE PLANNING/SUCCESSION MODEL

The following paragraphs delineate the steps as illustrated in Figure 1 to develop the proposed Workforce Planning/Succession Model in a descriptive manner. References are given using the survey data and best practices in published literature.

Strategic direction – organizational BIM strategy

The initial phase focuses on the identification of strategic direction in business development pertaining to BIM adoption and implementation, which often involves the decision-making at the top management level. Best practices in the industry such as the BIM Project Execution Planning Guide (PEPG) (CIC 2010) suggest that it is important for companies to examine their existing business services, immediate business needs/priorities, and feasible new business niches to decide on the scope of BIM investment. A comprehensive mapping between core business services and potential BIM usage is an effective approach as recommended by the PEPG.

Supply/demand analysis – BIM workforce forecast

Market demand for BIM workforce is directly related to the overall job/dollar volume of construction work that spells out BIM deliverables. Both market reports and the survey results suggested a drastic increase in BIM investment. Historical hiring statistics in construction companies are direct evidence for BIM workforce development, which however are mostly business confidentiality. There is no official

labor market forecast/outlook dedicated to BIM at this moment. But the supplemental industry survey did suggest the projections of BIM employment among companies represented by the survey participants in the next 5 years, which confirmed that significant increase in both the frequency and magnitude of budgeting dedicated BIM positions was anticipated.

Analysis of the supply side of BIM workforce came across similar challenges, which has a lot to do with the fact that BIM as a career option is still a recent concept. The profile of BIM job positions and desired qualifications remain ambiguous and need to be better defined as the body of knowledge about BIM enhances over time. Regardless, according to the industry survey results, no single source prevails in current BIM workforce supply. In-house employee training and continue education seems to be a popular solution. Noticeably, college recruiting for BIM workforce is not a preferred option at this moment.

Gap analysis – BIM competency/skill gaps

This is the phase where the succession planning is critical. At this phase, key positions (and how many) and job titles (what and who) to initiate the company's BIM efforts will be identified based upon a side-by-side comparison between the existing and desired BIM competency/skill inventory. For in-house BIM workforce cultivation, personal development plans have to be created and implemented, measured and calibrated to meet competency expectation. For new hires, appropriate and accurate job descriptions and qualifications have to be researched. In either scenario, aligning human resource with newly developed BIM business functions is the key via both top-down execution and bottom-up involvement. Activities in the succession planning sub-process are often repetitive and cyclical because of the continuous adjustments needed to accommodate the intrinsic uncertainties in current BIM evolution, and the possible growth of BIM business portfolio in the company. Designation of a BIM champion in the company (ideally one of the top executive personnel) is very important to take the ownership of this process.

Action plan – BIM workforce development

When reaching this phase, the company should have clear goals and objectives in BIM workforce development. Generally speaking, in-house BIM workforce cultivation requires focused training on employee's BIM knowledge and skill, which typically encapsulates literature review, software skills, project execution, business management and administration. Some companies have established mature internal training programs while others seek help from external consultants. External talent acquisition and recruiting strategies are aligned with identified intellectual pools. Decisions need to be made on whether seasoned BIM professional in the job market should be hired or new college graduates are preferred.

Execute/monitor/revise – BIM workforce management, retention and kaizen

Professional BIM training programs and recruiting efforts should be monitored and calibrated for effectiveness and efficiency. Piloting BIM projects are usually used to benchmark the performance of workforce development. Workforce management and retention should also be included as part of the overall development plan. Internal metrics for measuring success need to be created and standardized for

continuous improvement or Kaizen purposes.

CASE STUDY – A PROOF OF CONCEPT

The case study borrows an undergoing BIM workforce development effort in a small/medium size general contracting company. The company specializes in institutional and commercial construction while it has been outreaching for possible new business opportunities in the health care project niche, which arguably is the most mature market sector of BIM implementation. As a strategic direction, the owner of the company envisions BIM as a basic qualification that the company should possess in order to compete in the health care market. He also expects BIM to give the company an edge over competitors in their conventional business niche.

The company started BIM workforce planning with aligning potential BIM uses with their business goals (see Table 1). Although there was no immediate BIM job on the horizon, the company conjectured 5-10 BIM positions to be cultivated internally or through new hires. The senior project manager created a list of BIM qualifications for individual positions, and conducted the BIM competency/skill gap analysis among existing employees (see Table 2).

Table 1. Business Goals and BIM Use Mapping

Business Goals	Priority Ranking	Potential BIM Uses
Increase Field Productivity	1	Design Review, Clash Detection, 3D Coordination
Reduce Conflicts Between MEP Subs	2	Clash Detection, 3D Coordination
Increase Cost Estimating Accuracy	3	5D Modeling
Track Project Progress	4	4D Modeling
Create Better As-built Documents	5	3D Modeling
Improve Site Logistics	6	3D Modeling
Improve In-house Design Capacity	7	Design Authoring

Table 2. BIM Competency/Skill Gap Analysis

BIM competency/skill	Value to company	Employee competency/skill
3D Coordination	High	Medium
Cost Estimating	High	Low
Site Utilization Planning	High	Medium
Record Modeling	High	Medium
4D Modeling	Medium	Low
Design Review	Medium	Medium

To build the desired BIM competency, external consulting was solicited and is currently undertaking. The company also launched a college BIM internship program to evaluate potential new hires for potential BIM business in next 1-2 years. A most impressive part of the company's BIM workforce development was the direct involvement of the company's owner and top management personnel. The biggest barrier faced by the company so far is the investment in personnel training and budget for new hires, which is typical in small-medium construction companies.

CONCLUSION

This research recognized the need for strategic workforce planning for the ongoing BIM-driven transition in the AEC industry. It investigated the key issues and possible adaptation strategies in BIM adoption from the human resource, which has been rarely studied previously. A descriptive Workforce Planning/Succession Model was proposed to align companies' strategic direction in BIM investment with workforce development, and to dedicate organizational resources to BIM talent cultivation, acquisition and retention. Although still a very simple model, it offers companies, especially small and medium enterprises (SMEs) in the construction industry possible solutions to cultivate the competent talent and develop key competencies to explore new business opportunities and compete in the BIM market.

The major limitation of this research resides in the fact that there are no authoritative and comprehensive labor statistics pertaining to BIM jobs and employment. Market research reports provided conjectured data from surveys among industry professionals, which are suggestive instead of scientifically justified. There is also the fact that the body of knowledge about BIM and its implementation is still evolving, which makes it challenging for companies to create accurate job profiles and qualifications to acquire the right BIM talent for the right position with the right skill set in staffing and recruiting. Nevertheless, as college BIM education continues to mature, and academia-industry partnership enhances over time, a better BIM intellectual pool will be established. Meanwhile, with increased efforts in knowledge management and continuous improvement, a more holistic and in-depth Workforce Planning/Succession Model geared towards BIM transformation can be developed and adapted to much diverse needs from various types of companies at different sizes.

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