A Review of Evidence Based Design in Healthcare from Resource-Based Perspective

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Recent interest in evidence-based design (EBD) by the U.S. healthcare industry has led to new questions about how to best use this knowledge to improve the efficiency, safety, quality, and sustainability of new or existing facilities. Proponents of EBD claim that it enhances healthcare outcomes by utilizing empirical research to drive decision-making during all phases of healthcare facility planning, design, and construction. It has yet to be shown, however, how the benefits of the EBD can outweigh the upfront costs and lead to a sustained competitive advantage. We examine this possibility by using the resource-based view (RBV) and reviewing the literature over the last several decades. Then, we discuss EBD as a strategic resource by applying the RBV criteria, including value, rareness, inimitability and non-substitutability. Lastly, we develop propositions for future empirical studies by considering isolating mechanisms, such as organizational culture, unique historical conditions, and causal ambiguity that could successfully operationalize EBD into a strategic resource.

INTRODUCTION

For more than two decades, the United States has continued to spend large amounts on healthcare construction, even during the global financial crisis. In fact, from 2002 through 2011, both the private and public sectors have spent a total of $376 billion on healthcare construction (US Census Bureau, 2011). This expenditure represents an average annual increase of $2.8 billion from 2002 to 2008 and decrease of $1.7 billion from 2008 to 2011 (US Census Bureau, 2011). Even though these annual increases/decreases are not adjusted to inflation, it still shows the trend in spending for the construction of healthcare facilities. The latest dip in spending is expected to be temporary, however, as construction costs are predicted to rise over the next decades due to demographic, legislative, and technological changes (Basu, 2011). For instance, additional hospital space will be needed to accommodate a growing percentage of people over 65 seeking healthcare with the Baby-Boomers generation entering retirement (Basu, 2011). This need could be even greater if, new federal legislation (Affordable Care Act of 2010) is fully implemented; it is predicted to cover 32 million uninsured, calling for approximately 64 million square feet of additional space (Basu, 2011). As a result of this trend and expectations, healthcare administrators are exploring multiple strategies for controlling healthcare costs long term, including new approaches to facilities construction and management (Carpenter & Hoppszallern, 2011). One strategy the healthcare

industry looking at is Evidence Based Design (EBD), which promises better healthcare performance through long-run cost reducing facility design innovations.

EBD is defined as the use of evidence (credible research) during planning, design, and construction of healthcare facilities to harness better healthcare outcomes (Center for Health Design, 2008). After three decades of research, there is some evidence that various healthcare outcomes are directly or indirectly linked to some design approaches (Josep, 2006a, 2006b, 2006c, 2006d, Ulrich, Quan, Zimring, Joseph, & Choudhary, 2004; Rubin, Owens, & Golden, 1998; Ulrich, Zimring, Zhu, DuBose, Seo, Quan, & Joseph 2008). For example, one study revealed significant relationship between single patient room design and reduction in nosocomial infections (Ben-Abraham, Keller, Szold, Vardi, Weinberg, Barzilay, & Paret, 2002). Another study showed significant relationship between Polyvinly chloride (PVC) exposure and higher level of complaints about respiratory tract symptoms (Tuomainen, Stark, Seuri, Hirvonen, Linnainmaa, Sieppi, & Tukiainen, 2006)

Although considerable research has been devoted identifying the links between specific design interventions and their implications for healthcare outcomes (see Ulrich et al., 2008), less attention has been paid to the gap between evidence-based healthcare design and actual practice. While some experts have concluded that financial barriers are the main cause of the research-practice gap (Sadler, DuBose, Malone, & Zimring, 2008), others have explored the pros and cons of EBD in-depth and established a strong business case for its use (Berry, Parker, Coile, Hamilton, O'Neil, & Sadler, 2004; Sadler, DuBose, Malone, & Zimring, 2008). Still, despite ambitious claims, EBD has not been adopted by many healthcare institutions in a systematic way. This reluctance may be due, in part, to a lack of a critical, systematic review and analysis of its worth as a strategic resource in this industry. Equipped with the knowledge that is demonstrated a competitive advantage, healthcare institutions might be more willing to adopt EBD. A potential analytical approach to inform this adoption process is the resource-based view (RBV) which provides the necessary tools to evaluate EBD as a strategic resource.

Despite its frequent use in the strategic management literature in general, there are only several applications of Resource-Based View (RBV) in the healthcare environment (e.g., Short, Palmer & Ketchen, 2002; Weech-Maldonado, Meret-Hanke, Neff, & Mor, 2004; Khatri, 2005; Yarbrough & Powers, 2006; Tarafdar & Gordon, 2007). No study of EBD has been conceptualized through RBV. The purpose of this paper is to use RBV to discover whether EBD is capable of creating sustained competitive advantage for healthcare delivery systems. Overall, we aim to develop some propositions for future empirical testing.

We will achieve our goal through three major steps: 1) providing a theoretical background about EBD and RBV; 2) applying RBV criteria to EBD; 3) developing propositions through the analysis of step 2; and 4) discussing theoretical and managerial implications of utilization of EBD and its capability to provide sustained competitive advantage.

Evidence-Based Design (EBD)

Evidence-based design is "a process for the conscious, explicit, and judicious use of current best evidence from research and practice in making critical decisions, together with an informed client, about the design of each individual and unique project (Hamilton, & Watkins, 2009, p.9)." If one analyzes the evolution of the definition of EBD, one would be able to discern several important dimensions. First of all, EBD is a dynamic, not static, process. Secondly, EBD seeks the best available (objective) information in order to make decisions. Thirdly, EBD is a reciprocal and collaborative process that includes both the EBD team and the client who wants to utilize EBD for the construction of the new healthcare facility or for the renovation of an existing facility.

According to the Center for Health Design (CHD), a team with various backgrounds and skills such as research, finance, information technology, architecture, and clinical practice should evaluate the best credible research. This evaluation enables the team to make decisions about "each phase of the project including the visioning, strategic planning, functional programming, preconceptual design, schematic design, design development, construction documents, construction administration, commissioning, and post-occupancy evaluation (Center for Health Design, 2008, p 43)."

History of EBD

The CHD, a non-profit organization founded in 1993 and issues Evidence-based Design Accreditation and Certification (EDAC) to the qualified individuals, traces the roots of EBD back to the launch of evidence-based movement in 1972. Figure 1, adapted from CHD's website, depicts important times in the history of EBD. In the timeline, CHD recognizes the first hospital based upon the philosophy of Planetree, a non-profit organization founded by a patient in 1978 (Planetree, 2012). Planetree philosophy defines the patient-centered care by emphasizing the relationship between the material environment of healthcare facilities and physical and spiritual dimension of individuals (Planetree, 2012).

FIGURE 1
HISTORY OF EVIDENCE BASED DESIGN (EBD)

Evidence-based movement started	First Planetree Model Hospital	The Center for Health Design (CHD)	Pebble Project	600+ studies that provides evidence	The Fable Hospital	EDAC certification	1200+studies that provides evidence	100 individuals received EDAC certification
1972	1985	1993	2000	2004	2005	2008	2008	2009

Source: Adapted from CHD website at http://www.healthdesign.org/edac/about

Another milestone was the CHD's Pebble Project, which is started in 2000 to extend the healthcare design-outcome research-base by partnering with healthcare organizations and other firms (Pebble Project, 2010). Healthcare organizations that join Pebble Project share their experiences about the utilization of EBD with other organizations and also benefit from existing knowledge-base. This helps the expansion of the knowledge-base on safety, quality, efficiency, and performance of healthcare services. One such member organization is University Medical Center at Princeton, whose president says that, about EBD, the biggest discovery for them was the depth of design and outcome relationship that they learned during construction of their new facility (Pebble Project, 2012)

In the history of EBD, 2004 and 2008 marked as important dates for evidence that supports the EBD process (Figure 1), with the amount of evidence doubling during this four year period. In their comprehensive report which is the expanded version of their 2004 review, Ulrich et al. (2008) aimed to gather the evidence for the design-outcome link. In this two-step literature review, the authors first identified thirty-two key words and searched academic databases with these or combinations of these key words. Second, the authors screened the results by keeping only the empirically-based studies and studies that examine the link between environmental design and healthcare outcomes (patient, family and staff).

Ulrich et al.'s (2008) extensive literature review of more than 1000 articles found some support for the connection between evidence-based design and health care outcomes. For example, among many other relationships Ulrich et al. (2008) emphasized the significant relationship between access to daylight and reduction in depression. Moreover, scholars at the CHD attempted to reveal a link between physical environment and various healthcare outcomes related to patients, staff, residents, and operations in various healthcare settings such as hospitals, long-term care (Joseph, 2006b, 2006c, 2006d), and primary-care (Min Kantrowitz & Associates, 1993). Some scholars also took into account the role of various

healthcare stakeholders such as chief executive officers and nurses (Zimring, Augenbroe, Malone, & Sadler, 2008; Hendrich, & Chow, 2008).

Even though it can be asserted that better healthcare outcomes would have positive impact on financial performance, there are not many studies that support a link between EBD and financial performance. In an attempt to link EBD with financial performance, Sadler et al. (2008) pointed out the improved healthcare outcomes as a mediator between EBD and better financial performance. Even during an attempt to make a better business case for EBD (Sadler et al., 2008), one can only provide an indirect relationship between EBD and financial outcomes. Obviously, this indirect link makes it very difficult to sell the EBD idea to healthcare executives who like to see evidence for its positive contributions to the financial bottom line. In the future, more empirical research should be performed by including financial performance and its connection to EBD.

In 2005, the CHD's Pebble Project team designed the Fable Hospital, a virtual hospital based on the premise of EBD to provide some idea about return on investment (Sadler, Berry, Guenther, Hamilton, Hessler, Merritt, & Parker, 2011). The team estimated that the extra cost of EBD innovations would be recouped through operational savings and patient volume increase within a year (Sadler et al., 2011). After this imaginary hospital exercise, many recommendations in Fable Hospital have started to gain popularity, such as larger single-bed rooms and private-bathrooms, larger windows, noise reducing finishes, and ceiling lifts (Sadler et al., 2011). In the second version of Fable Hospital, Sadler et al. (2011) took into account more studies and the feedback of Pebble Project partners such as Dublin Methodist Hospital and Sacred Heart Medical Center at RiverBend. They estimated that building a 300 bed, 600,000 square foot hospital would cost $29 million more by using EBD improvements. This initial capital investment would be paid back, however, in about three years through an estimated $10 million in operational savings (Sadler et al., 2011). Since 2004, many success stories of Pebble Project partners have been featured in articles, magazines and the Pebble Project website.

Despite the success stories of Pebble Project partners and environmental pressures, as of March 29, 2012 the numbers of Pebble Project partner hospitals was still fewer than 50. According to the American Hospital Association, there are 5795 registered hospitals in the U.S. (AHA Fast Facts, 2009). This indicates that many healthcare institutions may not have bought into the idea behind the EBD. In order to overcome such low partnership participation, researchers need to show how specific design interventions cause improvement in healthcare outcomes and how those translate into better financial performance. The environmental pressures such as increasing number of pay-for-performance initiatives, changing reimbursement policies, and toughening reporting requirements on transparency and patient satisfaction indicate that the future for healthcare is going to be even more competitive.

Critique of EBD

Despite its promises about healthcare outcome and financial performance, some suspicions and criticism exist about efficiency and effectiveness of EBD. For example, is evidence-based design (EBD) a buzz word that was created as a marketing strategy to attract some business? How can one comfortably put EBD as a parallel paradigm to evidence-based medicine like Hamilton (2003) and Stichler & Hamilton (2008) suggested? These questions lead to some legitimate criticisms about EBD in regards to its objectivity, causality, and hasty recommendations (Stankos & Schwartz, 2007). Inferring causality and making recommendations by reviewing about 600 articles in the case of Ulrich et al. (2004) is not seen as enough rigor on the side of EBD when compared to evidence-based medicine by some scholars like Stankos and Schwartz (2007).

As a result of our analysis of literature review articles on EBD, we realized that evidence to support EBD may not be limited to the studies cited in 2004 and 2008 literature reviews. Rubin, Owens, and Golden (1998) wrote a similar literature review article six years before the review by Ulrich et al. (2004). By utilizing more than thirty key words about specific health environment features and patient outcomes, they identified 78,761 studies, classified 1219 of them as "possibly relevant," and found only 84 of them meeting the inclusion criteria. Later Ulrich et al. (2008) ran a more extensive literature review and updated their 2004 report. Since there is a ten year difference between 1998 and 2008 reports, it would be

insightful to compare them. Both Rubin et al. (1998) and Ulrich et al. (2008) mentioned the limitation of not having enough numbers of randomized-controlled trials or experiments. Both reviews included only empirical research and screened studies according to the strength of the research design and methods. Interestingly only 11 studies out of 84 from the 1998 article were also included in the 2008 review. The difference of 73 might indicate that there were different search or/and selection/retention parameters utilized in both studies. The difference also indicates the research base that could be utilized for EBD design is possibly larger than it has been conceived to be. Among the citations of the Ulrich et al. (2008) review, the number of studies that were dated after 1997 were 302 out of the total 454 citations.

Since one major criticism made by Stankos and Schwartz (2007) came from the limited number of studies about EBD compared to Evidence-Based Medicine, the increasing amount of literature that meets the inclusion criteria from 84 to 600 (in 2004), and even more additions in 2008 indicates that the knowledge-base for EBD is growing. Moreover, the global knowledge-base of EBD is growing with contributions from all around the world (e.g. Finland, Japan, Turkey, United Kingdom; see Ulrich et al., 2008). The utilization of EBD is also showing some signs of expansion outside the United States. Fahshoz & Cheng, (2010) illustrate the current prevalence and diffusion of EBD in the international market by providing stories of three different individuals from Brazil, Denmark, and New Zealand. The authors offer some challenges about the expansion of evidence-based design: EBD reflects and addresses the American way of building and the American health system; other countries generally have different health systems; and there are cultural and political differences between the U.S. and other countries. However, since Fahshoz & Cheng's (2010) article is based on individual perspectives and not based upon empirical research or evidence, one should approach them cautiously. These examples can be taken only as an indication of EBD's growth in the international market.

Overall, EBD is still in its infancy and in order to better establish itself, it should be subjected to rigorous research methods. It has potential to grow substantially if it does not ignore these methods. In EBD, as it is explained in its definition, decision making process should be based upon objective evidence, not upon subjective perceptions. Thus, as Ulrich et al (2008) suggested, recommendations in EBD should be based upon significant relationships between specific design interventions and specific outcomes.

Resource Based View (RBV)

The resource-based view (RBV) is one of the most utilized theoretical frameworks in the strategic management literature. Instead of RBV, different names are sometimes used such as resource-based perspective (RBP) or resource-based theory (RBT). Even though the name was initially given by Wernerfelt (1984), it would not be wrong to suggest that the most noticeable work for RBV was Barney's (1991) paper. However, one should also acknowledge the background work that led to the Barney's (1991) paper and also many other contributions after 1991 that enriched the RBV. As Barney (1991) acknowledged in his paper, his work rose upon the contributions of notable scholars such as Rumelt & Wesley (1981), Lippman & Rumelt (1982), Rumelt (1984), Porter (1980, 1981, 1985), and Dierickx & Cool (1989).

The 'resource' in RBV refers to the strategic resources that meet famous VRIN (Value, Rareness, Inimitability, Non-substitutability) criteria for sustained competitive advantage (SCA) (Crook, Ketchen, Combs, & Todd, 2008). VRIN criteria for resources are explained by Barney (1991, p. 105-106) as:

> *To have this potential, a firm resource must have four attributes: (a) it must be valuable, in the sense that it exploit opportunities and/or neutralizes threats in a firm's environment, (b) it must be rare among a firm's current and potential competition, (c) it must be imperfectly imitable, and (d) there cannot be strategically equivalent substitutes for this resource that are valuable but neither rare or imperfectly imitable. These attributes of firm resources can be thought as empirical indicators of how heterogeneous and immobile a firm's resources are and thus how useful these resources are for generating sustained competitive advantages.*

Sustained Competitive Advantage (SCA)

According to Barney (1991), achievement of long-term competitive advantage does not fully define SCA. Full definition of SCA includes compliance with VRIN criteria. Any one VRIN criterion alone is not a sufficient source for sustained competitive advantage (SCA); all four criteria must be present in order to attain the SCA.

Isolating Mechanism

Scholars explored the mechanisms behind one of the VRIN criteria, namely Inimitability. Even though the term "isolating mechanisms" refers to "reproductive isolation" in biology (Mary, 1970); It was introduced into the strategic management literature by Rumelt (1984) to refer to those mechanisms that make valuable resources of a firm inimitable or not perfectly imitable. Some of the isolating mechanisms mentioned in the literature are organizational culture, information asymmetries, managerial capabilities, social complexity, unique historical conditions, and causal ambiguity (Rumelt, 1984; Dierickx & Cool, 1989; Peteraf, 1993; Barney, 1991).

RBV as a View or a Theory

Like many other theories or views, RBV as well, utilizes organizational performance as the dependent variable. According to Barney (2001) some of the assumptions in RBV such as heterogeneous distribution of resources across firms and possible continuity of this heterogeneity have commonality with earlier SCP based Porter's (1980) competitive advantage theory, neo-classical microeconomics (Ricardo, 1817) and evolutionary economics (Nelson & Winter, 1982). Moreover, like RBV all these three theories also focus on the search to find the reasoning behind the outperformance of particular organizations relative to the others in the same industry (Barney, 2001).

There have been many attempts to link and measure the strength of relationship between strategic resources and organizational performance in various settings. Scholars such as Barney and Arikan (2001), Newbert, (2007), Crook, Ketchen, Combs, and Todd (2008) evaluated some of those attempts, especially the ones that are based upon RBV. Both Newbert (2007) and Crook et al. (2008) emphasized that even though RBV has been utilized by strategic management scholars in numerous studies to reveal the link between strategic resources and organizational performance, there are not many systematic reviews available to assess the strength of such relationship. In regards to the strength of the link between strategic resources and performance, Barney and Arikan (2001) claimed consistency through their qualitative review of 166 studies; Newbert (2007) suggested modest support through systematic review and analysis of 55 studies; and Crook et al. (2008) found effect size of 0.22 through meta-analysis of 125 studies. Contrary to the Newbert's (2007) modest support, Crook et al. (2008) found a strong support for the link between resources and performance. The strength of the support increases along with the compliance of resources to the RBT criteria (from $\bar{r}_c = 0.12$ to $\bar{r}_c = 0.26$) (Crook et al., 2008).

One can see the choice of name to refer RBV among scholars as an indication of deeper debate. Interestingly, Crook et al. (2008) preferred to use the name resource-based theory (RBT) over RBV; whereas, Newbert (2007) preferred RBV. One can notice the recent debate about RBV by only observing the preferences of scholars about its name. In their theoretical review article, Priem & Butler (2001) stated that RBV has not attained theoretical structure yet. Despite their choice of the name, Crook et al. (2008) also indicated that RBT still has not reached its full development as a theory. All these shows that we can expect even more debates on RBV in the future.

Some studies investigated possibilities of merging or integrating various other frameworks or theories with RBV, such as utilization of social capital theory within RBV (Chisholm & Nielsen, 2009) and the combination of the institutional with the resource-based view (Oliver, 1997). Subsequent sections will contribute to the growth of RBV literature by indicating another possible growth avenue. In the section below EBD will be explored as a possible strategic resource for RBV research in healthcare settings.

Despite the debate about its theoretical background, RBV's popularity continues to grow. This growing popularity can be observed by counting the number of studies that cited the early RBV articles such as Wernelfelt (1984) and Barney (1991), both of which were cited more than thousand times (Crook

et al., 2008). Moreover, the RVB has a vast research-base and the base is continuously growing through enrichments and additions. Overall, RVB is a well-established research track in strategic management literature and its popularity continues to grow despite the debate on the strength of the link between resources and performance.

EBD and SCA in Healthcare Settings

Would evidence-based design (EBD) have the potential to create sustained competitive advantage for some healthcare organizations? Would EBD be a source that could create some heterogeneity in a healthcare market? If it is possible, how might the process work? The following will seek some answers to these questions by applying RBV criteria into EBD. If one proposes EBD as a resource that could enhance sustained competitive advantage (SCA), as previously mentioned, RBV requires such a resource to be valuable, rare, inimitable, and non-substitutable (VRIN). Therefore, EBD should directly satisfy these criteria or indirectly lead an organization to the satisfaction of those criteria by creating new resources or by integrating with existing resources.

Is EBD Valuable?

Firm capital resources can be classified into three dimensions: physical, human, and organizational (Barney, 1991). Interestingly, EBD has some relationships with all these dimensions. EBD is a process to create a physical capital resource by utilizing human and organizational capital resources. After constructing the physical resource (e.g., hospital building) through EBD utilization, physical capital resource would have effect on human capital resources (e.g., staff effectiveness) or organizational capital resource (e.g., formal/informal coordination/planning). If the physical dimension is questioned, then, one can easily conclude that EBD is a valuable resource because it is related to multimillion dollar capital projects. However, by adding the two other dimensions, one can conclude that EBD is valuable since it brings exceptional talents, strategies and sources together to create a build-environment by utilizing credible research. As we previously mentioned, Barney (1991) also based RBV upon structure-conduct-performance (SCP) framework. This indicates that the main target of EBD is the "structure" of the SCP framework.

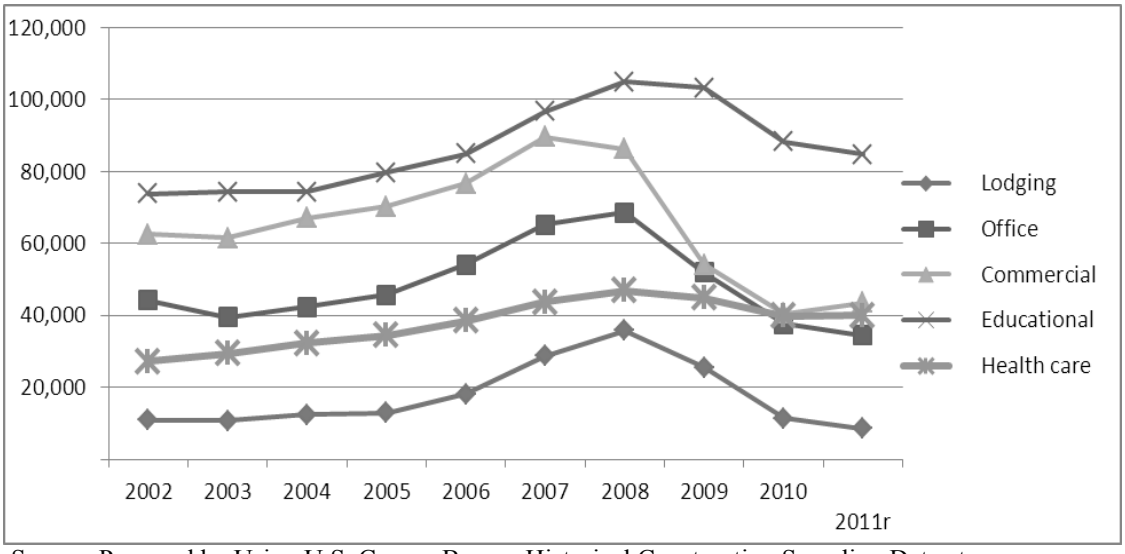
To illustrate the value of physical resources one can investigate the total value and the yearly trend of healthcare construction spending in the United States. Despite the global financial crisis that started in the middle of 2007, healthcare construction spending has been relatively stable. Especially, when it is compared with the sharp decrease in construction spending on commercial, office and lodging, the stability of healthcare construction spending stands out (see Figure 2). According to the U.S. Census Bureau from 2002 to August 2011 the U.S. spent $376 billion on healthcare construction with an increasing trend through 2008 (U.S. Census Bureau, 2011). When compared with 2008 numbers, there are approximately 7 billion reductions in healthcare construction spending in 2011. However, $39 billion healthcare construction spending both in 2010 and 2011 indicates the stabilizing trend for future. Furthermore, even before $39 billion is still substantially higher than $27 billion (inflation adjusted: $33 billion) spending in 2002. All these indicate that the U.S. has been spending large amounts on healthcare construction and this spending will continue in the future.

As previously mentioned, one of the basic principle of EBD is the decision-making process that utilize evidence which links physical environment with human and organizational capital resources. Furthermore, there is also some evidence in the literature about the relationship between physical environment and the staff or organizational outcomes (Josep, 2006, Ulrich, Quan, Zimring, Joseph, & Choudhary, 2004; Rubin, Owens, & Golden, 1998; Ulrich, Zimring, Zhu, DuBose, Seo, Quan, & Joseph 2008). Thus, if it is used in an ever evolving manner, it would be possible for EBD to generate a competitive advantage for certain healthcare institutions by affecting the previously mentioned three dimensions of firm resources.

Consequently, EBD has potential to be a valuable resource because of its link with physical, human and capital resources. Given that EBD used in the way it is presented in its definition, it has the potential

to affect billions of dollars in valuable physical resources that are linked to the human and organizational resources.

FIGURE 2
CONSTRUCTION SPENDING TREND (2002-2010)



Source: Prepared by Using U.S. Census Bureau Historical Construction Spending Data at http://www.census.gov/construction/c30/totpage.html

Is EBD Rare?

A shallow analysis might tempt one to say "yes" in regards to the question of the rareness of EBD by looking at the number of organizations which partnered in Pebble Project or number of organizations that revealed the use of EBD during the construction or renovation of their healthcare facilities.

Even though the number of Pebble project partners is growing, there were only over seventy healthcare organizations and corporate partners in Pebble Project (Pebble Project, 2010). In consideration of the fact that the seventy include both corporate and healthcare organizations, the number of healthcare organizations that joined Pebble Project would, of necessity, be less than seventy. As of March 29, 2012, there were less than 50 hospital members of Pebble Project.

Previous number might be misleading, since the actual number might be different from the reported number. There might be some organizations which are using EBD principles but have not partnered in Pebble project or revealed their use of EBD. Healthcare is a very competitive industry and one in which, organizations do not like to share information about their organization with their competitors. As a result, it is expected that many hospitals would be very hesitant to join the Pebble Project and share certain information about their organization. It is possible to still utilize EBD, yet not choose to simultaneously participate in the Pebble Project. Therefore, the relatively small number of Pebble Project Partner health organizations does not imply that other, non-participating health care organizations are not also utilizing EBD.

The sources that EBD teams utilize during the establishment of EBD process are available to all interested parties who are willing to invest time, effort, and a few other resources. The majority of publications of The Center for Healthcare Design are either publicly available or can be obtained for a very small fee. Furthermore, many of these publications can be classified as literature reviews, and original sources can be found with some effort. Architects, consultants and architectural firms can become a member and can share information with their clients during the design and construction of a healthcare facility. Thus, if one seeks the knowledge behind EBD, it is fairly accessible and it is not rare. However,

if one sees and uses EBD as a process of diminishing the research-practice gap, utilizing exceptional talent, tailoring on the basis of need, creating alternatives, and integrating with existing processes, then it would be classified as "rare".

Overall, EBD as a body of knowledge is fairly accessible and it is not rare. But as a process and application, it has the potential to be very unique and rare. This potential can be explored through the capabilities of the organization that is using EBD.

Is EBD Inimitable?

As subtly indicated in the "rare" section, it is possible to imitate EBD. A team of talented people can imitate EBD, without naming the process EBD. One does not need to speculate in order to assert that in the current healthcare market many healthcare organizations are already utilizing some aspects of EBD without labeling it as such. Many new construction projects already include some of the design interventions that were mentioned in Ulrich et al.'s (2008) paper such as single bed rooms, access to daylight, appropriate lighting, views of nature, family zone in patient rooms, noise-reducing finishes, ceiling lifts, decentralized supplies, and acuity adaptable rooms.

Is EBD Non-Substitutable?

Again, as was subtly pointed out in the "rare" section, substitutes of EBD can be generated with enough time and investment. The question is: do all organizations have the motivation, funds, time and human capital to invest in order to generate an EBD substitute? Moreover, not all organizations are able to utilize EBD or its substitute to its full potential. Ulrich et al. (2008) mentioned various outcome measures such as hospital acquired infections, medical errors, patient falls, pain reduction, patient's sleep, patient's stress or depression, the length of stay, privacy and confidentiality, communication, staff injuries, staff stress, staff effectiveness, and staff satisfaction. All these outcome measures require special attention during all phases of a project that utilizes EBD or an unnamed similar design process. Ambiguity in the causal linkages of many of these outcome measures and various unique organizational characteristics and mechanisms may make the process and outcome of EBD unique and non-substitutable for some organizations.

As indicated previously, at first glance, EBD fails to satisfy most of the VRIN criteria. Except for the Value criterion, it is challenging to build a case on EBD's potential as a strategic resource. However, the main idea behind EBD – the continuous process of examining design decisions through utilization of empirical research– seems to have capacity to overcome the challenges. EBD can become an amalgam of processes that would be valuable, rare, inimitable and non-substitutable through some mechanisms that are explored in sections below.

Mechanisms Enables EBD to Satisfy VRIN Criteria

What would be the mechanisms that have potential to make the EBD process satisfy VRIN criteria and create heterogeneity in the market? Is it possible for some healthcare organizations to attain sustainable competitive advantage and outperform others by utilizing some of these mechanisms?

As it was mentioned in previous sections, isolating mechanism such as organizational culture, information asymmetries, managerial capabilities, social complexity, unique historical conditions, and causal ambiguity (Rumelt, 1984; Dierickx & Cool, 1989; Peteraf, 1993; Barney, 1991) might have potential to make EBD processes inimitable or imperfectly imitable.

Organizational Culture

The organizational culture in a health care setting has potential to blend with EBD process and create unique mechanisms that would be inimitable or imperfectly imitable. According to Schein (1985) organizational culture:

> *Organizational culture is the pattern of shared basic assumptions——invented, discovered, or developed by a given group as it learns to cope with its problems of*

> *external adaptation and internal integration——that has worked well enough to be considered valid and, therefore, to be taught to new members as the correct way to perceive, think, and feel in relation to those problems (Schein 1985).*

In light of this definition as a "pattern of shared values" that is created through complex processes, organizational culture might be able to act as a mechanism that enhances inimitability. Information asymmetries in the attainment of EBD knowledge; management capabilities during the application of EBD; complex social interactions among EBD team and members of an organization; and historical conditions at the time of EBD utilization might be able to provide necessary conditions for inimitability. Moreover, joint optimization of EBD and culture change might allow healthcare organizations to attain various aspired cultures such as culture of safety, culture of efficiency, culture of family-centered care, and culture of patient centered care (Hamilton, Orr & Raboin, 2008).

There are studies that show the direct or indirect link among physical environment, certain healthcare outcomes and previously mentioned aspired cultures. There is significant evidence that single-bed rooms are associated with lower hospital acquired infection (HAI) rates, better patient sleep, improved privacy, higher patient satisfaction, and enhanced communication for patients and family members (Ulrich et al., 2008). Moreover, there is empirical evidence in the literature that single-bed rooms are associated with lower medical error rates, patient falls, patient stress, and staff stress, simultaneously with higher staff efficiency, and staff satisfaction. There is strong evidence that access to daylight and appropriate lighting would reduce depression; the view of nature would reduce pain and patient stress; utilization of noise-reducing finishes would reduce patient stress; and the availability and utilization of ceiling lifts would reduce the number of staff injuries (Ulrich et al., 2008). As can be observed from the associations, EBD supports the establishment of a culture of safety through the reduction of HAIs and the increase of staff efficiency; the culture of family-centered and patient-centered care through improved communication with patient and family members, reduced patient stress, and improved patient sleep and patient privacy.

EBD has potential to support the desired organizational culture for healthcare institutions by recommending and implementing such a physical environment that would lead to better healthcare outcomes. In other words, utilization of EBD for the construction or renovation of healthcare facilities would help in the achievement of a very unique organizational culture that would lead to outstanding organizational performance. Causal ambiguity in this process has potential to satisfy the non-substitutability criterion. As a result of this process, the amalgam of EBD processes and organizational culture would satisfy VRIN criteria and healthcare organizations can ultimately achieve sustained competitive advantage.

> *Proposition 1: By blending, effecting or changing the organizational culture, EBD would be able to satisfy all VRIN criteria. This would lead to outstanding performance and ultimately the sustained competitive advantage for the healthcare organizations.*

Evolutionary Economics

Some scholars also suggest the selection-retention process from evolutionary economics or some similar dynamic capability adaptation- change process (Helfat & Peteraf, 2003) as a possible source of sustained competitive advantage (e.g., Barnett, Greve & Park, 1994; Barney, 2001; Helfat & Peteraf, 2003; Mathews, 2002). EBD design processes exhibit an evolutionary course since variation-selection and retention process can be observed. By examining the continuous change in healthcare design code books one can discern this evolutionary pattern. Throughout the history of healthcare construction, various design innovations have been implemented, tested, selected and retained. This evolutionary perspective might provide some unique organizations inimitability and they might outperform the other organizations as a result of this inimitability.

Proposition 2: The evolutionary dimension of EBD which includes the variation-selection and the retention process would allow healthcare organizations to retain or achieve the better healthcare design and sustained competitive advantage.

Supply Inelasticity and Unique Historical Conditions

Some scholars propose supply inelasticity as a source of sustained competitive advantage (Barney, 2001; Peteraf, 1993). Contrary to the general tendency in neo-classical microeconomics theory, RBV suggests supply inelasticity of some production factors (resources and capabilities) because of the large amount of time and investment required to create those resources, ambiguity of creating similar resources in a short period of time, and non-exchangeable or non-transferable features of some of those resources and capabilities (Barney, 2001).

In the case of healthcare design, once a healthcare facility is designed and constructed, the options become limited during the renovation of the facility. Thus, if a healthcare organization did not use EBD during the design and construction of a new facility, it would be very costly to do an application later. Some design factors can never be modified through renovations, but might instead require costly rebuilding of the facility. Moreover, Certificate of Need (CON) regulations in many states are another obstacle for the initiation of new construction. The states that have Certificate of Need (C.O.N) programs limit the construction of new facilities or purchase of new medical equipment with an ultimate goal of controlling healthcare cost and preventing duplicated unnecessary services (NCSL, 2011). As of June 2010 there were 36 states which had existing CON regulations (NCSL, 2011). The 14 states that have repealed the CON regulations retained some of the mechanisms of the CON regulations for various reasons (NCSL, 2011). By considering the EBD's relationship with the physical resource, it would be easily asserted that there is some inelasticity in EBD as a resource.

Overall, supply inelasticity of healthcare facility construction, as a result of various reasons such as CON regulations, unique historical conditions, time and financial constraints, would provide unique advantages to healthcare institutions that utilize EBD for the construction of their healthcare facilities.

Proposition 3: Due to supply inelasticity, those healthcare organizations that utilize EBD would achieve better performance than their competitors and ultimately attain sustained competitive advantage.

Comprehensive EBD Approach and Causal Ambiguity

Utilization of EBD might be done at various spanning very comprehensive as well as less comprehensive approaches. A comprehensive approach not only includes some specific design interventions but also some decisions that might impact health and safety of patients, patient families, healthcare workers, and community at large. These decisions are related to the features and safety of materials that are used for construction, and durable and non-durable equipment purchased to be used for the operation of healthcare facilities. EBD process can be integrated with Leadership in Energy and Environmental Design (LEED) and continuously search evidence for energy-efficient environmental design innovations positively associated with healthcare performance. LEED is an internationally recognized certification program that was initiated in 2000 by a non-profit organization, U.S. Green Building Council (USGBC, 2011).

A comprehensive EBD approach does not only look at one dimension of a product or design intervention while disregarding other dimensions. While deciding on options of using vinyl, carpet, plastic, rubber, wood etc. on flooring or various type of fabrics, furniture, shower curtains, etc. for furnishing, a decision based solely on the prevention of HAIs point of view might cause bigger problems such as the reduction of air quality in healthcare facilities because of the emission of hazardous chemicals from the building materials, medical equipment, and furnishing (Rossi & Lent, 2006). Tight control on the healthcare facility air in order to prevent the entrance of outside pollutants, climate conditions, or dangerous microorganisms while disregarding the possible health effects of minerals, metals, plastics, and materials that are used in healthcare construction or medical equipment (Rossi & Lent, 2006) would

indicate the failure brought about by not utilizing EBD to its full capacity. Moreover, attention to the inside quality of air by considering all dimensions; yet ignoring the environmental impact of those building materials or medical devices as a result of their production process (Rossi & Lent, 2006) would not be considered a comprehensive EBD approach. The production process of those building materials or of medical equipment is linked to outside air quality and ultimately to health of the community.

All previous examples indicate that utilization of EBD to its full potential requires a comprehensive approach. EBD's full potential means achieving the optimum design option in all performance areas of healthcare. For example, a design option that improves staff satisfaction substantially while reducing patient or family satisfaction significantly would not be classified as an optimum design intervention. Thus EBD should not only utilize the best available empirical research for healthcare design decisions but should also balance all those decisions in order to achieve optimal performance in all areas including clinical, operational, and financial.

Comprehensive EBD approach might also include some other design interventions that might be beneficial to optimize the design decisions. Researchers have been also investigating the effects of incorporating various design interventions in healthcare such as gardens (Marcus, & Barnes, 1995); green, ecological, and environmentally friendly designs, materials, and programs (Cohen, 2006; Guenther, & Atwood; 2006; Brannen, 2006; Rossie & Lent, 2006; Schettler, 2006 & Harvie, 2006); natural and artificial light sources (Joseph, 2006a); and better acoustics and sound absorbing finishes (Joseph, & Ulrich, 2007; Solet, Buxton, Ellenbogen, Wang, & Carballeira 2010).

Overall, EBD proposes a team with various backgrounds utilizing the best available evidence to make strategic design decisions while considering the unique environmental and economic conditions of a healthcare institution. If an EBD team uses a comprehensive approach during this decision-making process through balancing various design options, they would achieve a unique and dynamic design process. Moreover, this unique, dynamic and comprehensive design process can operate as an isolating mechanism itself because of causal ambiguity. Causal ambiguity indicates the difficulty of discovering the source of a competitive advantage due to ambiguous causal relationships (Peteraf, 1993; Lippman and Rumelt, 1982). Thus, such a team can potentially create a valuable, rare, inimitable, and non-substitutable resource through such comprehensive approach.

> *Proposition 4: A comprehensive EBD process would create causal ambiguity and satisfy VRIN criteria. This would lead to outstanding performance and ultimately sustained competitive advantage for healthcare service providers.*

DISCUSSION AND IMPLICATIONS

In this paper, we explored the possibility of EBD as a source of sustained competitive advantage for healthcare organizations. We explored this possibility by applying RBV's VRIN criteria on EBD. Out of the four VRIN criteria, "value" is the one most easily satisfied by EBD. EBD's capacity to satisfy other VRIN criteria depends upon its level of use and upon some isolating mechanisms. Isolating mechanisms such as organizational culture, information asymmetries, managerial capabilities, social complexity, unique historical conditions, and causal ambiguity (Rumelt, 1984; Dierickx & Cool, 1989; Peteraf, 1993; Barney, 1991) might transform EBD into a rare, inimitable and non-substitutable strategic resource.

After the VRIN criteria analysis of EBD, we developed four propositions by employing organizational culture, evolutionary economics, supply inelasticity and comprehensiveness of EBD's use for future empirical testing. EBD has a potential for an expansion because of its dynamism. Thus, more propositions can be developed in future studies.

This paper is an initial step in exploring EBD as a strategic resource. EBD is still in its infancy. However, its knowledge-base is expanding through additions of more empirical studies that are showing the link between physical environment and healthcare outcomes. The numbers of EBD-utilizing healthcare organizations are expected to increase along with the expanding knowledge-base. Thus, in the future, more opportunities will become available to test EBD's potential as a strategic source.

Theoretical Implications & Directions for Future Research

As discussed earlier, scholars are still debating on the status of RBV: whether it is a view or a theory. By emphasizing this debate we indicate the need for more studies that utilize RBV as a theoretical framework. Moreover, due to the suggestion of EBD as a possible strategic resource, the application dimensions of this paper overweight its theoretical contributions. But yet, since it suggests a new research avenue to test RBV's assumptions by using EBD, it might be considered valuable from theoretical perspective too. Furthermore, the extensive discussion on EBD's compliance with VRIN criteria also expands the dimension of theoretical application. Overall, since researchers can only confirm or falsify reliability of a theory by testing its assumptions, the proposals that lead future studies will expand the opportunities.

Managerial Implications

Most of the time, facility construction is the largest capital investment for healthcare organizations. As opposed to the other industries, healthcare industry continues construction spending even during recession times (see Figure 2). Decision makers in healthcare organizations always consider the pros and cons of large and one-time capital investments. During this consideration, it is worthy to consider the principles of evidence-based healthcare design. Research indicates that if it is utilized efficiently, EBD is capable of improving patient safety, and staff and patient outcomes (Ulrich et. al, 2008). EBD, also, promises to recover its initial extra cost within three years through operational savings (Sadler et al., 2011).

Even though, the propositions in this paper have not been empirically tested, we still encourage healthcare executives to not to disregard the potential of EBD. Given that, the attainment of sustained competitive advantage (SCA) is very important to healthcare executives. We recommend healthcare executives to consider both the supply inelasticity of facility construction and EBD's potential at the earliest possible point in the process. It is reasonable to take lessons from previous research and applications about the physical environment's effects on organizational culture, patient satisfaction, staff satisfaction, and various other healthcare outcomes before creating a new healthcare facility. A good EBD team can become very instrumental in creating sustained competitive advantage for healthcare organizations.

During the delivery of healthcare services, a team which is composed of various healthcare professionals would use the best available evidence to make decisions about the treatment of a patient. This is called evidence-based medicine. In a similar way, both before and during facility construction, a team with various backgrounds would seek the best available evidence while they are making certain design decisions. An EBD team would, in this instance act similarly to a medical team. A medical team uses evidence-based medicine through the art of balancing the demonstrated negative and positive effects of a procedure, drug, surgery, etc on various physical and mental dimensions of a patient in order to achieve optimal health. Similarly, It is expected from EBD team also to balance the effects of EBD by considering design interventions and their effects on various dimensions of healthcare performance. In this way, the structure component of Donabedian's structure-process-outcome framework for quality would be addressed by integrating team-work with the physical dimension.

CONCLUSION

In sum, if it is regarded as a static tool, EBD would not be a source of competitive advantage because it does not satisfy at least three of the VRIN criteria (i.e. Rareness, Inimitability, and Non-substitutability). However, if it is regarded as a dynamic and continuously evolving process, EBD has the potential to be a resource that would provide sustained competitive advantage to healthcare organizations. The knowledge-base for EBD is expanding. This expansion will allow scholars to empirically verify the potential of EBD in future.

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