CONSIDERATIONS FOR STREAMLINING A VERTICALLY INTEGRATED COMPANY: A CASE STUDY

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ABSTRACT

This study focuses on the application of vertical integration, supply chain management, and lean construction practices to Butler Manufacturing Company, a pre-engineered metal building manufacturing company. Butler engineers, designs, manufactures, and erects building systems and architectural products for the nonresidential construction market. It is currently the leading producer in the 5 billion-dollar metal pre-engineered metal building market. Butler is vertically integrated. Nevertheless, its design, manufacturing, and construction businesses operate more-or-less independently. The company therefore is not able to reap the benefits of a truly integrated enterprise.

In addition to describing the industry and Butler's organization, the purpose of this case study is to explore vertical integration within Butler for two reasons: (1) to identify means for achieving true integration amongst the company's various businesses and (2) to guide the company in becoming a "lean" organization. This study investigates the possibilities of achieving closer alignment between Butler's design/manufacturing arm and its construction arm. Such alignment may be achieved by implementing lean production principles not only within but also across organizational boundaries. This study also briefly touches on the company's supply chain.

This paper points out that Butler's design/manufacturing arm and its construction arm are not taking advantage of available opportunities presented by vertical integration, supply chain management, or lean production practices. It recommends that these divisions of Butler learn to work together more closely and toward joint exploitation of these opportunities.

KEY WORDS

Vertical integration, supply chain management, lean construction, pre-engineered metal building systems, Butler Manufacturing, BUCON, corporate strategy.

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INTRODUCTION

Butler Manufacturing Company (Butler) is a 100-year old company, famous for its pre-engineered metal buildings. Butler buildings have long clear spans and thereby provide unobstructed open floor space that can be used for warehousing, distribution centers, manufacturing plants, low-rise office buildings, etc. Butler designs and fabricates its primary structural elements by cutting and welding plate steel to form columns and beams, and its secondary structural members by cold-forming. Economy in materials is thereby achieved so that Butler buildings are more cost competitive than conventional steel buildings for these light-industrial applications. The threshold for economic superiority varies, however, with the market prices for steel.

Butler's buildings comprise relatively standardized and modular components. Despite the use of pre-engineered features in its building components, Butler has moved towards custom design over the years because the cost of design is relatively small compared to the cost of materials and manufacturing—the latter two accounting for nearly 85% of the product cost. This custom design aims at optimizing materials savings. Components are nevertheless standardized and pre-punched during manufacturing to allow for some flexibility downstream in the supply chain—namely, in shipping and during erection. By creating more unique designs for primary framing components and standardized parts for secondary members, an optimal structural solution is achieved. Nonetheless, Butler's handoff from design/manufacturing to construction is rather traditional, where loads of materials are shipped and staged at the site.

Butler comprises a Building Division (which has design and fabrication capabilities), BUCON (construction services), and other wholly owned subsidiaries. Butler thus has in-house design-build capabilities; however, vertical integration between manufacturing and construction is not as seamless as it could be. The primary purpose of this case study is to explore the benefits of application of vertical integration, supply chain management, and lean construction practices within Butler. The authors will investigate the possibilities of achieving closer alignment between Butler's design/manufacturing arm and its construction arm. This entails identifying internal hand-offs and buffers, and then creating flow and implementing other lean practices in Butler and its subsidiaries. This alignment may be achieved by implementing lean production principles not only within but also across organizational boundaries. At a later point, the case study may be extended to include an analysis of supply chain improvements with Butler's suppliers. The overall aim of this research is to assist Butler in further entrenching itself in the pre-engineered metal building market.

METAL BUILDINGS INDUSTRY IN THE UNITED STATES

Pre-engineered metal buildings have been used for over 150 years, starting with their application for housing in the 1840s during the California Gold Rush (Shoemaker 1999). Historically, pre-engineered metal building systems were used for hangars, sheds, and garages. More recently, technological improvements in welding, computer design methods, architectural finishes, and metal building technology (e.g., the introduction of standing seam roofs) have enabled engineers to adapt metal-building systems for new applications. These advancements have led to a steady growth in the use of pre-engineered metal building systems for structures such as schools, offices, churches, and shopping centers. In fact, nearly 70% of low-rise, nonresidential construction involving buildings with less than 150,000 square feet (roughly 14,000 m^2) is done with metal building systems, according to the Metal Building Manufacturers Association (Shoemaker 1999).

Today, the pre-engineered metal building market is valued at $5 billion, with a compound annual growth rate of 6.1% for the period 1998 to 2003 (Darnay 2000, DeJong 1999). Due to higher demand and a boom in construction, the compound annual growth rate of the market in the period 1993 to 1997 was 9.3%. The strongest growth occurred in 1994, when the market grew by 16.4% (DeJong 1999).

In contrast to the more fragmented steel and heavily fragmented construction industries, the pre-engineered metal building industry is concentrated and oligopolistic. The top three competitors in this market, Butler, Varco Pruden, and Robertson Ceco, account for 55% of the market. With a 25% market share, Butler is the leading producer of metal building systems (DeJong 1999). Competition among manufacturers of pre-engineered buildings is based primarily upon price, service, product design and performance, and marketing capabilities (Butler 2000).

The basic elements of any pre-engineered metal building system are constant: primary rigid frames, secondary members (wall girts and roof purlins), cladding and bracing (Shoemaker 1999). The secondary members are usually cold-formed into C and Z shapes. The primary frames are designed using welded plate members instead of the hot-rolled sections used in conventional steel design. This practice permits the use of tapered beam sections. By varying the web depth and flange size over the length of a member, pre-engineered metal manufacturers can produce designs that are more cost effective than their conventional steel counterparts. Pre-engineered buildings compete with conventional forms of building construction in the low-rise commercial, community, industrial, and agricultural markets. Competition amongst substitute products is primarily based upon cost, time of construction, appearance, thermal efficiency, life-cycle performance, and other specific customer requirements (Butler 2000).

COMPANY ORGANIZATION

Butler engineers, designs, manufactures, and erects pre-engineered metal buildings and components both domestically and internationally. The company's sales netted $960 million in 2000 (Butler 2001 p. 1). Butler is functionally organized, with products and services falling into four principal business segments (businesses and subsidiaries and relative segment sales are in parentheses (Butler 2000)):

1. **Building Systems** (Building Division, Lester, and Butler International; 61%), provides custom-design services and fabricates pre-engineered steel and wood-frame building systems for commercial, community, industrial, and agricultural uses;
2. **Construction Services** (BUCON; 15%), provides construction management services for purchasers of large, complex, or multiple-site building projects;
3. **Real Estate** (Butler Real Estate; 3%), provides build-to-suit-to-lease development services for corporations that prefer to lease rather than own their facilities; and
4. **Architectural Products** (Vistawall; 21%), delivers primarily curtain-wall and storefront systems, custom window systems, skylights, and roof vents for low-rise, medium-rise, and high-rise non-residential buildings.

Since the bulk of Butler's work is accomplished via its Building Division segment and BUCON, this study focuses on these two divisions. The following sections describe the main functions and operations pertaining to these two divisions.

ENGINEERING DESIGN

Butler performs the design of its pre-engineered metal buildings in-house because the required structural engineering knowledge in cold-formed steel design is neither widely taught nor readily available. Butler's engineering design function is distributed amongst its businesses and manufacturing locations. Butler has engineering design offices in each of its manufacturing facilities to serve regional markets. These design offices handle the more routine designs of smaller projects. Butler's construction arm, BUCON, also has its own engineering forces to design the building projects it oversees. In addition, Butler has a main engineering office at its headquarters in Kansas City, MO to manage projects of exceptional scope and size. The company also uses this main office to handle any overflow designs if the engineering resources of the other design offices are overburdened. In case all Butler's design engineers are otherwise engaged in projects, Butler may contract with a select group of structural design firms in the Kansas City area. All non-BUCON related design work is scheduled out of Butler's main office and is then assigned to the various engineering and manufacturing facilities.

MANUFACTURING

Butler manufactures pre-engineered metal buildings and light-gauge roof and wall panels. In fact, the company holds patents covering several product technologies, mostly in the cladding systems.

Butler's Building Division has six manufacturing facilities, distributed geographically across the United States, to serve the North American metal building market. The work performed at these facilities includes conventional metal fabricating operations, such as punching, shearing, welding, extruding, and forming of sheet and structural steel. Butler also operates painting lines for its structural steel components. Butler's manufacturing facilities vary in size, with the largest being eight to ten times bigger than the smallest. All six plants have the ability to make the primary structural components and at least some of the panel systems. Some plants make certain structural cold-formed shapes that the other plants do not produce.

Butler's largest and smallest plants in Galesburg, IL, and Visalia, CA, respectively, are well on their way to implementing lean production practices. The remaining facilities are implementing *kaizen* (continuous improvement) in order to drive lean production. Butler conducted over 300 kaizen work studies last year (Butler 2001 p. 13). Visalia employees for example, with the help of industry consultants, have created a value stream map of their structural steel fabrication process. This value stream map uses a symbol system that was developed in the course of implementation of the Toyota Production System; it was recently documented by Rother and Shook (1998). Employees use this map to reorganize work at the job-floor level in order to better manage production flows. As a result of kaizen, they have relocated machines in order for production lines to be physically straightened out where possible. They also have strategically sized work-in-progress inventories and physically located them in so-called 'supermarkets.' Their new capital investments in tools and equipment do not necessarily favor bigger and faster machines, but rather aim at alleviating bottlenecks and balancing production lines. Visalia employees continue to organize *kaizen* exercises on a bimonthly basis.

The design and procurement processes performed in-house at the Visalia plant have also been mapped, but lean production principles in this area have yet to be applied. It is striking that the hand-off from design to fabrication—governed by Butler's proprietary, computer-aided design system, named Pronto—is traditional and batch-oriented. Opportunities for process improvement are to be investigated in this area.

A typical Butler manufacturing plant operates two 8-hour shifts per day, five days per week, during non-peak seasons. The company experiences seasonal customer demand that peaks during the summer months. Sales during the third quarter are typically 30% greater than sales during the first quarter. To accommodate such market variability, Butler's plants employ three shifts, instead of two, during the peak season. Butler has realized that by working more closely with construction owners, it can reduce its workflow variability and thereby be more competitive and profitable.

CONSTRUCTION

Butler brings its building systems' products to market through various agreements with contractors. It sells its materials predominantly through two construction channels—Butler Builders and BUCON (Figure 1).

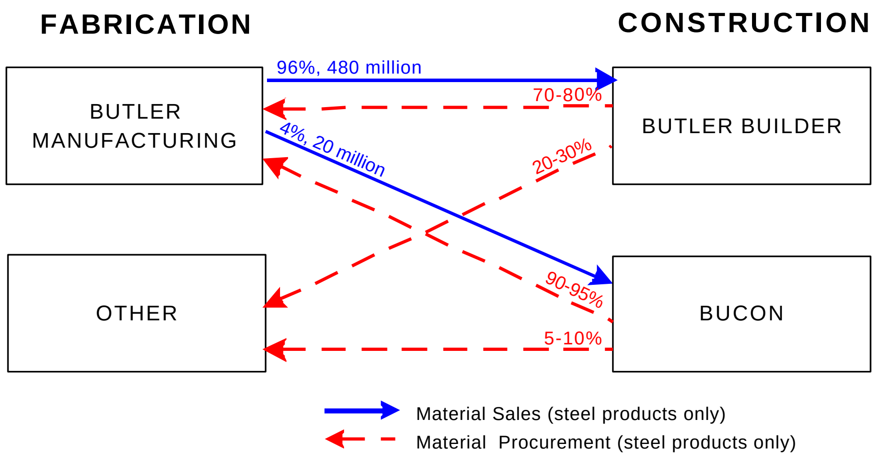

Figure 1: Steel product flows between fabrication and construction (in US dollars)

Butler Builders

For most buildings, on the order of 50,000 to 100,000 square feet (roughly 4,500 to 9,000 m^2), Butler works through local, independent general contractors called Butler Builders. These contractors can manage Butler projects and erect Butler structures, but they also build conventional structures.

Butler builders work with owners to identify project needs and may hire architect-engineers (AEs) to develop the main architectural design of the facility (Figure 2). Butler gets involved in the project delivery process only after the owner has decided to build a Butler building. This decision tends to be made after a significant number of design choices already have been locked in. Butler then handles the structural engineering (a Butler engineer may act as the structural engineer of record) and shop detailing phases, manufactures the components, and delivers them to site. In the meantime, Butler Builders make arrangements to erect the structure either with their own labor forces or through a subcontract.

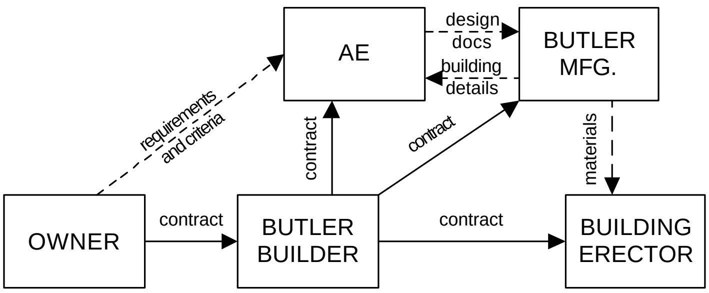

Figure 2: Butler Builder Project Delivery

Butler uses a network of over 1,500 Butler Builders (of which 1,200 in the US nationwide) to market and distribute its Building Systems products throughout the world. Butler Builders are independent general contractors authorized by Butler to sell and erect Butler Buildings based on their high standards for quality, customer service, and value. In addition to providing construction services, the Butler Builders, in many cases, offer complete design and engineering services—that is, most of them have design-build capabilities. Butler Builders range from very small, sole proprietorships, to large general contracting firms. Butler has assigned them specific territories by county across the United States.

Butler delivers 70-80% of the materials needed by these independent contractors (Figure 1). So, although the company does not have an exclusive relationship with the Butler Builders, it is a major supplier to them. Butler Builders can elect to bypass Butler by using conventional steel or substitute products. However, when they opt to use a pre-engineered metal building system, they do so through Butler. Butler does not have a franchise relationship with the Butler Builders, but it does have an affiliation that is stronger than a regular distributorship.

Butler Builders are generally small and more-or-less restricted in geographical operating radius. Due to their size and geographic restriction, Butler learned that it could not adequately serve its large national customers with only the Butler Builders.

BUCON

In the 1970s, in an effort to gain more control over its distribution channel, Butler forward integrated into construction by creating Butler Construction (also known as BUCON, Inc.) initially as a design-build general contractor. While Butler uses the Butler Builders to market its pre-engineered metal building products, through BUCON it also maintains its own construction forces to pursue projects independently of/or in conjunction with Butler Builders. BUCON operates as a separate company—albeit a wholly owned subsidiary of Butler. BUCON provides comprehensive design, planning, execution, and construction management services to major corporations with large or complex facility needs, such as 1,000,000 square feet (roughly 90,000 m^2) distribution centers, hangars, athletic arenas, and manufacturing plants. BUCON's revenues are derived primarily from specialty contracting, providing the building shell erected to general contractors or building owners. Competition is based mainly upon price, time necessary to complete a project, design, and product performance (Butler 2000).

Butler launched its BUCON subsidiary in an effort to respond to the needs of construction owners. BUCON allows Butler to engage in projects that are a lot larger (on average 300,000 square feet or 27,000 m^2) than it otherwise would be able to pursue via a typical Butler Builder. Furthermore, BUCON serves as a single-point contact for owners who have multiple construction projects that are located beyond the operating radius of any one Butler Builder.

BUCON includes two operating units, Butler Erection Services (BES) and Butler Heavy Structures (BHS). BES, the smaller of the two units, serves the general building market. BES employs approximately 30 to 150 ironworkers who travel from project to project around the country. BES rents cranes locally to support its steel erection work. This setup is unique as compared to the more traditional setup of steel erectors who own their cranes but work with a local labor force only on local projects. In contrast to BES, BHS serves market segments requiring large complex building designs using heavy fabricated mill steel in combination with Butler's pre-engineered secondary structural and metal cladding systems.

BUCON's role in the construction process varies on a project-by-project basis. It can act as the designer, general contractor, and/or a material-erect subcontractor to another general contractor. BUCON, itself, does not compete with Butler Builders since its mission is to supplement the Builder organization and its projects are normally much larger than Butler Builder projects. Sometimes, BUCON subcontracts out work to a Butler Builder. BUCON also performs "furnish and erect" and "material only" subcontracts using products from several Butler company businesses, predominantly the company's Building Division.

Regardless of BUCON's role in a project, Butler's Building Division typically manufactures and furnishes its product to BUCON. For select projects, BUCON can purchase hot rolled steel shapes from other fabricators to expand its scope beyond Butler's pre-engineered buildings, if those shapes are the most appropriate solution to meeting particularly heavy load requirements.

VERTICAL INTEGRATION ANALYSIS: BENEFITS

Porter (1980) defines vertical integration as the combination of technologically distinct production, distribution, selling, and/or other economic processes within the confines of a single firm. It represents a decision by the firm to use internal or administrative transactions, rather than market transactions, to accomplish its economic purposes. While Butler is a vertically integrated company that can design/engineer, manufacture, and erect prefabricated metal buildings and components, this does not mean that it always performs all these functions. Instead, Butler's Building Division and BUCON can take on any combination of roles, as described in the previous sections.

Figure 3 illustrates alternatives for Butler's Building Division (referred to as Butler Manufacturing), Butler Builders, BUCON, and others to offer design-build services. The thickness of the lines in the figure reflect the frequency or commonality of occurrence of supply chain relationships. The model that Butler historically has pursued is shown in black (the thick line connecting Butler Mfg.–Butler Mfg.–Butler Builder–Butler Builder). This case study looks into how Butler and BUCON can better exploit their 'preferred' relationship (which many other companies would find enviable) rather than behaving to the extent they do as independent companies.

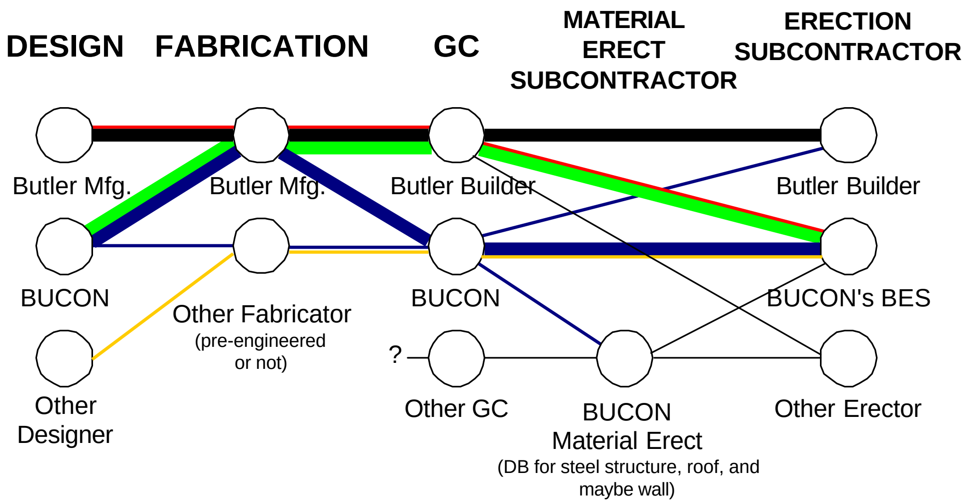

Figure 3: Vertical Integration of Project Services

While Butler prides itself on being vertically integrated, it has not tapped all the potential benefits of vertical integration—especially between BUCON and the Building Division (Butler's manufacturing arm). Vertical integration has important benefits and costs that need to be considered in any strategic decision, the significance of which will depend on the particular industry (Porter 1980). Both the costs and benefits need to be examined in order to assess fully the implications of vertical integration within a firm. The following subsections examine the advantages of integration and test their application to Butler's present case—specifically focusing on the relationship between Butler Manufacturing and BUCON. The costs of integration are then addressed in the subsequent section.

ECONOMIES OF COMBINED OPERATIONS

By putting technologically distinct operations together, the firm can sometimes gain efficiencies (Porter 1980). Butler has reaped such economies by integrating its engineering design and manufacturing in-house. In fact, as explained earlier, Butler has located its engineering design offices next to each of its manufacturing facilities, in order to cater to regional market needs. The structural engineers at Butler have specialized knowledge and use computer programs specifically tailored to design pre-engineered building systems. By performing the engineering in-house, Butler is able to design systems around the parameters specified in its manufacturing plants. Most outside structural engineers would not be able to design a structure that is supported by Butler's manufacturing process. Furthermore, for Butler to have a flexible manufacturing system capable of accomplishing a range of designs is cost prohibitive to own and to operate. Hence, by having structural engineers in-house, Butler has exploited cost savings related to combined operations.

ECONOMIES OF INFORMATION

Integrated operation may reduce the need for collecting some types of information about the market, or, more likely, may reduce the overall cost of gaining information (Porter 1980). Butler has capitalized on and can further exploit such economies in two main ways.

First, Butler's Building Division can use BUCON's material sale projections to better plan its plants' production needs. Even though Butler has a Butler Builders advisory council, this source does not provide information as openly as BUCON can. After all, market information flows more openly through an organization than through a series of independent parties (Porter 1980). Butler can therefore use BUCON to obtain faster and more accurate information about the end customer.

Butler's internal relationship with BUCON—its single-largest builder—provides transparency of the market information. However, Butler and BUCON can make their relationship even more transparent and thereby allow for better distributed decision making by each organization. If BUCON had a better idea of the Building Division's capacity utilization due to work from the Butler Builders and, likewise, if the Building Division had a better handle on BUCON's demand, Butler could move closer to true integration. The extent to which Butler has exploited this type of economy is not visible to the authors and requires further investigation.

Second, a great benefit of vertical integration between the construction, engineering, and manufacturing functions is access to technology. Since Butler's Building Division has a research and development (R&D) facility in Kansas City (near Butler's and BUCON's headquarters), BUCON is able to utilize this technology to better market itself against other specialty contractors. This access of product R&D is rarely found in the construction industry and presents a great competitive advantage for BUCON. Similarly, BUCON is a great source of construction R&D (constructibility input) for the Building Division. Butler's R&D facility uses construction innovation from BUCON to improve product performance and/or reduce product cost. Slaughter (1992) found that while innovation by builders occurs to a great extent in the construction industry, manufacturers rarely commercialize the builders' innovations. Butler's unique in-house construction and manufacturing capabilities should allow it to develop products that are more marketable and constructible against its competitors who do not have this joint capability internally.

ECONOMIES OF STABLE RELATIONSHIPS

Both Butler's manufacturing division and BUCON could develop specialized procedures for materials, information, and financial transactions between each other that would not be feasible with an independent supplier or customer—where both the buyer (BUCON) and the seller (Butler's Building Division) in the transaction face the competitive risk of being dropped or squeezed by the other party (Porter 1980). The stability of the relationship will allow Butler's manufacturing arm to tune its products to the exact requirements of BUCON (e.g., by making more constructible products). Similarly, it will also allow BUCON to adapt itself more fully to the characteristics of Butler's manufacturing arm—the reason why BUCON was started in the first place.

ECONOMIES OF AVOIDING MARKET TRANSACTIONS

By operating as an integrated unit, Butler's manufacturing and construction (BUCON) divisions save on some of the selling, price shopping, negotiating, and other costs of market transactions (Williamson 1975, 1979, Porter 1980). Although there may be some negotiating between the two Butler divisions, this cost should not be nearly as great as that of selling to or purchasing from outside parties. Butler's marketing department is rightfully limited in size because Butler distributes most of its products via its network of Butler Builders. The balance of the products is sold in-house to BUCON (Figure 1), which also allows Butler to maintain only a small sales force. Similarly, because BUCON purchases most of the material it needs from Butler, BUCON's purchasing department can be very small.

In its effort to assist Butler in gaining presence in a market segment where hot rolled milled shapes have greater applicability, BUCON has in recent years purchased more steel from independent fabricators. If this continues, BUCON will have to increase the size of its purchasing department—a transaction cost that is not automatically apparent. BUCON fails to see the transaction costs involved in dealing with companies outside of Butler. Costs pertaining to transactions on the open market may be significant. Furthermore, while the cost of conventional steel may be competitive presently—as severe deterioration in the world steel market prompted foreign producers to dump steel into the US market (Standard 2000)—this situation could very well change in the near future.

Butler and BUCON could jointly engage in target costing, based on the customers they jointly pursue (Cooper and Slagmulder 1997, 1999). This effort would exploit Butler's in-house design, fabrication, and construction capabilities.

ECONOMIES OF PRODUCTION (INTERNAL CONTROL AND COORDINATION): LOAD LEVELING VS. SURGING

The costs of scheduling, coordinating operations, and responding to emergencies may be lower if the firm is integrated. Furthermore, steadier supply of raw materials or the ability to smooth deliveries may result in better control of production schedules, delivery schedules, and maintenance operations (Porter 1980). Porter states that such economies of control can reduce idle time, the need for inventory, and the need for personnel in the control function. While Butler has integrated some of the construction (via BUCON) into its business, it has not managed to reap all these economies of production. As a matter of fact, because Butler's Building Division and BUCON coordinate their projects separately and because they are in different businesses (manufacturing vs. construction), they understand little about or show little concern for the demands of each other's business.

BUCON, for example does not firmly grasp how Butler goes about manufacturing scheduling. In fact, BUCON prides itself on building projects in record time. It advertises this as a customer sales pitch. BUCON accomplishes this by staging most—if not all—of the fabricated materials needed for the project near the construction site, in predefined phases. This means that much of Butler's pre-engineered, custom-made products for a given phase must be delivered before erection commences. For example, BUCON recently erected the structure of a 1 million square-foot facility in Hurricane, Utah, using 6 cranes in a mere 28 days! Part of that material was fabricated at the Visalia plant; the balance was fabricated in the San Marcos, TX, and Galesburg, IL, plants. Manufacturing all the material in the Visalia plant in the time frame BUCON desired would have tied up the plant for a long time and prevented it from doing other jobs for Butler Builders. Such surging of demand for fabrication challenges Butler's ability to schedule work at manufacturing plants. In and by itself, surging of demand might not be a problem for the manufacturing plants if only the timing of the surges were predictable and reliable. However, large uncertainty in BUCON's demand (the overall project schedule may or may not be controlled by BUCON) makes it difficult for Butler to schedule other work. If and when a large BUCON project is delayed, Butler may not be able to reschedule other demands at its manufacturing facilities in order to use idle production capacity effectively.

Figure 4 illustrates the situation in a highly simplified manner. The plant's capacity is shown to be constant over time. In reality, it varies with the nature of the product being produced and the number of shifts being worked. BUCON's demand for product, as dictated by its pre-project schedule, is shown with a solid line. As uncertainties manifest themselves on the project during execution, BUCON may have to revise its demand (shown with a dashed line, the black arrow highlights the shift). This situation becomes especially problematic when the updated demand exceeds plant capacity.

Fabricating BUCON products early may not be an option, especially when significant design uncertainty is causing the delay. Furthermore, with the two divisions (BUCON and Butler's Building Division) operating more-or-less independently, the Building Division could very well refuse to pay the holding cost for completed, fabricated-steel components. Laydown yards at Butler plants also tend to be limited in area. Clearly, problems abound with BUCON's roadrunner mentality, which it believes is necessary to respond to the needs of the construction industry.

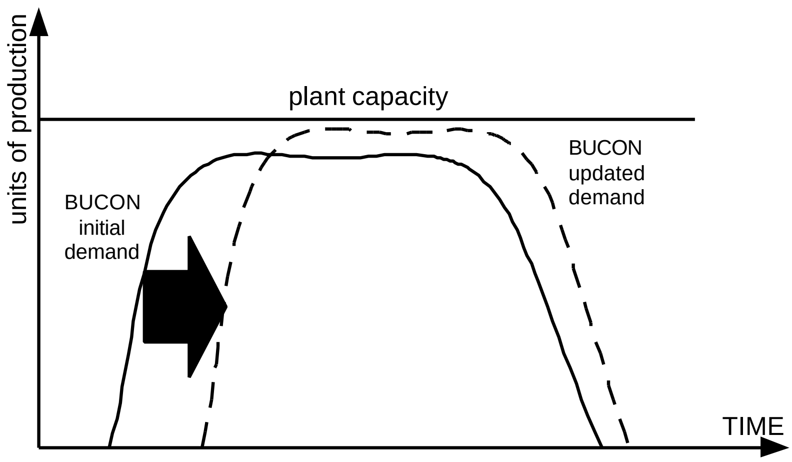

Figure 4: Surging of Demand on Fabrication Capacity and Delay in Demand due to Project Uncertainty

The authors remind the reader of the story of the tortoise and the hare. The hare may have been running fast, yet the tortoise won the race! BUCON's choosing to be a hare strains its own as well as the Building Division's production system. An area of further research therefore is to investigate BUCON's potential ability to smooth demand, thereby allowing for better control of manufacturing production schedules, delivery schedules, and maintenance operations (Ohno 1988, Porter 1980, Rother and Shook 1998).

ASSURE SUPPLY AND/OR DEMAND

Vertical integration assures the firm that it will receive available supplies in tight periods or that it will have an outlet for its products in periods of low overall demand (Porter 1980). Because the Building Systems segment is a major supplier to BUCON, BUCON is able to plan better with lower risk of interruptions, elimination of changes in suppliers, and lower risk of being caught in a situation in which prices in excess of average market prices must be paid to meet an emergency. However, the reverse scenario is not true. Since BUCON is a small customer to the Building Division, the Building Division does not enjoy a similar assurance in demand from BUCON.

ENHANCED ABILITY TO DIFFERENTIATE

Vertical integration can improve the ability of the firm to differentiate itself from others by offering a wider slice of value, added under the control of management (Porter 1980). This aspect allows BUCON to differentiate itself from its competitors by providing Butler's patented products. The technology that sets Butler furthest apart from its competitors is its double-lock standing seam roof—better known as MR-24®. Butler's patented systems are a quality/value trade-off for building owners. Butler holds patents covering several product technologies (mostly in the cladding systems), but it does not license to any third parties. Therefore, in the market segment in which BUCON operates, it has sole access to Butler's products.

ENTER A HIGHER-RETURN BUSINESS

A firm may sometimes increase its overall return on investment by vertically integrating. If the stage of production into which integration is being contemplated has a structure that offers a return on investment greater than the opportunity cost of capital for the firm, then it is profitable to integrate, even if there are no economies of integration per se (Porter 1980). Butler's forward integration into construction in the 1970s may have been a wise move since the construction industry was booming at the time. After all, the barriers for entry into the construction business have always been very low. There is no proprietary technology and no large capital requirement to enter the business, although bonding capacity is an issue. Furthermore, most construction costs are variable in nature, varying with production. Nevertheless, the construction industry is—generally speaking—not as lucrative as manufacturing or fabrication. As mentioned, by integrating construction into its business, Butler has gained an opportunity to learn more about what drives the delivery-to-market of their product and gain constructibility knowledge that it can incorporate into its designs.

ELEVATE ENTRY AND MOBILITY BARRIERS

If vertical integration achieves many of the aforementioned benefits, it can raise mobility barriers. These benefits give the integrated firm some competitive advantage over the un-integrated firm, in the form of higher prices, lower risk, or lower costs (Porter 1980). In this case, as capital requirements for entering the construction industry are not significant, the compulsion for other pre-engineered metal building companies to be integrated (into construction) has little competitive significance. In addition, since material suppliers tend to be much larger than the contractors they serve, they exert high bargaining power in the construction industry. The low entry barriers in the construction industry allow any such supplier to potentially forward integrate. For example, mechanical equipment suppliers could enter the mechanical subcontractor market. Such market shifts are currently taking place. Consequently, Butler's forward integration into construction does not elevate mobility and entry barriers.

DEFEND AGAINST FORECLOSURE

Even if there are no positive benefits of integration, it may be necessary to defend against foreclosure of access to suppliers or customers if competitors are integrated (Porter 1980). General contractors would have a difficult time obtaining materials from pre-engineered metal building manufacturers if these manufacturers offered in-house construction, as in Butler's case. The current consolidation in the construction industry can only stand to entrench Butler's integrated position in the market.

VERTICAL INTEGRATION ANALYSIS: COSTS

The costs of vertical integration are also important in assessing Butler's case from a strategic perspective. Since most of the costs of Butler's forward integration into construction are low—i.e., low entry and exit barriers, low capital investment requirements, low fixed costs—these costs are not elaborated on in this paper. Nevertheless, there are three costs of integration that Butler cannot overlook.

MAINTAINING PRODUCTION BALANCE

The productive capacities of the upstream and downstream units in the firm must be held in balance or potential problems arise. The stage of the vertical chain with excess capacity (or excess demand) must sell some of its output (or purchase some of its inputs) on the open market or sacrifice market position (Porter 1980). Both Butler's Buildings Division and BUCON need to learn to ensure proper balance between themselves so as not pay this cost of integration. This step is tricky because the vertical relationship often compels the firm to buy or sell from its competitors. For this reason, when Butler's manufacturing arm was unable to satisfy BUCON in terms of price and schedule, BUCON has opted to shop for services elsewhere. This is not so much of a problem for Butler's Building Systems—although an opportunity is thereby lost—because it can sell its excess output to Butler Builders. The greater difficulty arises when demand surges, as described earlier.

DULLED INCENTIVES

Vertical integration means that buying and selling will occur through a captive relationship. The incentives for the upstream business to perform may be dulled because it sells in-house instead of competing for the business (Porter 1980). BUCON feels that Butler's manufacturing arm has lately become less price and schedule competitive due to this. By contrast, the manufacturing arm has a differing perspective because it sells 96% of its products externally via the Butler Builders. Whether or not these dulled incentives actually reduce performance in Butler is a function of the managerial structure and procedures that govern the relationship between the administrative units in the vertically-integrated supply chain.

DIFFERING MANAGERIAL REQUIREMENTS

Businesses can differ in structure, technology, and manufacturing despite being vertically integrated. Manufacturing and construction are fundamentally different—both in structure and mentality. Construction tends to promote the roadrunner mentality. Butler's Building Systems division has begun to think in terms of lean production. The tendency to apply or to expect the same managerial style in both elements of the chain is a major risk of integration. Understanding how to manage such different businesses is a major cost Butler is incurring. Management capable of operating one part of the vertical chain very well may be incapable of effectively managing the other. A common managerial approach can be counterproductive for vertically integrated businesses.

SUPPLY CHAIN MANAGEMENT

Increased competition in today's global markets and heightened expectations of customers have forced firms to heavily invest in their supply chains (e.g., Simchi-Levi 2000) and establish various kinds of preferred relationships. Table 1 presents alternative forms of supply-chain collaboration.

Type of Collaboration Structure	Vertical Integration (mergers & acquisitions)	Joint Venture	Direct Equity Position	Licensing	Single Sourcing	Preferred Suppliers	Market-Based Contracting
Mode of Governance	Hierarchical	Collaborative					Competitive
Equity Stake	100% ◄——►		1%	0%	0%	0%	0%
Description	Firms wholly owns or has controlling interest in supplies	Firm and supplier establish a third firm to provide goods and services	Firm takes equity stake in supplier	Permission to utilize a firm's patents or proprietary technology for a fee or royalty payment.	Collaborative relationship without ownership by guaranteeing business over a length ot time	Collaborative relationship with a limited number of accredited suppliers	Firm selects from available suppliers on the basis of short term contracts (no alliance)

Table 1: Continuum of Collaborative Options
[adapted from Sanderson and Watson (1997 p. 390) and McCann and Gilkey (1988)]

The literature on supply chain management talks about the flows and handoffs of information, products, and funds, but it rarely touches on production system design. Yet, it is important to make a clear choice regarding the design of the production system(s) that organizations in the supply chain will use. This choice affects how in-house operations of any individual firm are executed and managed, and, more importantly, it affects how operations that involve multiple firms are executed and managed. It is in these areas that lean construction contributes a theoretical basis that is unclear or absent in the literature on vertical integration and supply chain management. By applying lean principles, Butler may find a more satisfactory balance between design/manufacturing and construction than it currently has.

Butler's in-house design, manufacturing, and construction capabilities represent complete vertical integration of the organizations involved. In addition to managing its vertically integrated businesses, Butler has also achieved different levels of supply chain integration with its external suppliers. The question of vertical integration vs. other means of collaboration—i.e., the make vs. buy decision—needs to be explored more fully for Butler's case.

COMMODITY PRICE EXPOSURE

Butler's primary commodities are steel, aluminum, and wood. Steel is the company's largest purchased commodity, and steel is not cheap. In fact, 70 to 80% of Butler's manufactured product cost is in the steel itself. To protect against potential price increases, Butler enters into forward steel purchase agreements in its metal buildings business for periods of approximately one-year duration. To the extent that there are increases in the company's steel costs, they are generally recaptured in the company's product sales prices (Butler 2000). Typically, Butler's Building Division centrally establishes one contract with each supplier. Generically, Butler's Building Division projects rough material requirements for its various products. The mills then quote annual pricing based on Butler's projected volumes. If Butler were able to reduce the seasonal variability of its demand for steel, steel mills might provide even better pricing to Butler.

Butler has investigated how it might further enhance its buying power. It has found that the structure of its metal building business does not support the idea of pooling steel purchases with buyers from other industries. Butler already is a significant purchaser of steel, and mills are typically configured to support the construction market—not the construction market and another segment. In other words, pre-engineered metal building manufacturers buy from different mills than do automobile- or appliance manufacturers.

OTHER MATERIAL SUPPLIERS: DOOR AND WINDOW MANUFACTURERS

Besides steel mills, Butler deals with other suppliers. Depending on its projects, Butler may also supply doors, windows, ventilators, and rainwater drainage systems. To gain better access to new window and door products, Butler became even more vertically integrated by acquiring door and window suppliers. In March 1997, the company acquired certain assets of Rebco West, Inc., a west-coast manufacturer and distributor of entrance doors and storefront products. In June 1997, Butler acquired Moduline Windows, Inc., a manufacturer of architectural windows for the nonresidential buildings market (Butler 2000).

Butler has also formed a downstream alliance with an overhead door supplier. In an effort to gain more buying power, Butler is trying to aggregate door demand with other door customers. By forging more strategic alliances with its suppliers and working with other companies to aggregate demand, Butler could possibly broaden its supply chain.

CONCLUSIONS

Butler's Building Division and BUCON are facing opportunities to exploit vertical integration, which they are currently not taking advantage of to the fullest extent possible, These two divisions must learn to work together more closely and toward a common goal. They are co-dependent on one another, but this point is not totally apparent when judging either side's current practices. Issues arise as to how each division should deal with this situation. Decisions made by one division could materially affect the performance of the other. In the end, incompatible behavior would deteriorate the performance of Butler as a whole.

The paper has shown that the intended benefits of vertical integration according to Porter (1980) have not been realized in this case. Perhaps true vertical integration is not what Butler should aim for. In fact, few books on supply chain management and lean production even mention vertical integration. Besides vertically integrating, numerous other means for collaboration exist. Moreover, vertical integration often reflects financial reporting but does not in-and-by-itself guarantee an appropriate design of the production system. Lean construction provides as an alternative a more fundamental way of conceiving process interactions within and across organizational boundaries. Butler is already moving towards becoming a lean company. It is implementing lean practices in its fabrication facilities. The Galesburg plant is successfully leading the way over Butler's other manufacturing facilities. Furthermore, BUCON has recently engaged consultants to help make their organization leaner. The company should further extend the application of lean production to managing its design arm, construction, and project acquisition.

This case study hopes to help create the basis for transparency that is needed between the two divisions in order to assist them in making mutually beneficial decisions. While working towards a better balance between the production systems of Butler's Building Division and BUCON, the company can also focus on taking greater advantage of other supply chain improvements in order to enhance its overall competitiveness.

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