Implementing Business Analytics within the Supply Chain: Success and Fault Factors

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Abstract: Implementing business analytics across a large company is more about understanding that organization's culture, than it is about the actual technology. Understanding an organization's motivation, advantages and roadblocks is imperative for successful implementation and benefit. This research examines both the critical success factors along with the implementation faults of the largest steel producer in North America, and discusses how these cultural factors play out on a large scale during an ERP implementation. First, this research identifies general critical success factors as business plan and vision; change management; communication; ERP team composition, skills and compensation; project management; top management support and championship; and system analysis, selection and technical implementation (Hoon Na and Delgado 2006). Then, general implementation faults are identified as operational problems, motivational problems, knowledge problems and regulatory problems (Mayntz 1997 in Niehaves, Klose, Becker 2006). These theories are applied to the specific case of Nucor Steel. Application is contextualized through a historical perspective, identifying a low-cost business model, and enormous divisional autonomy as hindrances to the implementation of a common, shared ERP. A timeline of business analytics at the company is given, beginning in 2002, at which point a culture shift occurred though the acquisition of a major competitor. Divisional autonomy at this time, began to be challenged, leading to easier integration of reporting systems and cross-company data analysis. Then, details are provided as to how this company is making a case for a new, innovative, business model and how it is developing needed expertise in the area of business analytics. Changes in the steel business are requiring companies to move from a low-cost model to a value-added model increasing the need for innovation in all areas of the company. These innovations inevitably require the use of more complex data analytics that cut across the entire company, instead of a limited, independent divisional approach. Finally, this paper looks at how a current, actual, implementation is being planned and employed within the culture. Through the use of "Best Practices" teams, the company is facilitating communication and collaboration among previously autonomous divisions. These teams are charged with developing processes that will allow for innovation and improvement in all areas of the business. Additionally, in-depth and timely details are provided in this discussion as this ERP implementation is currently underway. This research allows for a foundation as future work can investigate further developments in this migration of both the company's ERP and its culture.

Keywords: success factors, implementation faults, business analytics, enterprise resource planning, ERP, historical considerations

1. Introduction

As companies become not only consumers, but also producers, of big data, data analytics has become more and more important to a company's future (Liu 2015). Companies who see data analytics as a competitive advantage must look within at internal drivers and roadblocks to this innovation prior to implementing these process changes. As more companies recognize these competitive advantages, business intelligence and analytics have become significantly more important in both academic and industrial areas over the last twenty years (Chen, Chiang and Storey 2012).

In order to leverage advantages from data analytics, companies are currently tasked with transitioning to a model that enables Business Intelligence on a large scale. This transition involves much more than implementing software. For many companies cultural and environmental issues must be considered as well. This paper describes relevant success factors and implementation faults and how each relate to one company in the manufacturing sector. As the largest steel producer in the United States, the Nucor Corporation has a significant manufacturing infrastructure and an accompanying infrastructure in technology. Reliant on varied systems, from shop floor level II systems to payroll and compliance, data are produced and consumed at surprising levels.

In order to address the complexity of moving to a model where data analytics can be a competitive advantage, the culture of this organization must be viewed through a theoretical lens. First, a process theory approach (Markus & Tanis 2000) will be described in the context of this implementation. Second, the historical context of Nucor, as a low-cost commodity producer will be examined, and how this business model allowed for enormous growth throughout the company's history. Third, the impetus for a deviation from this simple model

will be explained and how this new business model required Business Analytics and the development of new expertise within the company. Throughout this document details will be provided as to how general success factors and implementation faults specifically apply to this case.

2. Theory and Methodology

This study utilized a process theory (Markus & Tanis 2000) approach in order to understand the influence of critical success factors and implementation faults within the company's ERP migration. This theoretical foundation organized ERP migration into 4 distinct phases.

The first phase, chartering, involves making the business case for the migration along with determining the constraints of the solution. The second phase, the project phase, focuses primarily on system configuration, testing and training. The third phase, known as shakedown, includes the phases typically considered "going live" and subsequent testing and configuration changes. This phase continues until the system is considered stable, and users fall into routine use of the system. The fourth and final phase, onward and upward, includes maintenance and enhancements of the no-longer-new system.

2.1 Success factors identified

Within these phases, seven critical success factors were identified as a business plan and vision, change management, communication, ERP team composition, skills and compensation, project management, top management support and championship, and system analysis, selection and technical implementation (Hoon Na and Delgado 2006).

A business plan and vision are required in order to make a case for an ERP implementation or migration. Without a clear focus and vision, key participants will not understand their respective roles. Along with a justification of why a change in process is needed, identifiable goals and targets must be established prior to the migration.

Change management is a requirement in that, the new ERP system will bring about numerous process changes involving many areas groups and contributors. In order for these changes to become successful, good change management is required. Because change is a difficult and a complex process, care must be taken that the change management process fit within the context of the culture of the organization.

As with most change, effective communication is key to success. Communication especially among participants is required as these changes in process will dictate a need for increased interdependencies. Process theory (Markus & Tanis 2000) also suggested that more than one directional communication is needed. Feedback must also be received and acted upon by the implementation team.

The composition, skills and compensation of this implementation team, is identified as another critical factor to ERP success. This team must foster innovation and creativity. More than that, the team must also be cross-functional and represent the key constituents in the migration (Hoon Na and Delgado 2006). Team members must also understand key business processes and how they are utilized within the business.

Considering the significance of the change process and the business processes that will undergo change, good project management was also identified as a success factor. Without a clear plan of execution and coordination, the migration flounders and becomes too unwieldy within the company. Resources are quickly consumed without demonstrable successes making the prior justification of change difficult to see.

Due to the enormous resources required for a successful ERP implementation, top management support and championship is required. Due to the fact that an ERP change cuts across most parts of the company, sustained coordination and commitment must be fostered. A project champion from top management can help maintain focus on the project as other interests compete for these energies and resources.

Lastly, the system analysis, selection and technical implementation plays a key role as a success factor. The system itself must fit the organizational needs and processes. In order to align with the justification outlined earlier, in the business plan and vision, the new implementation should decrease long term resource

requirements. Increased requirements effectively nullify the initial need for the modification and create an environment where adoption of processes are resisted.

2.2 Implementation faults identified

Along with success factors, implementation faults also play a key role in effective ERP migration. These faults were identified as operational problems, motivational problems, knowledge problems and regulatory problems (Mayntz 1997 in Niehaves, Klose, Becker 2006).

Operational problems are those resulting from incorrect implementation methods or project members capabilities. These implementation obstacles can be the results of other faults identified below. These operational problems create issues when attempting to introduce significant changes within an organization.

Motivational problems also create issues when attempting to coordinate change. Due to the fact that significant resources must be devoted to a successful migration, a lack of motivation by key constituents can be an impediment to change.

Knowledge problems were also identified as implementation faults that can derail a successful migration. Consistent with the identification of the composition, skills and compensation of the implementation team defined as a success factor above, when critical team members lack the required knowledge, implementation is difficult.

The last implementation fault, regulatory problems, was identified as external regulatory efforts overlooked by internal stakeholders. These regulatory problems are heightened when internal and external systems are in conflict. Without all stakeholders involvement, regulatory problems can lead to other faults, such as knowledge problems and operational problems.

2.3 Methods

Data collection for this study was triangulated through the use of three related techniques. First, a documentary analysis was conducted of several key public documents about the industry and company. These documents provided the historical context of the company, identifying the historical business model, and cultural setting.

Second, field observations were conducted over a six year period. These observations showed how the company is making a case for a new, innovative, business model and how the industry itself is changing, requiring this type of new model.

Third, interviews were conducted in order to determine how the actual implementation is being planned and employed within the culture. These interviews provided insight into the success factors and implementation faults and how these are integral into the transition.

3. History

3.1 Historical advantages

Since the door of the first Nucor “mini-mill” opened in 1969, Nucor’s business model had been relatively simple. With several key competitive advantages, outlined below, Nucor found it possible to be the low price leader within the steel bar production environment. First, the mini-mill arc-furnace concept itself was more efficient than competing blast furnaces giving Nucor a comfortable margin to work within. Second, a “pay for performance” model was innovative at the time, incentivizing teammates to develop more efficient production methods. By tying wages directly to production, measured simply in quality tons produced, the company encouraged efficiencies unattainable among competitors. Third, rural locations without Union influence allowed Nucor to be the employment leader in most of its locations. With the early divisions in Darlington, SC, Norfolk, NE, Jewett, TX, and Plymouth, UT, Nucor was undoubtedly the largest employer in each of these regions. Coupled with a history of stability, Nucor was able to attract and retain a committed employee base.

These advantages allowed Nucor to keep its costs much below those of its competitors. In 1975, the seven largest steel companies in the United States had employment costs of over $110 per ton, while Nucor costs were less than $45 per ton (Iverson 1975).

This cost advantage, and simple business model created a culture within Nucor of divisional autonomy. Divisions prospered with relatively little involvement from the corporate headquarters and were encouraged to be innovative in keeping production costs low (Iverson 1998). For most of its history, divisions were successful by being operationally innovative, but interactions among divisions were not integrated into the success formula (personal communication, Atlanta, GA, 2013).

Table 1: Timeline of Nucor Bar Mill business analytics

Timeline	Description
2002	Nucor purchases Birmingham Steel, along with the Ross ERP in use at those facilities
2005	Nucor begins implementing consistent ERP across all bar divisions
2010	Implementation of common ERP completed
2011	Decision made to change ERP platform
2012	Best Practices team approach adopted
2013	Business Intelligence Best Practice team established
2014	Oracle EBS selected as ERP, plans to implement are established, with CapGemini selected as the ERP implementation team

3.2 Low price leader business model

In order to understand some of the challenges facing Business Analytics at a large steel producer, we must first explore how earlier successes attributed to, and also hindered data innovation. With lower costs than the competition, Nucor's pricing structure and business model were simple; determine the market price for commodity steel products, and sell those products at prices lower than the competition. For over 30 years, Nucor stayed true to the pricing model and by the year 2000, Nucor had a significant share of the market in the United States, and had gone from being a price follower to a pricing leader. Over its history, Nucor grew from under 2000 to over 22,000 employees, earning $488 million in 2013 (Nucor 2013). Remaining innovative operationally was imperative to curtail competition. However, these cost control measures became no longer enough to grow at a rate to satisfy shareholders. Fortunately, previous successes placed Nucor in a position to change its growth strategy from one of Greenfield growth to growth through acquisition. However, divisional autonomy remained important and crucial to the company's culture. As the Bar Group grew from 4 divisions in 2002 to 19 divisions by 2007, the need for a common ERP along with other consistencies became apparent.

3.3 Initial divisional interactions: The common ERP

As divisions were acquired, so too were their cultures and business processes. These inconsistencies in business practices became problematic as Nucor divisions acted more like independently owned steel mills than parts of a bigger interconnected company able to provide more capability to its customers than simply low cost steel. For example, prior to the common ERP, each division used differing shipping documents and invoices sent to the same customer. These larger customers expected consistency and the demand for collaboration was apparent.

3.4 Theoretical perspectives on history

This view of the history of Nucor allows us to identify the critical success factors (Nah & Delgado, 2006) and implementation faults (Niehaves, Kiose, and Becker, 2006) when considering a major ERP implementation and upgrade. Certain historical advantages the company had enjoyed can be viewed as enabling innovation, while others prevent such progress.

As one of the first adopters of the minimill, Nucor leverages its history to define itself as innovative. This innovation, along with the benefits, continually reinforced, allows Nucor to more easily develop a business plan and vision for change when attempting to make changes to processes. Additionally, top management is encouraged to believe in and support innovation, thereby facilitating support and championship in innovative projects.

This culture of historical innovation also alleviates motivational problems when projects perceived as important are identified. With the correct justification of the business plan and vision, along with a connection to this historical culture, groups can be motivated and mobilized.

Conversely, however, the cost advantage created by the minimill, leading to the subsequent focus on volume over other considerations has made innovation more difficult in certain areas. With divisions encouraged to operate independently, strong communication channels are difficult to develop. Regulatory faults may also be a consideration as divisions have been encouraged to primarily focus on production instead of process. Additionally, while change management relates directly with historical culture, project management principles had not been encouraged, until recently, as focus on volumes, not processes were key.

4. Why business analytics?

4.1 The case for innovation

From the standpoint of the process theory framework, this historical perspective was used as the beginning of the chartering phase. The advantages that Nucor enjoyed, had now become hindrances to growth and innovation. However, cultural changes had begun in the company, making this chartering phase possible.

As mentioned previously, Nucor's growth strategy went from one of Greenfield growth, to one of growth through acquisition. These acquisitions provided enormous advantages for Nucor, but also led to difficulties related to working together in providing quality experiences for customers. Key customers described Nucor as a mesh of independently run steel mills, rather than one business that can take care of a large customer who purchased numerous products from several different divisions (personal communication, Charlotte, NC, 2011). Each Nucor division maintains its own independent Sales department, Accounts Payable department and makes independent decisions about customer credit. This independence is beneficial for local ownership and therefore local cost containment. However, Nucor's largest customers cited this disconnect as the most difficult aspect of doing business with the company (personal communication, Charlotte, NC, 2011).

Reporting is also a key complaint both within and outside the company (personal communication, Chicago, IL, 2012). With this independence, comes inconsistency in both data, and how data is used. For example, one key metric used throughout the company is an "on-time delivery" report. This metric is used to determine how much product at a division is delivered to the customer on-time. On the surface, the metric seems straightforward. However, without central governance, literally each division defines this metric differently. Because some divisions operate their own fleet of trucks, "delivery" means that material is located at the customer's location within a given time frame. Other divisions, those who contract truck fleets, define "delivery" as material produced and at the shipping bays at a given time frame. Additionally, some divisions allow "on-time" to be counted as delivered within the same week as the initial promise date, while others use the initial promise date exactly. Add the ability to "re-promise" an order, due to limitations outside the control of the division, and variations in the seemly straightforward metric allow each division to define the metric differently.

4.2 New expertise needed

Governance is an obvious solution to this problem. Not so obvious is how to establish self-governance; a must in a culture such as Nucor's. Building on previous successes through innovations in operations, Nucor is now in a position where it needs innovative thinking and effective best practices in the area of Information Technology, Business Analytics and Business Intelligence. These changes are more about collaboration than they are about technology. Nucor's challenge is ironic when considering the company's history. Now, with Nucor's significant market share coupled with a desire to grow further, the commoditization of steel is undesired, and new revenue channels are essential. Limiting the effect of commoditization

Earlier in this work, Nucor's historic business model was described as simple; determine the market price for commodity steel products, and sell those products at prices lower than the competition. However, growth in market share, due to both Greenfield and acquisitional growth strategies, have made this simple model unsustainable. Now, in order to sustain a desired annual growth rate of 10%-15%, Nucor must eliminate its reliance on low cost steel production and grow in other areas. John Ferriola, Nucor's CEO has stated that one avenue to realize sustainable growth is through "Commercial Excellence" where the company provides value-

added services to customers and is able to increase margin as a result of these value-adds. This Commercial Excellence initiative requires unprecedented efforts in Business Analytics and will be detailed below.

4.3 Commercial excellence: How can business analytics provide a competitive advantage?

In 2011, John Ferriola, Nucor's Chief Operating Officer, outlined the Commercial Excellence initiative in order to provide Nucor's customers value-added services for which Nucor could charge. Commercial Excellence was introduced as a way to provide innovation to customers, and all divisions were charged with "5 pillars" that defined Commercial Excellence (Commercial Excellence Video, Farriola, 2011). Each pillar required Business Analytics to insure success.

The first pillar of commercial excellence was the goal of being "market driven". This entails responding to market conditions locally and quickly in order to take advantage of outside forces. Business Analytics is required in order to understand these outside conditions, with the ability to act quickly and in concert with other divisions.

The second pillar was defined as being "easy to do business with". Simply put, Nucor encouraged divisions to remove barriers to customers where possible. This attribute, when effectively implemented leads to the next pillar, defined below.

The third pillar endorsed "strong, durable, loyal relationships". This foundational principle ensures the company's position in the supply chain. One IT example cited many times is Electronic Data Interface (EDI) and Vendor Managed Inventory (VMI). These services connect a vendor and customer making the relationship "sticky" and difficult to separate.

Fourth, "sustainable results", focused attention on longevity, a core principle in the company. As a mature steel maker, Nucor is interested in long-lasting relationships that will provide profits for years to come.

The fifth pillar described the entire process and one where divisions "do it together'. This principle was needed as a way to channel efforts across the company and encourage consistency. Consistency is re-iterated often, and Business Analytics and master data management are keys to this process.

Although these five pillars do not provide a template, they provide a general direction for future innovations that are uniform across the company. Historically, divisions have had little to no interactions, and this consistent message attempts to bring innovations together in order to provide services that can cross divisional boundaries.

5. Implementing innovation

5.1 Collaboration

In 2011, the chartering phase had come to completion. The business case had been made, and the company had decided to move toward innovation. During the chartering phase, several key success factors could be identified. First, the business plan and vision had been identified through the formulation of Commercial Excellence (Commercial Excellence Video, Farriola, 2011). Second, top management support and championship was present. Nucor leadership identified the need for change and made clear that expectations included these new initiatives. However, during the chartering phase, development of change management, project management, communication and systems analysis, selection and technical implementation as success factors showed only limited exposure.

However, in order to achieve the foundational principles set forth in Commercial Excellence, Nucor built innovation around an existing culture of empowerment at the local level. Success had been proven in creating innovations in low-cost operations, so the initiative of Commercial Excellence strove to bring these same innovations into the commercial area as well. These innovations would require collaboration not yet realized. From 2005 to 2010, each division within the Nucor Bar Group adopted a single Enterprise Resource Planning (ERP) system. This implementation was at first divisive within the group but later laid the foundation for unprecedented collaboration (personal communication, Chicago, IL, 2009). However, as each division went on-line with the ERP, different business processes were incorporated without considering best practices.

Therefore, while all 19 divisions shared an ERP, business processes differed, limiting Business Analytics significantly.

5.2 A catalyst: New ERP

Acknowledging the shortcomings of the current system and how it was implemented in a fragmented manner, in 2011 the bar group decided to remove the current ERP system and start over, under a new system. As the chartering phase came to a close and the project phase had begun, a group was created with the task of evaluating a new ERP and implement a process of creating best practices where appropriate across the group. This group, called "NuFocus" summarized the intention as:

> *Why are we investigating in a new ERP solution? To support EXCELLENCE in the Bar Mill Group – Commercial, Operational, Financial and Talent. We will recognize maximum value from these new tools and resources if we recognize and seize the opportunity it represents. Investing in a new ERP solution gives us the opportunity to examine our current business processes and needs, consider what "Doing it Together" needs to look like in two, five or even ten years from now, and then work together to establish "best practice" processes that support the overall strategic direction of Nucor. (NuFocus Update, accessed 5-15-2014)*

Because divisional autonomy is a core cultural value at Nucor, these best practices cannot be determined or adopted via edict, but instead must come through a difficult and expensive process of collaboration, consensus and adoption among 19 divisions. Therefore, in order to allow each division to have a voice in the process, this NuFocus team separated into 10 Best Practices teams defined around areas of business, in order to gain consensus around configuration of the new ERP.

Best Practices Teams. A Best Practices team was established for each of the 10 defined areas of business. These areas were quality, sales, scrap (raw material), operations, planning and scheduling, costing, human resources, finance, master data management and business intelligence. The purpose of these teams included eight goals. These goals will be identified and then special attention will be given to the business intelligence team.

First, teams were to focus on improving the bar mill group processes. In order to determine what processes to focus on, the teams would need to define what processes should be common for the entire group and what processes are best left local to the division. Second, current state processes were to be documented. Rationale for this activity included gap identification. In order to understand what components might be missing, teams had to understand what processes were used at each division in the current state. Third, after identifying current practices, processes were to be evaluated in order to determine "best" practices. Fourth, once these practices were evaluated, the teams were to propose a practice that can be used by all divisions, or by the group. The new process might be a process used at one division, a combination of processes, or an entirely new process for the group to adopt. Fifth, upon the proposal of a common best practice, teams were charged with gaining "buy-in" from management at all affected divisions. The purpose of "buy-in" was identified as the most important of all steps (charter, Best Practices Teams, 2013). Sixth, the adopted practice was to be codified and documented. Seventh, the team was to support the independent consultant group with implementation of the common process in the ERP. Eighth, the team was charged with training the bar mill group on the new process, in conjunction with the outside consultant group.

Accomplishing these eight goals involved a great deal of personal, face-to-face meetings, along with a great deal of long-distance collaboration. Initially, teams would brainstorm in order to determine which processes, within each business area, provided the greatest value to the group. Much attention was given to those processes that gave the company a competitive advantage, or would decrease the cost of doing business. Once the brainstorming was accomplished, the teams strove to gain consensus on the processes. Historically, Nucor had not been very concerned with cross-divisional consistency. This history and culture sometimes made consensus difficult or impossible to achieve.

Expected BI Outcomes. The Business Intelligence Best Practice Team was established in 2013 to provide Nucor with important information from data. Participants included 12 individuals from different divisions. As mentioned earlier, the prior ERP system was implemented without a great deal of planning around

consistency, and therefore gathering information from collected data was difficult. Improvements were sought as to the collection of usable and consistent data making Business Analytics and Business Intelligence possible.

> *Business Intelligence is the combination of technologies, methodologies and architecture that transforms raw data into useful information.*
>
> *A powerful business intelligence platform will allow the Bar Mill Group Divisions to maintain the autonomy that has been and will continue to be an essential component of our success while allowing us to leverage our size and collective knowledge to further enhance and improve our business practices and processes driving value to all of our stakeholders.*
>
> *Our team will provide the processes, architecture and systems to allow our teammates to transform data from disparate sources into information, empowering all 4500+ bar group team members to make fast and effective data driven decisions. These decisions will impact all facets of our business in delivering results aligned with our growth strategies (charter, Business Intelligence Best Practice Team, 2013)*

Specific outcomes for this team are still being established, but opportunities for improvement are vast. Currently, with business intelligence consisting of a few common reports, Nucor hopes to make the information available to those who need it quickly and accurately in order to make better, timely decisions. This team will provide expertise to other best practices teams, and acknowledges that the success of business intelligence at Nucor is dependent on the work done by every best practice team.

Of the four phases outlined earlier; chartering, project, shakedown, and onward and upward. Nucor is currently in the project phase. During the chartering phase, the critical success factors identified were business plan and vision and top management support and championship. During the project phase, change management and communication were identified. Observations of project management have been limited. Additionally, only limited system analysis, selection and technical implementation observations have been made during the project phase.

6. Suggestions for further study

In March of 2014 Nucor announced that Oracle E-Business Suite would be the ERP to be implemented for the bar group. In July of 2014, Cap Gemini was selected as the software implementer. Due to the timeliness of this work, many more questions, as to the successes and failures of implementing business intelligence in the largest steel producer in North America, remain. Further study should be conducted into how these plans progress, and how business intelligence is integrated at Nucor.

7. Implications

According to Waller and Fawcett (2013), big data usage encourages companies to change their business model design and day-to-day decision making. Although the importance of Business Intelligence is rarely questioned, companies are left with the “how” from a transition standpoint in moving from an old business model to the new. This study addresses the “how” in a particularly focused way. Although the mechanisms described here are described from the context of one particular company, many of these successful tools and strategies could be replicated across the industry.

8. Conclusion

The importance of Business Analytics in the steel manufacturing business might not seem evident on the surface. However, this work examined how data driven decisions are important and expected in one particular, large steel manufacturer in North America. First, the historical context of Nucor, as a low-cost commodity producer and how this business model allowed for enormous growth throughout the company’s history was examined. Special attention was given to how these past successes created a culture where collaboration and consistency were avoided. The impetus for a deviation from this simple model was explained and how this new business model required business analytics and the development of new expertise within the company. Then, seven critical success factors were identified as a business plan and vision, change management, communication, ERP team composition, skills and compensation, project management, top management support and championship, and system analysis, selection and technical implementation (Hoon Na and Delgado 2006). mplementation faults were identified as operational problems, motivational problems, knowledge problems and regulatory problems (Mayntz 1997 in Niehaves, Klose, Becker 2006).

Additionally, after the historical context and current requirements were given, this work outlined how Nucor is currently implementing business intelligence from a high level in order to remain competitive in the steel market. Throughout this document details were provided as to how general success factors and implementation faults specifically apply to this case. Finally, future work was examined, as current implementations are ongoing and are scheduled into 2016. Re-inspection of this company and its efforts to implement business analytics should be periodic.

References

Bagranoff, N., Brewer, P. (2003). PMB Investments: An Enterprise System Implementation. Journal of Information Systems. 17(1). p. 85-106.

Chen, H., Chiang, R. H. L., Storey, V. C. (2012). Business Intelligence and Analytics: From Big Data to Big Impact. MIS Quarterly. 36:4, p. 1165-1188.

Herbert, I., Seal, W. (2009). The Role of Shared Services. Management Services. 53(1). p. 43 – 47.

Iverson, K. (1975). Open letter to steel customers.

Iverson, K. (1998). Plain Talk: Lessons from a Business Maverick. John Wiley & Sons: New York.

Liu, Y. (2015) Big Data and Predictive Business Analytics. Journal of Business Forecasting. Winter 2014-2015.

Markus, M.L., Tanis, C. (2000). The Enterprise System Experience – From Adoption to Success. in R.W. Zmud (ed.) Framing the Domains of IT Management: Projecting the Future…Through the Past. Pinnaflex Educational Resources, Inc. Cincinnati, OH. p. 173-207.

McCarthy, J.L. (1996). Passing the Torch at Big Steel. Chief Executive. 111:22.

Nah, F.F., Delgado, S. (2006). Critical Success Factors for Enterprise Resource Planning Implementation and Upgrade. Journal of Computer Information Systems. 46:5 p. 99-113.

Niehaves, B, Kiose, K, Becker, J. (2006). Governance Theory Perspectives on IT Consulting Projects: The Case of ERP Implementation. E-Service Journal. 5:1. p.5-26.

Nucor 2013 Annual Report.

Nucor Corp. Website, http://www.nucor.com/story, accessed 2014.

Oliver, D., Whymark, G., Romm, C. (2005). Researching ERP Adoption: and Internet-Based Grounded Theory Approach. Online Information Review. 29(6). p. 585-603.

Rodengen, J. L. (2012). The Legend of Nucor. Write Stuff Enterprises, LLC: Fort Lauderdale, FL.

Shaul, L., Tauber, D. (2013). Critical Success Factors in Enterprise Resource Planning Systems: Review of the last Decade. ACM Computing Surveys. 45(4). p. 55:2 – 55:39.

Tarn, J.M., Yen, D.C., Beaumont, M. (2002). Exploring the Rationales for ERP and SCM Integration. Industrial Management and Data Systems. 102(1). p. 26-34.

Verville, J., Bernadas, C., Halingten, A. (2005). So You're Thinking of Buying an ERP? Ten Critical Factors for Successful Acquisitions. Journal of Enterprise Information Management. 18(5,6). p. 665-677.

Waller, M. A., Fawcett, S. E. (2013). Data Science, Predictive Analytics, and Big Data: A Revolution that will Transform Supply Chain Design and Management. Journal of Business Logistics. 34:2. p. 77-84.

Wang, P., Ramiller, N. (2009). Community Learning in Information Technology Innovation. MIS Quarterly. 33(4). p. 709-734.

