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REVIEW CENTRIC RESEARCH ON LEAN MANUFACTURING AND IMPLEMENTATION

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ABSTRACT: The purpose of this article is to review Lean manufacturing strategies and implementation to understand their implications. Based on these findings an attempt will be made to create a novel method of implementing lean principles into a new organization. If a novel method cannot be identified, areas of new research or possible theory building will be highlighted. Lepine's review centric strategies will be utilized to "summarize previously established studies and concepts, pinpoint potential problems (such as factual errors), and inspire new discussions and directions for further research activity (Lepine, 2010)." Lean manufacturing implementation can be seen as dependent on four main factors; Inventory control/reduction, Alignment with organizational goals, Cost allocation, and Management accounting. Lean principles and strategies are rarely effective without some level of control in these four areas. Time is a major limitation to thoroughly completing this task. It would be preferable to have more time to thoroughly delve into the questions and concerns found during this review. In addition Real world testing of the theories explored and developed through article exploration. For example surveys, interviews, and implementation of pilot programs based on theories. The current business climate is rapidly changing and advancing. Methods of continuous improvement are becoming the standard for organizational survival. Organizations that try to implement lean strategies in a hurried non-methodical manner can be as open to poor performance as organizations that don't recognize the need for continuous improvement. This research will hopefully be a first step to helping new comers to lean principles recognize the current state of their organization. This will better enable said new comers to plan a methodical approach to implementing lean principles.

KEYWORDS: Lean, Inventory control, Just in Time, Cost, Alignment, Management Accounting.

1 INTRODUCTION

As a young employee of a world class manufacturing company you are taught the general principles of lean manufacturing and it is implied that these principles are best in class. The purpose of this paper is to objectively review the axiomatic nature of these principles. There is an abundance of peer reviewed literature that examines different aspects of lean manufacturing. For this paper we will look at (Meade, Kumar, & White, 2010), (Bradley & Willett, 2004), (Ohlmann, Fry, & Thomas, 2008), (Hamblin, 2002), (Siggelkow & Rivkin, 2006), and (Brush & Karnani, 1996), all of which were used to determine key factors of implementing lean manufacturing.

1.1 RESEARCH METHOD

The review-centric approach was chosen because "There is great value in research intended primarily to review and summarize the theoretical and empirical knowledge existing in a given literature or content domain, especially when the review is relevant, comprehensive, and coherent as a compelling narrative that partitions and puts in order essential past accomplishments while identifying important challenges and future opportunities. The value of published reviews that accomplish these ends is supported indirectly by citation counts that can be quite remarkable, and also in the Academy of Management's recent decision to publish yearly reviews of advances in research in the Academy of Management Annals. In

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fact, the mission statement of the Annals explains why reviews of this type are important and valuable to scholars: the "Annals summarize previously established studies and concepts, pinpoint potential problems (such as factual errors), and inspire new discussions and directions for further research activity." From this statement it is easy to appreciate that these types of reviews not only provide for synthesis and a convenient repository for existing knowledge in a given area but can also impart the motivation for theoretical research that can advance our understanding of a concept or process relevant to management and organization. Although a review.(Lepine, 2010) p. 507."

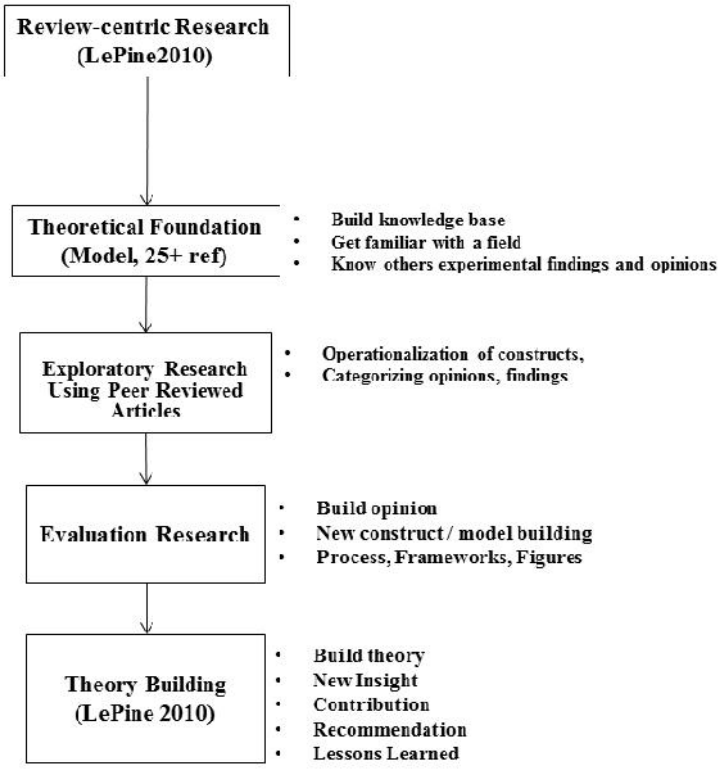

Fig. 1. Review Centric Research model from tcmg495spring14

Fig. 1 shows the process of the review centric research model used.

1.2 WHAT ARE THE FACTORS THAT CONTRIBUTE TO LEAN MANUFACTURING?

Causal Model: Figure 2 shows the relations between Lean manufacturing and its key drives: Inventory Reduction, Alignment, Cost Allocation, and Management accounting. The negative/positive effects will be explored throughout this paper.

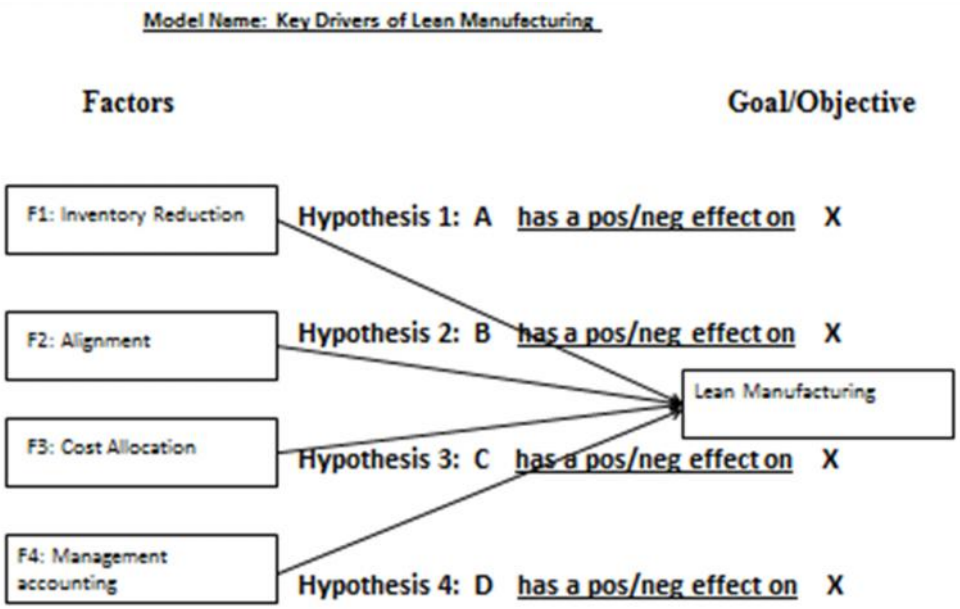

Figure 2: Lean manufacturing Causal Model

2 LEAN MANUFACTURING

2.1 EXAMPLE 1

"Under standard cost accounting systems, reductions in inventories lead to falling reported profits. Rapid reductions in inventories intensify the impact to the bottom line. When a company embarks on an improvement program such as lean manufacturing, a likely result will be an initial drop in reported profits due to the leaning out of inventories [1] p. 858."

2.2 EXAMPLE 2

"In the current economic climate, many companies have lowered prices in response to their customers' demands and competition while incurring higher costs for labor, benefits, and raw materials. The Lord Corporation relies on productivity improvement from its **lean-manufacturing** program to mitigate the resulting squeeze on profit [2] p.123."

2.3 EXAMPLE 3

"In just over 30 years, Toyota has grown from a fledging car manufacturer to a leader in the global auto mobile industry. Much of Toyota's success has been attributed to its efficient manufacturing operations, often called the Toyota Production System or **lean manufacturing**.[3] p. 352."

2.4 EXAMPLE 4

"The priority ranking of the performance measures for manufacturing industry has changed dramatically in twenty years. There has been a move from an emphasis on quality and reliability, to customer perceived value, to 'delighting the customer' and latterly to a total responsiveness to meet variability in customer needs. These changes in external emphasis have been parallelled by changes within organisations which have led to a paradigm of lean manufacturing with the emphasis on eliminating waste, delayered organizations, effective supply chain management, etc. [4] p. 272."

2.5 EXAMPLE 5

"Many organizations face the challenge of searching broadly for new configurations of activities. Broad exploration, spanning numerous individual activities, is particularly important in response to systemic innovations. Consider, for instance, the shift from mass manufacturing to '**lean' manufacturing** (Milgrom & Roberts, 1990). [5] p. 779."

2.6 EXAMPLE 6

"There has been much discussion recently about 'lean' manufacturing (Womack et al. 1990, Peters 1992), which reduces the specialization of supervisory workers, or eliminates the distinction between supervisory and production workers, by giving more responsibility to production workers. [6] p. 1070"

2.7 EXPLORATORY DISCUSSION

Based on the ideas of the above authors, we can infer that Lean Manufacturing is not a simple topic. Meade (2010) says Implementation of lean manufacturing can negatively affect profits[1]. While Bradley & Willet (2004) says lean manufacturing can be used to mitigate profit reduction as a result of lowering prices to meet customer demand [2] . Ohlmann (2008) says that lean manufacturing is given much of the credited for Toyota growing from a fledgling car company into a global automobile industry leader [3]. Hamblin (2002) says the lean manufacturing paradigm emphasis waste elimination and effective supply chain management to increase perceived customer value [4]. Siggelkow & Rivkin (2006) says lean manufacturing can be a result of organizations searching for new configuration of activities or responding to systemic innovations [5]. Brush & Karnani (1996) say lean manufacturing reduces the specialization of supervisory workers by giving more responsibility to production workers [6]. Lean manufacturing is a very versatile tool that can be adapted to a wide range of business needs e.g. adapting to customer demand, increasing customer satisfaction, fostering innovation, and helping a business grow. However, business implementing lean manufacturing should consider that the benefits may not be immediately visible.

I agree that the benefits of lean implementation can be slow to reveal themselves [1]. As such it might be important to have a visionary leader who can develop an implementation strategy to mitigate the perceived negative effects of this new strategy. When a proven manufacturing process approaches maturity, demand and competition usually forces a business to either reduce prices or create some new innovation to justify the cost. I also agree that lean manufacturing can help mitigate the impacts of price reduction [2]. When all the *low hanging fruits* of productivity improvement have been realized lean manufacturing is an efficient mitigation tool. Lean manufacturing has been proven to be a useful tool for expanding a business [3]. Customer satisfaction can be used as a feedback tool with lean manufacturing [4]. Lean manufacturing can help ease the transition into new business configuration or innovations [5]. What I find most important is that lean manufacturing is a powerful way to get employees from all levels of the business involved in productivity improvement [6]. An innovated leader can't accomplish innovative goals without getting employees at all levels to buy in. If done correctly lean manufacturing can accomplish this buy empowering subordinates.

3 INVENTORY REDUCTION

3.1 EXAMPLE 1

"**Inventory reduction** policy refers to the reduction targets for the finished goods inventory over the modelled period of months. A build-to-stock environment with a periodic review of random demand and consistent replenishment lead time is modelled. Reductions were accomplished through a gradual reduction in safety stock targets. Three scenarios were examined in the study [1] p. 860."

3.2 EXAMPLE 2

"While JIT ideas have been enthusiastically embraced by manufacturing practitioners, the small replenishment batch sizes advocated are difficult to reconcile with the standard management science cost trade-off approach. The difficulty is diagnosed as being due to the standard assumption that capital for inventor is borrowed and hence boundless. We present a new analysis of **inventory reduction** decisions, such as adopting JIT replenishment or component substitution, using a detertninistic batch sizing model which assumes that inventory is financed by the investors in the company and is thus finite [7] p. 750."

3.3 EXAMPLE 3

"A firm that deals efficiently with its suppliers will have low raw-materials inventories. A firm that has efficient internal operations will have low work-in-process inventory. From this perspective it appears that firms' inventory holdings in raw materials and work in process seem to have generally improved significantly over time. However, there is no strong empirical evidence regarding the finished goods inventory. Intuitively, a firm that produces based on forecasting may have higher finished-goods inventory in order to have a higher service level (based on the goods availability). But the firm may have its finished-goods **inventory reduced** with better forecasting through better supply chain coordination such as vendor-managed inventory. Neither of these contradictory predictions can be shown to have a dominant effect [8] p. 1016"

3.4 EXAMPLE 4

"The Manitoba Telephone System (MTS) wanted to forecast demand for telephones in order to control the inventory in their phone centers. Although this appears to be a very straight forward problem, data difficulties made it impossible to use most of the common forecasting models. Nevertheless, the use of a very simple forecasting model resulted in an **inventory reduction** of 45 percent [9] p. 95."

3.5 EXAMPLE 5

"In recent decades the automotive industries of Japan and the United States have experienced dramatic transformations. One major development has been the adoption of a set of process innovations commonly known as 'just-in-time' (JIT) manufacturing. Pioneered by Toyota in the late 1950s, JIT methods were widely implemented in Japan starting in the late 1960s, making their way to North America about a decade later (Im and Lee, 1989; Nakamura, Sakakibara and Schroeder, 1994). A central feature of JIT is the ability to operate with minimal levels of inventory. **Inventory reduction** exposes defects in the manufacturing process, forcing managers and workers to eliminate sources of variability and waste (Schonberger, 1982) [10] p. 73"

3.6 EXAMPLE 6

"In recent years manufacturing managers and academic researchers have dramatically changed their view of work-in-process (WIP) inventories. These inventories, held as a buffer between processing steps in manufacturing plants, were once considered essential for maintaining a steady production flow. But the wide acceptance of 'just-in-time' (JIT) production has led to the contrary view that these inventories prevent the discovery of problems on the shop floor and can thus be detrimental to productivity. According to this new perspective, **inventory reductions** expose defects in the manufacturing process, forcing managers and workers to eliminate (rather than accommodate) sources of process variability [11] p. 466"

3.7 EXPLORATORY DISCUSSION

Inventory reduction is an important factor when trying to create a lean manufacturing process. Meade (2010) defines inventory reduction as a policy that reduces targets for the finished goods inventory and utilizes a build-to-stock environment with periodic reviews of demand [1]. The build to stock environment is related to the concept of "Just in time" (JIT) replenishment. Betts & Johnston (2001) propose a novel approach to JIT because JIT ideas have been enthusiastically embraced by manufacturing practitioners, but the small replenishment batch sizes advocated are difficult to reconcile with the standard management science cost trade-off approach [7]. A journal written by Chen (2005) says that inventory reduction is a complex process because intuitively, a firm that produces based on forecasting may have higher finished-goods inventory in order to have a higher service level (based on the goods availability). But the firm may have its finished-goods inventory reduced with better forecasting through better supply chain coordination such as vendor-managed inventory. Neither of these contradictory predictions can be shown to have a dominant effect [8]. R. Cohen (1986) uses simple forecasting methods to achieve significant inventory reduction [9]. Lieberman & Asaba (1997) say that JIT and inventory reduction helped the automotive industries in Japan and the United states experience dramatic transformation and can expose defects in the manufacturing process [10]. Lieberman & Demeester (1999) say that the JIT approach to inventory reduction offers benefits over work-in-process (WIP) inventories because JIT

inventory reductions gives manufacturers the opportunity to expose defects in the manufacturing process, and allows them to eliminate (rather than accommodate) sources of process variability [11]. Inventory reduction is needed to fully

realize lean manufacturing but as stated above, for all its benefits it is not easy to accomplish and should be planned/forecasted carefully.

Inventory reduction aims to reduce finished good stocks and accomplish a build-to-stock raw material inventory [1]. "Just in time" (JIT) inventory replenishment is a strategy that reduces the raw material inventory of a business but can prove troublesome if traditional inventory analysis methods are used [7]. Inventory reduction can cause problems if a business requires higher levels of service but these difficulties can be mitigated with good forecasting and supply chain coordination [8]. Simple forecasting methods are useful when implementing inventory reduction [9]. Worldwide industries have benefited from the implementation of JIT inventory reduction and can be a key tool to identify and eliminate defects in the manufacturing process [10]. Although WIP inventories help the manufacturing process by providing a safety or emergency stocks, you will reduce your ability to expose defects in the manufacturing process [11].

4 ALIGNMENT

4.1 EXAMPLE 1

"It may not be surprising that poor organizational strategies often fail, but research in strategy implementation demonstrates that even good strategies fail during implementation (Bonoma, 1984; Huff and Reger, 1987; Wooldridge and Floyd, 1989). Failure of a new strategy or a strategic innovation is often due to the inability or resistance of **individual employees to commit to a strategy and adopt the necessary behaviors for accomplishment of strategic objectives** (e.g., Heracleous and Barrett, 2001) [12] p. 425"

4.2 EXAMPLE 2

"It has become increasingly clear in the research literature that successful organizations have found ways to ensure that their **organizational missions are aligned both in terms of fit with the external environment and with all factors internal to the organization** [13] p. 54."

4.3 EXAMPLE 3

"A more detailed account of the performance implications of human resources, however, goes beyond their role as a repository of knowledge and routines (Cohen & Bacdayan, 1994; Nelson & Winter 1982) and has to include the degree of **alignment of individual interest with organizational goals** (e.g. Wright, McMahan, & McWil liams, 1994; Wright & Snell, 1991). To the extent that individual members of the organization are motivated to behave in line with organizational goals, the potential advantage derived from the availability of knowledge and skills translates into actual performance[14] p. 418."

4.4 EXAMPLE 4

"This paper explores the nature of interpersonal risk and its propagation. It assumes a different tack from many of the main ideas discussed in the risk management literature which deals with human and financial consequences of risk (Francis and Armstrong, 2003). It is suggested that **how interpersonal risk emerges, evolves and is managed contributes to employee alignment with corporate goals**, and helps to engender a cultural commitment in relation to problem-solving and innovation as a firm-specific capability (Whitley, 2001) [15] p. 31"

4.5 EXAMPLE 5

"In addition to the traditional personnel and human resource management (HRM), there is a need for a new approach to personnel management, which we will call Human Capital Management (HCM). HCM emphasizes an **alignment between the individual and the organization** and in our view offers the challenge and the key to successful management in the future [16] p. 171."

4.6 EXAMPLE 6

"What is missing from the current study is a means by which to demonstrate **how founder- employee alignment might affect results**. If part of the problem in a growing firm is the dilution of owner-intention effects, we would expect this dilution to be less in firms where the employees' intentions and those of the founder are more consistently aligned. In effect, if

employees are hired because of a shared belief about innovation or strategy, or if they gain this orientation through training, socialization or role modeling, the resulting intention level of employees might better reflect those of the founding entrepreneurs, and the dilution effect seen here would be less [17] p. 43"

4.7 EXPLORATORY RESEARCH:

Alignment is how well the company's mission fits the goals of its stakeholders. Gagnon (2008) says both poor and good organizational strategies fail during implementation due to the inability or resistance of individual employees [12]. Crotts (2005) says it's clear in research literature that successful organizations have found ways to ensure that their organizational missions are aligned [13]. Grottschalg & Zollo (2007) says the performance implications of human resources includes the degree of alignment of individual interest with organizational goals, to the extent that individual members of the organization are motivated to behave in line with organizational goals [14]. Amour (2004) says that how interpersonal risk emerges, evolves and is managed contributes to employee alignment with corporate goals, and helps to engender a cultural commitment [15]. Marrewijk & Timmers (2003) says there is a need for a new approach to personnel management, which emphasizes an alignment between the individual and the organization [16]. Kundu & Katz (2003) says part of the problem in a growing firm is the dilution of owner-intention effects and this dilution is expected to be less in firms where the employees' intentions and those of the founder are more consistently aligned. If employees are hired because of a shared belief about innovation or strategy, or if they gain this orientation through training, socialization or role modeling, the intention of employees might better reflect those of the founder [17].

The authors quoted stress the importance of alignment. When implementing business strategies, lean manufacturing or any other strategy, alignment is essential [12]. Successful organizations find ways to ensure alignment when implementing new innovations or strategies [13]. Human resource departments are now being measured by how effectively employees are aligned with the current mission of the business [14]. To aid in alignment it is important to reconcile the personal goals of your employees with the mission of the business in order to foster a culture of commitment to the business [15]. As such manufacturing managers need to adapt their approach to personnel management in an effort to emphasize alignment between employee goals and the mission of the business [16]. When growing or expanding a business alignment is important because dysfunction can result from new employee's that have goals that are not aligned with the firm's leadership [17].

5 COST ALLOCATION

5.1 EXAMPLE 1

"While there is general agreement that incremental fixed costs are relevant for pricing decisions (e.g., Horngren and Foster 1987, p. 304), the question of how such a joint incremental cost should be allocated for pricing has not been answered. Indeed, the prevailing view appears to be that there is no optimal method of allocating the fixed costs-the choice among methods is arbitrary. To our knowledge, our model is the first in which a cost allocation arises endogenously in a firm's pricing (bidding) decision. We show that the firm's optimal implicit cost allocation is tidy in an ex ante sense, but not in an ex post sense [18] p. 1134"

5.2 EXAMPLE 2

"However, managers in both public and private sectors recognize the need for **cost allocation** in product costing, inventory valuation, and in the measurement of the decentralized unit's income. Modem cost accounting innovations have emphasized the need for full cost allocation when advocating activity based costing and management [19] p. 247."

5.3 EXAMPLE 3

"WHILE the topic of **cost allocation** has received a great deal of attention in the accounting literature, most of this attention was confined to guaranteeing the internal efficiency of the firm. In particular, issues related to the minimization of 'agency costs' have been addressed in this context (see Zimmerman [1979] or Magee [1988], as examples). No study has explicitly tied cost allocation to the firm's ability to compete vis-a'-vis other incumbent firms in the market. The reason such a linkage has been overlooked is the belief that overhead costs that are associated with the use of common resources tend to be mostly fixed in nature. As a result, the rule employed in allocating such costs to various departments or products should not affect production or pricing decisions, which are the main determinants of outside market performance [20] p. 387"

5.4 EXAMPLE 4

"If the **costs incurred by the firm are not easily traced to a particular output** (for example, the electric bill for a shared manufacturing plant), the costs must be allocated. The demand for a given output is assumed to be a function of the price. Hence, the cost allocation scheme that is selected will affect both the price and the demand for the output [21] p. 1060"

5.5 EXAMPLE 5

"Since cost allocation has been widely viewed as an arbitrary process, the theory of choice among allocation alternatives is little advanced. This paper illustrates some practical problems that result in the absence of well-established guidelines for choosing among cost allocation alternatives [22] p. 579"

5.6 EXAMPLE 6

"Cost allocation has long been a controversial issue in the economics and accounting literature. While economists and accounting researchers typically recommend marginal cost pricing in allocating firms' resources, firms usually go against the admonitions and persist in allocating costs.' This gap between theory and practice has been greatly reduced by Zimmerman (1979), who observes that control of agency problems and congestion costs can explain the pervasion of cost allocations in practice [23] p. 1264."

5.7 EXPLORATORY RESEARCH:

Cost allocation is one of the ways in which we can actively see the results of lean manufacturing implementation. Cohen (1990) says while there is general agreement that incremental fixed costs are relevant for pricing decisions. The prevailing view appears to be that there is no optimal method of allocating the fixed costs the choice among methods is arbitrary [18]. Balachandran & Ramakrishnan (1996) says managers recognize the need for cost allocation. Modern cost accounting innovations have emphasized the need for full cost allocation when advocating activity based costing and management [19]. Gal-Or (1993) says a great deal of attention is confined to guaranteeing the internal efficiency of issues related to the minimization of 'agency costs' but no study has explicitly tied cost allocation to the firm's ability to compete vis-a'-vis other incumbent firms in the market. The reason this link is overlooked is the belief that overhead costs that are associated with the use of common resources tend to be fixed. Therefore allocating such costs should not affect production or pricing decisions, which are the main determinants of outside market performance [20]. Pavia (1995) says if the costs incurred by the firm are not easily traced to a particular output, the costs must be allocated. The demand for a given output is assumed to be a function of the price. Hence, the cost allocation scheme that is selected will affect both the price and the demand for the output [21]. Verrechia (1982) says because cost allocation has been widely viewed as an arbitrary process, the theory of choice among allocation alternatives is not significantly advanced [22]. Whang (1989) says cost allocation is controversial, even though economists and accounting researchers typically recommend marginal cost pricing in allocating firms' resources, firms usually go against this advice and persist in allocating costs [23].

Although sometimes thought of as "arbitrary" the process of properly allocating cost and regularly monitoring them can help keep track of the "pulse" of your business. Even when there is no optimal method of allocating fixed cost, incremental fixed cost is relevant for making pricing decisions. [18]. Management has recognized the need cost allocation and as a result there is a cost allocation emphasis in accounting innovations. [19]. A lot of effort is geared toward cost minimization but it is not clear how cost allocation explicitly effects how a firm is able to compete with competing or larger firms because it's assumed that overhead is generally the same from firm to firm [20]. Cost allocation via expressing demand for a given output as a function of its price can be a method to account for various cost that are not easily traceable [21]. More advanced theories of choosing cost allocation alternatives need to be developed to combat the view of cost allocation as an arbitrary process [22]. Many economist and accounting professionals view cost allocation as an ill-advised method for allocating a firms resources [23]. Because of the controversy surrounding cost allocation towards the end of the twentieth century, there is a need to objectively examine the cost allocation process using modern tools and methods to conclusively determine the impact (positive or negative) of on the lean manufacturing process.

6 MANAGEMENT ACCOUNTING

6.1 EXAMPLE 1

"THE INCREASING complexities caused by growth in areas served, population, and finances make it imperative that **management accounting** assume an important role in management processes. In this article, some management accounting concepts will be explored, although detailed descriptions of how they work will be avoided [24] p. 692."

6.2 EXAMPLE 2

"While some academic accountants might consider that **after-the-event management evaluation** is something of an intellectual backwater, the ramifications of stewardship affect more than ex post considerations. It is our intention to show that broad stewardship requirements can be seen as a vital subject for ex ante decision making, especially by management. Furthermore, complexities associated with reporting to a firm's interrelated participants can put great strain on the intellectual and physical capacity of the profession [25] p. 544."

6.3 EXAMPLE 3

"PRICE-EARNINGS (P /E) RATIOS play a prominent role in investment analysis, and much attention has been given to exploring their determinants. This article investigates the relation between the **accounting method a firm** uses for reporting purposes and the firm's P/E ratio. In particular, we want to find out if a significant portion of the variability of P/E ratios is associated with differences in accounting methods [26] p. 41"

6.4 EXAMPLE 4

"Soviet accounting is primarily an instrument for control by higher agencies of plan fulfilment: 'This is the objective to which most of its practices and rules have been tailored' (p. 254). Mr. Campbell argues that the emphasis placed on tailoring the system to this function, and also some 'fundamental carelessness' in designing the system, have been jointly responsible for its major inadequacies. The **information supplied to the higher authorities for decision-making purposes** is often misleading, and leads to faulty pricing decisions. And as the information is assembled in categories adapted to the needs of the central planning control, it is unsatisfactory for control of costs within the enterprise [27] p. 483."

6.5 EXAMPLE 5

"If one is to discuss "**Management accounting**" one must know what it is. There is no common agreement so I make free to adopt a working definition, although before I am through I will have changed it. First what do I mean by accounting? Accounting is an activity, a certain kind of data-collection [28] p. 112."

6.6 EXAMPLE 6

"In **management accounting** literature an institutionalist stream is emerging that generates intense discussions and research (Scapens 1994; Burns and Scapens 2000; Duindam and Verstegen 2000). Although the discussion in the discipline of **management accounting** often refers to new institutional economics literature as well as original institutional economics literature, there are fewer references in the opposite direction. In this paper we try to strengthen the connection between **management accounting** and institutional economics. Analyzing the functioning of **management accounting rules** and practices creates an opportunity to substantiate the view of the economy seen as an instituted process. Management accounting practices are one part of the institutional infrastructure that control, coordinate and facilitate

human decision-making [29] p. 1137."

6.7 EXPLORATORY RESEARCH:

Management accounting is another method for keeping track of the health of a business strategy. Sound and refined management accounting can be used to make shareholders and the public aware of the businesses success. Singer (1961) says there is no common agreement on what management accounting is but accounting is an activity, a certain kind of data-collection [28]. Davies (1965) says accounting is primarily an instrument for control by higher agencies of plan fulfilment. The

information [is] supplied to the higher authorities for decision-making purposes [27]. Baker (1971) says complexities caused by growth in area, population, and finances make it imperative that management accounting assume an important role in management processes [24]. Aiken (1975) says academic accountants might consider after-the-event management evaluation an intellectual backwater. Broad stewardship requirements can be seen as a vital subject for ex ante decision making, especially by management [25]. Craig (1987) says much attention has been given to exploring the determinants of price earning ratios. [His] article investigates the relation between the accounting method a firm uses and the firm's P/E ratio [26]. Verstegen (2006) says management accounting practices are one part of the institutional infrastructure that control, coordinate and facilitate human decision-making [29].

There is no official agreement on how to define management accounting is but it is an accounting activity which involves data collection. [28]. It can be primarily an instrument for control by higher agencies of plan fulfilment in which case the information supplied to the higher authorities for decision-making purposes can be manipulated to achieve a specific outcome [27]. However, complexities caused by growth in multiple facets of business highlights how important the management accounting process can be [24]. In some cases management accounting can be a “hindsight” utilizing tool but, to be truly utilized management accounting strategies should be utilized on a broad stewardship level as a vital tool for ex ante decision making by management [25]. The relationship between management accounting and the determinants of price-earning-ratios is still unclear. [26]. Management accounting is important because it can help managers control, coordinate and enable decision-making [29]. Unfortunately, as in the case of Davies review management accounting tools can be abused by subordinates to influence the decision making process of executive leaders in an organization or as a tool to intimidate subordinates. However, with proper oversight and implementation it can be a useful decision making tool when implementing lean manufacturing.

7 EXPLANATION AND DISCUSSION

All of the main factors of lean manufacturing can have a positive effect on lean manufacturing. The different factors need to be used methodically while considering the effects that each factor has on the other. A tempting strategy in management is to “mimic” successful managers. However simple mimicry without good understanding and a methodical approach will not yield consistently positive result. For example if you were to employ JIT strategies without understanding the possible drawbacks, and without aligning the managers and workers in the manufacturing process, you might see cost savings on inventory in the short run. However your manufacturing schedule may suffer negative effects because proper contingencies designed into the new manufacturing process. This indicates poor performance and might negatively affect the motivation of employees that will have low performance ratings because the system is not flexible. Again all factors need to be considered in with respect to each other before implementation.

Strategies based on Cost allocation, alignment, management accounting, and their sub factors are the easiest to implement without adverse reactions. Inventory reduction however can adversely affect lean manufacturing. Strategies like Just in Time part flow for example may not have adequate systems to deal with random occurrences. For example, if a long lead time part fails during the manufacturing process, the JIT strategy may not be flexible enough to acquire a new part in time to meet schedule. If the part is acquired in time, there may be significant cost and quality implications for reducing the designed lead time of the part.

Lean manufacturing is important. “Citing anecdotes from a few firms including Litton, FMC, Westinghouse, Iron Age (1973) prophesied that ‘the big industrial plant may be going the way the big bands went.’ Contrary to that prophecy and other more recent business literature, plant size, on the average, increased from 1972 to 1982. However, the rate of this increase has been decreasing, and the larger plants grew in size at a slower rate than the smaller plants. Additional data from 1980 to 1984 show that the rate of growth slowed dramatically and even turned negative for some large plant size categories [6] p.1078.” Brush says that firms are ultimately getting smaller over time. However demand in manufacturing markets is not decreasing. There are more cars today in the United States than there were thirty years ago despite there being smaller and less car factories in the US. To meet this growing demand while seemingly shrinking in size manufacturers has to employ lean tools to be able to compete. The model generated in this paper can help firms focus on important aspects for successfully implementing these strategies.

7.1 REVISED MODEL OF LEAN MANUFACTURING AND IMPLEMENTATION

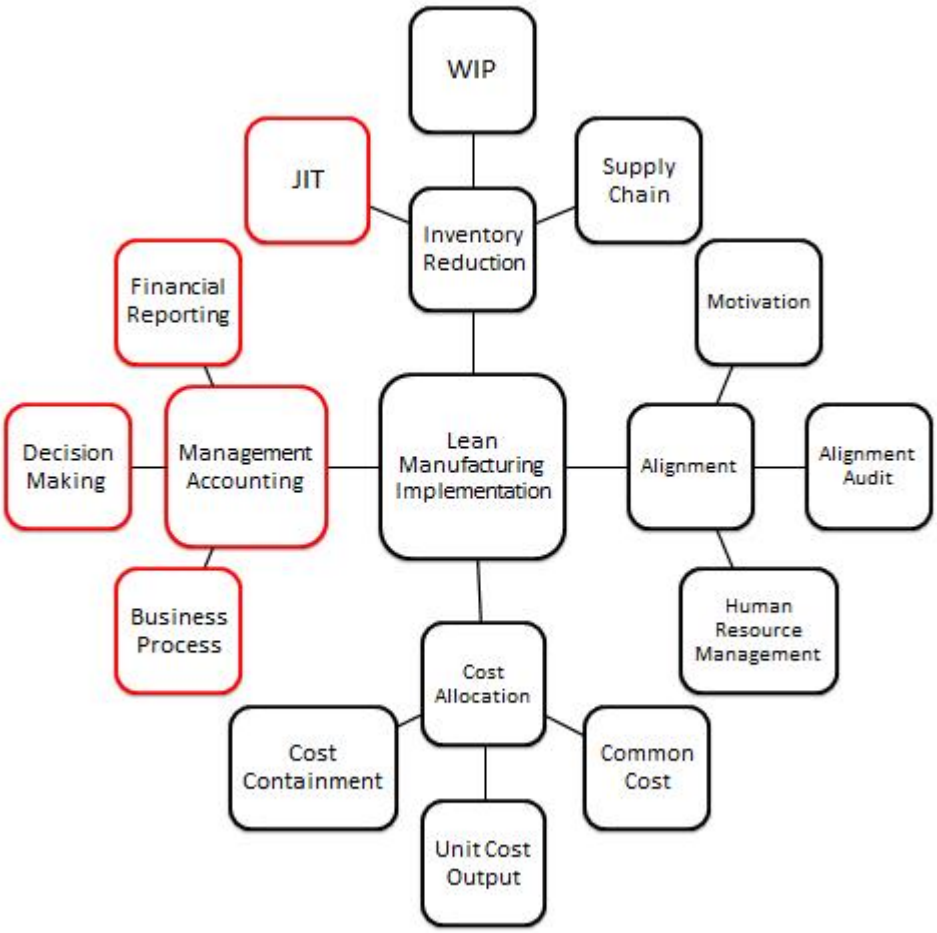

Figure 3: Expanded Model of Lean manufacturing based on research

Figure 3 above shows a revised model of lean manufacturing and its implementation. From the aforementioned references important sub-factors of the four main factors were identified. Factors and sub-factors that have the potential for expanding future research is highlighted in red.

8 CONTRIBUTION AND NEW INSIGHT

Based on the results of this study there are two possible areas of interest for future independent research and or expansion of this article. Regarding management accounting Baker says "To some, these may have sounded familiar, but for others these concepts may represent a new way of thinking about the ac- counting function. Consider what the accounting department is presently doing and what it could be doing. The disciplines and capabilities of the ac- counting department can provide the opportunity to develop powerful tools to aid in managing the utility [24] p.695." I agree with Baker's comment, Management Accounting might be the most important of the 4 main factors discussed in this paper because it can be a method to organize and track the performance of the entire organization and making sure that the other factors are being managed in a way that is well balanced and beneficial to the business. There is also much debate on exactly what constitutes management accounting and what methodologies should be used to implement this accounting practice. Future research should focus on designating an industry standard for management accounting

Regarding inventory reduction Betts says "Uncertainty introduces, as usual, the possibility that maintaining safety stock would increase performance. Since JIT replenishment eliminates uncertainty as well as buffer stock, such policies will be further encouraged at low investment levels due to their ability to liberate capital tied up in safety stock of these components. The situation with component substitution is more complex since while a substitution policy reduces buffer stock it also increases demand for the substituted item which in turn affects the safety stock setting. Additionally,

introduction of demand uncertainty raises the prospect that retaining some cash may be an optimal hedge against business failure, which further complicates the analysis [7] p.761." I am not as comfortable with JIT replenishment as Betts and I think Inventory reduction (JIT) concept of inventory control need to be thoroughly evaluated to help deal with the inherent inflexible aspects of the strategy. Reduction has to be balanced against cost allocation and alignment with employees. To help verify the validity of inventory reduction strategies, there needs to be a way to highlight poor performance that is directly attributed to the complications of inventory reduction. This will make it easy to gradually modify the inventory to better fit the particular manufacturing process; ultimately making your strategy more robust.

9 CONCLUSION

I found that the assumed axiomatic nature of Lean Manufacturing strategies is supported by the literature reviewed, as long as these strategies are implemented in a methodical manner. Four main factors of lean manufacturing were identified and supported by peer reviewed literature. The relationship between lean manufacturing and its factors is not simple. Depending on the implementation and how well each factor is balanced in respect to the other factors will determine the negative or positive effect. For example all three remaining factors will not be consistently successful if an organization's leadership and workers are not adequately aligned with the strategies being implemented. Likewise without good management accounting, it will be hard to keep track of the efficacy of strategies based on the remaining three factors if strategies are being implemented across a large organization. Ensuring that an appropriate balance is kept between the four main factors of lean manufacturing is a key to success.

Future research on this topic would benefit greatly from real world testing of the models presented. An additional item for future research would be evaluation to find a more flexible way of implementing JIT management without spending too much capital on safety stocks.

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REFERENCES

[1]. Meade, D.J., S. Kumar, and B. White, *Analysing the impact of the implementation of lean manufacturing strategies on profitability.* The Journal of the Operational Research Society, 2010. **61**(5): p. 858-871.
[2]. Bradley, J.R. and J. Willett, *Cornell Students Participate in Lord Corporation's Kaizen Projects.* Interfaces, 2004. **34**(6): p. 451-459.
[3]. Ohlmann, J.W., M.J. Fry, and B.W. Thomas, *Route Design for Lean Production Systems.* Transportation Science, 2008. **42**(3): p. 352-370.
[4]. Hamblin, D.J., *Rethinking the Management of Flexibility-A Study in the Aerospace Defence Industry.* The Journal of the Operational Research Society, 2002. **53**(3): p. 272-282.
[5]. Siggelkow, N. and J.W. Rivkin, *When Exploration Backfires: Unintended Consequences of Multilevel Organizational Search.* The Academy of Management Journal, 2006. **49**(4): p. 779-795.
[6]. Brush, T. and A. Karnani, *Impact of Plant Size and Focus on Productivity: An Empirical Study.* Management Science, 1996. **42**(7): p. 1065-1081.
[7]. Betts, J. and R.B. Johnston, *Just-in-Time Replenishment Decisions for Assembly Manufacturing with Investor-Supplied Finance.* The Journal of the Operational Research Society, 2001. **52**(7): p. 750-761.
[8]. Chen, H., M.Z. Frank, and O.Q. Wu, *What Actually Happened to the Inventories of American Companies between 1981 and 2000?* Management Science, 2005. **51**(7): p. 1015-1031.
[9]. Cohen, R., F. Dunford, and F.A. Mazur, *Forecasting for Inventory Control: An Example of When "Simple" Means "Better".* Interfaces, 1986. **16**(6): p. 95-99.
[10]. Lieberman, M.B. and S. Asaba, *Inventory Reduction and Productivity Growth: A Comparison of Japanese and US Automotive Sectors.* Managerial and Decision Economics, 1997. **18**(2): p. 73-85.
[11]. Lieberman, M.B. and L. Demeester, *Inventory Reduction and Productivity Growth: Linkages in the Japanese Automotive Industry.* Management Science, 1999. **45**(4): p. 466-485.
[12]. Gagnon, M.A., K.J. Jansen, and J.H. Michael, *Employee Alignment with Strategic Change: A Study of Strategy-supportive Behavior among Blue-collar Employees.* Journal of Managerial Issues, 2008. **20**(4): p. 425-443.

[13]. Crotts, J.C., D.R. Dickson, and R.C. Ford, *Aligning Organizational Processes with Mission: The Case of Service Excellence.* The Academy of Management Executive (1993-2005), 2005. **19**(3): p. 54-68.
[14]. Gottschalg, O. and M. Zollo, *Interest Alignment and Competitive Advantage.* The Academy of Management Review, 2007. **32**(2): p. 418-437.
[15]. Amour, W.F.S., *Interpersonal Risk Aversion: An Impediment to Learning and Knowledge Translation for Innovation.* Risk Management, 2004. **6**(2): p. 31-47.
[16]. Marrewijk, M.v. and J. Timmers, *Human Capital Management: New Possibilities in People Management.* Journal of Business Ethics, 2003. **44**(2/3): p. 171-184.
[17]. Kundu, S.K. and J.A. Katz, *Born-International SMEs: BI-Level Impacts of Resources and Intentions.* Small Business Economics, 2003. **20**(1): p. 25-47.
[18]. Cohen, S.I. and M. Loeb, *Implicit Cost Allocation and Bidding for Contracts.* Management Science, 1990. **36**(9): p. 1133-1138.
[19]. Balachandran, B.V. and R.T.S. Ramakrishnan, *Joint Cost Allocation for Multiple Lots.* Management Science, 1996. **42**(2): p. 247-258.
[20]. Gal-Or, E., *Strategic Cost Allocation.* The Journal of Industrial Economics, 1993. **41**(4): p. 387-402.
[21]. Pavia, T.M., *Profit Maximizing Cost Allocation for Firms Using Cost-Based Pricing.* Management Science, 1995. **41**(6): p. 1060-1072.
[22]. Verrecchia, R.E., *An Analysis of Two Cost Allocation Cases.* The Accounting Review, 1982. **57**(3): p. 579-593.
[23]. Whang, S., *Cost Allocation Revisited: An Optimality Result.* Management Science, 1989. **35**(10): p. 1264-1273.
[24]. Baker, J.B., *MANAGEMENT ACCOUNTING TOOL AIDS.* Journal (American Water Works Association), 1971. **63**(11): p. 692-695.
[25]. Aiken, M.E., L.A. Blackett, and G. Isaacs, *Modeling Behavioral Interdependencies for Stewardship Reporting.* The Accounting Review, 1975. **50**(3): p. 544-562.
[26]. Craig, D., G. Johnson, and M. Joy, *Accounting Methods and P/E Ratios.* Financial Analysts Journal, 1987. **43**(2): p. 41-45.
[27]. Davies, R.W., Soviet Studies, 1965. **16**(4): p. 483.
[28]. Singer, F.A., *Management Accounting.* The Accounting Review, 1961. **36**(1): p. 112-118.
[29]. Verstegen, B.H.J., *Relating the Institutional Approach in Management Accounting to Institutional Economics: An Essay on Dual-Mode Rationality.* Journal of Economic Issues, 2006. **40**(4): p. 1137-1151.