

## LEAN AND VIRGINIA'S WOOD INDUSTRY – PART II: RESULTS AND NEED FOR SUPPORT

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This two-part publication about Lean practices by Virginia's wood products and furniture manufacturing industries reports results from researching the awareness, the implementation status, the business results, and the need for external implementation support of Virginian companies. This second manuscript focuses on business results and the need for external implementation support. Except for "sales per employee," where less than half of respondents reported an improvement due to the implementation of Lean in their operation, a majority of respondents indicated improved business results for "lead time," "on-time delivery," "inventory turnover," and "cost per unit." With respect to the need for external Lean implementation support, only 23 percent of respondents answered in the affirmative. "Training management," "training shop floor employees," and "implementing [Lean] with extensive employee involvement" were, with 67, 58, and 48 percent frequencies, the most often named forms of Lean implementation support requested. Results from this study seem to indicate an opportunity to support the well-being of Virginia's wood products and furniture manufacturing industries through improved communication of the benefits of Lean and offering specific types of training to companies.

*Keywords:* Wood products industry; Furniture manufacturing industry; Lean awareness; Lean implementation; Need for external Lean implementation support; Commonwealth of Virginia

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### INTRODUCTION

This is the second manuscript in the two-part series about Lean and Virginia's wood industry reports on findings from a census survey conducted in 2010 covering all primary and secondary wood products manufacturers in the Commonwealth of Virginia. The first manuscript (Fricke and Buehlmann 2012) reported results related to companies' Lean awareness and Lean implementation. The survey, mailed to 1,193 wood products (North American Industry Classification System (NAICS) 321, U.S. Census Bureau 2010a) and furniture manufacturing (NAICS 337) companies in Virginia obtained 188 valid responses for an adjusted response rate of 15.76 percent.

Findings reported in the first manuscript (Fricke and Buehlmann 2012) include that roughly 72 percent of respondents were aware of Lean, or more particularly, knew one or more of the following five terms which are widely used to refer to Lean initiatives: Lean Manufacturing (known by 56 percent of respondents), Lean Management (51 percent), Lean Production (44 percent), Lean Thinking (30 percent), or Toyota Production System (TPS, 25 percent). Thus, hypothesis one investigated in this research, stating that "The majority of wood products and furniture manufacturing companies in

the Commonwealth of Virginia are not aware of Lean” was rejected. Using a list of 29 elements used by Lean practitioners (see Table 1, Fricke and Buehlmann 2012), an assessment of the depth of Lean awareness of individual respondents was possible. Twenty-three percent of respondents were not aware of any of the 29 elements, while the remaining 77 percent of respondents knew at least one element. Some elements, like "mission statement," "just-in-time," "training shop floor employees," "employee cross-training," or "vision statement" were known by 64, 57, 50, 49, and 43 percent of the respondents, respectively. In comparison, other, more Lean-specific elements such as "A3-report," "quick changeover," "error proofing (Poka Yoke)," "visual management," or "PDCA-cycle" (6, 8, 12, 12, and 13 percent awareness, respectively) were known by fewer respondents. Analyzing the results of the survey by industry sub-segment, allowed to reject hypothesis two, stating that "There is no difference in Lean awareness between different sub-segments of the wood products and furniture manufacturing industries in the Commonwealth of Virginia ( $p = 0.0089$ , Kruskal-Wallis test, Fricke and Buehlmann 2012)." Thus, Lean awareness differs between at least two of the eight wood and furniture industry sub-segments tested.

Only 47 percent of respondents indicated that their companies have implemented one or more of the 29 Lean elements listed in the questionnaire. In fact, from 188 responding businesses, more than 100 reported that none of the 29 elements are implemented, 35 companies reported that 1 to 5 elements are implemented, 29 companies 6 to 10 elements, 6 companies 11 to 15 elements, 7 companies 16 to 20 elements, 4 companies 21 to 25 elements, and 7 companies reported that 26 to 29 elements are implemented, respectively. Since 53 percent of respondents indicated that no Lean elements are implemented in their company, hypothesis three stating that "The majority of wood products and furniture manufacturing companies in the Commonwealth of Virginia have not implemented Lean," could not be rejected. Thus, based on this research, it can be concluded that the majority of the wood products and furniture manufacturing industries in the Commonwealth of Virginia have not implemented Lean. However, hypothesis four, stating that "There is no difference in Lean awareness between different sub-segments of the wood products and furniture manufacturing industries in the Commonwealth of Virginia," produced evidence making it possible to reject the hypothesis and to conclude that there are differences in Lean implementation status between the wood products and furniture manufacturing industries in the Commonwealth of Virginia ( $p = 0.0096$ ). In fact, large differences in the level of Lean implementation between industry sub-segments were observed. While all industry sub-segments contain respondents that have not implemented any Lean elements, sub-segments differ in that some segments do not have any Lean-implementation leaders (defined as businesses that have implemented or plan to implement all Lean elements). Particularly, no respondents from the "sawmills" and the "wood container and pallet manufacturing" industry sub-segment indicated to have implemented or are planning to implement more than 17 and 13 Lean elements, respectively. Conversely, the "wood kitchen cabinet and countertop manufacturing" and the "engineered wood products" industry sub-segments have leaders that have implemented or are planning to implement all 29 Lean elements.

Survey results also allowed the rejection of Hypothesis five stating that "Wood products and furniture manufacturing companies in the Commonwealth of Virginia employing a Lean change agent are no different in respect to Lean implementation status as compared to companies without a Lean change agent ( $p < 0.0001$ )." Thus, according to the data from this survey, companies employing a full or part-time Lean change agent,

worked with more Lean elements (on average, with 19.80) as opposed to companies without a Lean change agent, who worked with 3.59 Lean elements, on average.

This second manuscript in this two-part series answers questions relating to business results from pursuing Lean implementation and the need for external Lean support. The question pertaining to business results of Lean implementation is of fundamental importance, as businesses strive to undertake only efforts that result in a positive payback, unless other legal, moral, or personal reasons exist. As a substantial number of organizations involved in manufacturing, service, and the public sector have made a commitment to implementing Lean, empirical evidence exists that becoming Lean is a worthy effort for organizations. Womack *et al.* (1990) were early proponents of the benefits of Lean, as their studies on the Japanese automotive industry showed that factories applying Lean principles are more effective and efficient because they require less human effort and time to assemble a vehicle, less assembly space per vehicle, and less average inventory of parts to produce a “...greater and ever growing variety of products... (Womack *et al.* 1990, p.13),” with fewer defects than typical mass-production factories. Such results are consistent with Lean principles, as Taiichi Ohno, who is considered to have “...pioneered the concept of Lean production (Womack *et al.* 1990, p.11)” described the goals of Lean as: “All that we are doing is looking at the time line from the moment the customer gives us an order to the point when we collect the cash. And we are reducing that time line by removing the non-value-added waste (Ohno 1988, p. ix).” Today all major car manufacturers have developed their own production systems based on Lean, such as, for example, Volkswagen’s “...self-learning organization (Volkswagen AG 2009)” or the Renault Production System (RPS), which borrows elements “...extensively from the Nissan Production Way (Renault 2009).” However, while the automotive industry is among the industries with the highest Lean penetration, Lean has been adopted by companies involved in other types of activities. Examples of successful Lean implementations include Lockheed Martin Aeronautics Sector (Kandebo 1999), or British Aerospace (Cook 1999) in manufacturing, the Virginia Mason Medical Center (Virginia Mason Medical Center 2008) or Flinders Medical Centre (Ben-Tovim *et al.* 2007) in health care, the Starbucks Corporation (Starbucks 2010, Jargon 2009) in the refreshment industry, or public institutions such as, for example, the City of Grand Rapids, MI (Scorsone 2008; Bhatia and Drew 2006). Lean also is practiced by leading companies in the wood products and furniture industry, such as Steelcase (Steelcase 2006), HON (HON 2010), or Merillat (Merillat-Masco Builder Cabinet Group 2009). However, implementing and sustaining Lean is not easy. Companies have struggled with the concept, and numerous companies have failed. Difficulties and obstacles come from a wide range of sources and only the determination of the organizations' leaders allows them to be overcome and reap the rewards of successful Lean implementations.

As most organizations in the wood products and furniture industry are too small to build all the required resources internally, external Lean implementation support may be a critical element determining the success of Lean for companies. Such support from third-party organizations has been shown to increase the chance of successful Lean implementations (Greenwood *et al.* 2002). However, research conducted has shown that smaller companies typically are more reluctant to implement structured forms of training and improvement programs such as, for example, Lean (Kotey and Folker 2007; White *et al.* 1999). Reasons can be found, among other things, in the lack of resources available in small organizations (Curran *et al.* 1997) and a short-term planning horizon versus the more long-term realization of benefits from training programs (Westhead and Storey

1996). To investigate the potential need of external Lean implementation support, the survey inquired about companies' need for external Lean support.

## **HYPOTHESES**

This second manuscript about Lean and Virginia's wood industry reports on findings from a census survey conducted in 2010 covering all primary and secondary wood products manufacturers in the Commonwealth of Virginia. The first part (Fricke and Buehlmann 2012) tested hypotheses related to companies' Lean awareness and Lean implementation. Also, one of the hypotheses tested pertained to the impact of the presence of a Lean change agent in companies. In this manuscript about Lean and Virginia's wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries, the following hypotheses were tested:

### **Business Results**

Companies, to be able to justify the considerable investment in Lean implementation, need to generate positive returns from their efforts. Therefore, hypothesis six and seven were tested:

H<sub>60</sub>: "The majority of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) companies in the Commonwealth of Virginia implementing Lean does not benefit from improved business performance."

H<sub>70</sub>: "There is no difference in business results from Lean implementation between sub-segments of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia."

### **Need for Support**

To judge the industry's need for support with Lean transformations, the survey inquired about industry practices in implementing Lean and, in particular, about the industry's need for implementation support. Hypotheses eight and nine, thus, tested:

H<sub>80</sub>: "The majority of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) companies in the Commonwealth of Virginia does not need support for their Lean implementation efforts."

H<sub>90</sub>: "There is no difference in need for external support for Lean implementation between sub-segments of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia."

## **METHODOLOGY**

In the Summer of 2010, a census survey was conducted among the wood products (NAICS 321, U.S. Census Bureau 2010b) and furniture manufacturing (NAICS 337, U.S. Census Bureau 2010c) industries located in the Commonwealth of Virginia. A mailing list of 1,193 companies was compiled from Manta's online business listings (Manta 2010), the 2009 Virginia industrial directory (DandB 2009), the manufacturer index of the Wood Products Manufacturers Association (WPMA 2010), and the membership list of the Architectural Woodwork Institute (AWI 2010). A mail survey following Dillman's (2006) total design method asking categorical and open-ended questions (Fink 2003; Rea

and Parker 2005) about basic demographic company information; questions regarding companies' Lean practices (*e.g.*, Lean awareness, Lean implementation, business results, and need for external support); and product and market-related questions. After 10 weeks with 188 usable answers (response rate 15.76 percent), the survey was closed and non-response bias was tested by comparing survey responses to 30 responses obtained from randomly-selected non-respondents who were asked four questions from the questionnaire after closure of the survey. For three of these questions, no significant ( $\alpha = 0.05$ ) differences between the respondents and non-respondents were found ( $p = 0.90, 0.19,$  and  $0.67$ , respectively, Fisher's exact test). However, the fourth test comparing the industry sub-segment distribution of respondents showed a significant difference ( $p = 0.01016$ , Fisher's exact test). In particular, companies from "other wood product manufacturing (NAICS 3219)" including "millwork (NAICS 32191)," "wood container and pallet manufacturing (NAICS 32192)," and "manufactured home (mobile home) manufacturing (NAICS 32199)" were over-represented, while companies from "office furniture (including fixtures) manufacturing (NAICS 3372)" were under-represented. Therefore, results presented in these two manuscripts have to be read with caution. A more detailed discussion of the survey methods, address collection, non-response bias, and study limitations can be found in Fricke and Buehlmann (2012).

## RESULTS AND DISCUSSIONS

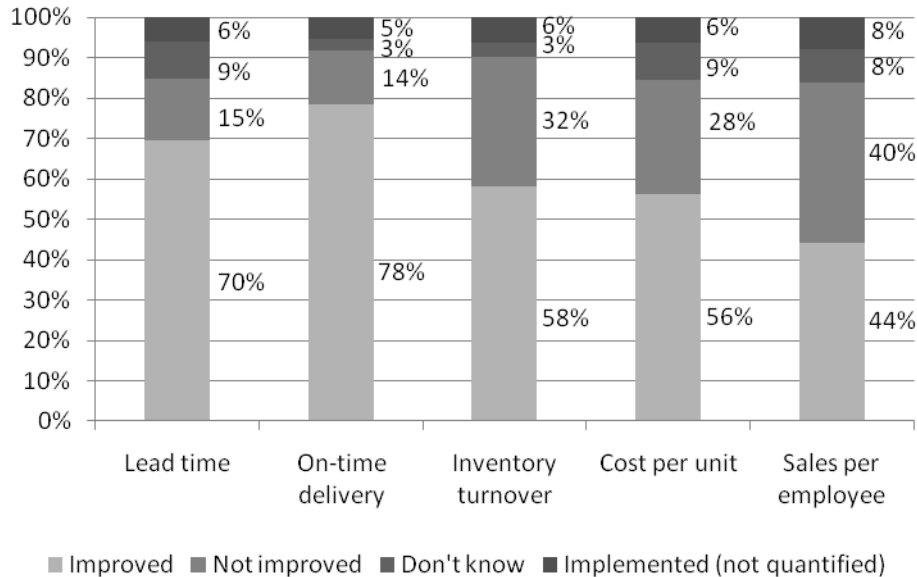
To evaluate actual business results obtained in Virginian companies implementing or planning to implement Lean elements, survey respondents were asked to provide information about the performance indicators implemented and to specify improvements observed. Also, questions pertaining to the companies' need for external Lean implementation support were asked.

### Business Results from Lean Implementation

To answer hypothesis 6 that "The majority of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) companies in the Commonwealth of Virginia implementing Lean does not benefit from improved business performance" and hypothesis 7 that "There is no difference in business results from Lean implementation between sub-segments of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia," the mail questionnaire asked survey participants a list of questions about Lean key performance indicators (KPI, Parmenter 2009). These KPIs consisted of "lead time," "on-time delivery," "inventory turnover," "cost per unit," and "sales per employee (Emiliani 2007)." Twenty-three percent of all survey respondents ( $N = 44$ ) answered the question pertaining to the use of KPIs and improvements achieved due to the use of Lean.

Twenty percent of all survey respondents ( $N=37$ ) indicated that in their company, the KPI "on-time delivery" was implemented, followed by "lead time (18 percent,  $N = 33$ )," "cost per unit (17 percent,  $N = 32$ )," "inventory turnover (17 percent,  $N = 31$ )," and "sales per unit (13 percent,  $N = 25$ )." Unfortunately, the survey data did not make it possible to assess whether the non-respondents to the questions pertaining to the use of KPIs simply refused to answer these questions while using KPIs in their companies, or if they refused to answer because they had no KPIs. Most likely, both situations do exist as companies committed to Lean use KPIs for performance measurement.

Of the respondents to the question about results from Lean implementation in their companies, 70, 78, 58, and 56 percent indicated that improvements regarding “lead time,” “on-time delivery,” “inventory turnover,” and “cost per unit,” have been achieved. Forty-four percent of the respondents indicated that they also improved “sales per employee.” Figure 1 provides an overview of the answers to the question about performance improvements associated with Lean implementation efforts. Respondents were offered four choices for each KPI, *e.g.*, “improved,” “not improved,” “don’t know,” and “KPI implemented but results not quantified.”

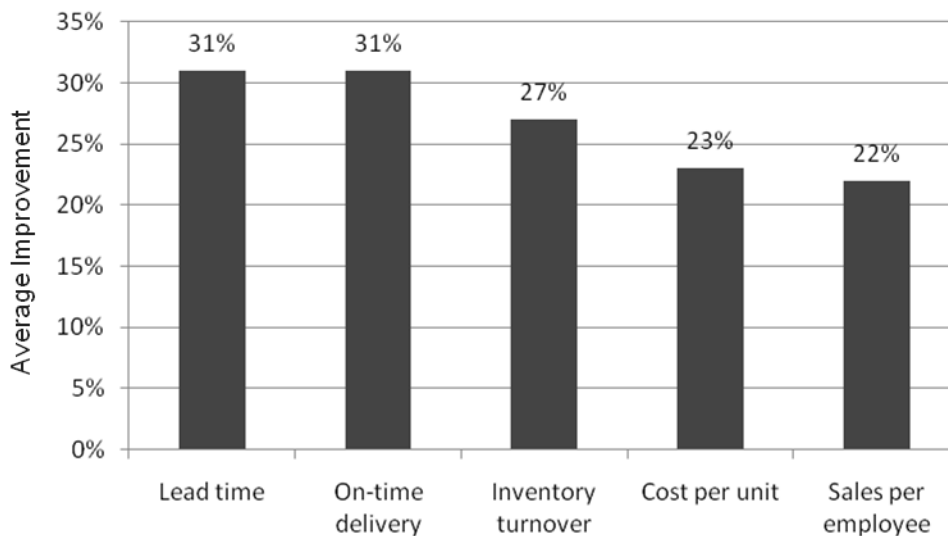


**Fig. 1.** Answers from survey respondents regarding improvements in business results made through Lean implementation efforts

Thus, the majority of respondents of the question pertaining to performance indicators and improvements have achieved considerable improvements, and hypothesis 6 was rejected. Lean was least successful in improving “sales per employee,” with no improvement achieved reported by 40 percent of the respondents. The lack of improving “sales per employee” may be a function of the current economic slowdown that the wood and furniture manufacturing industries are experiencing (Buehlmann *et al.* 2010 and 2009) following the global recession that started in 2008 (Reinhart and Rogoff 2008; Kitching *et al.* 2009). The lack of improvement of “sales per employee” is followed by a lack of improvement in “inventory turnover,” “cost per unit,” “lead time,” and “on-time delivery,” with 32, 28, 15, and 14 percent of respondents indicating a lack of improvement, respectively. Interestingly, 9, 3, 3, 9, and 8 percent of respondents did not know if the KPIs “lead time,” “on-time delivery,” “inventory turnover,” “cost per unit,” and “sales per employee,” were implemented and/or if these KPIs improved due to the use of Lean (Fig. 1).

Respondents indicating improvements (Fig. 1) were then asked about the size of improvements achieved for the five KPIs inquired about in the questionnaire (*e.g.*, “lead time,” “on-time delivery,” “inventory turnover,” “cost per unit,” and “sales per employee”). Average responses of all respondents were 31, 31, 27, 23, and 22 percent,

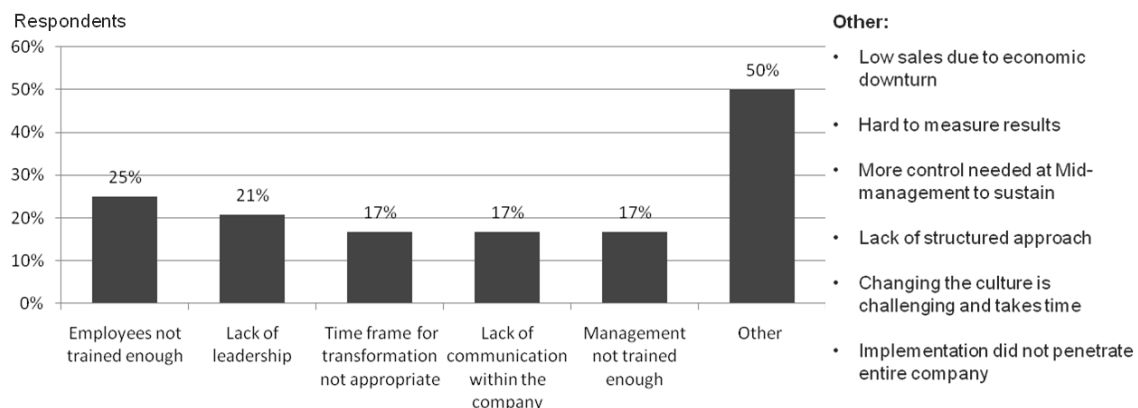
respectively, for “lead time,” “on-time delivery,” “inventory turnover,” “cost per unit,” and “sales per employee,” as shown in Fig. 2.



**Fig. 2.** Average improvement (in percent) reported by respondents for the five KPIs inquired about in the survey

As a follow-up question, survey participants were asked whether the improvements gained through their Lean efforts met their expectations (response rate 32 percent,  $N = 60$ ). The majority of these respondents ( $N = 35$ , 58 percent) were satisfied with the improvements achieved through the implementation and use of Lean. However, almost one-third ( $N = 19$ , 32 percent) replied that their Lean implementation did not yield the expected results while ten percent reported mixed experiences.

Furthermore, survey participants were asked “...why certain improvements did not meet expectations.” Few survey participants (response rate 13 percent,  $N = 24$ ) explained the reasons for their dissatisfaction. As shown in Fig. 3, the answers given most frequently, in decreasing order of frequency, were “employees not trained enough,” “lack of leadership,” “time frame for transformation not appropriate,” “lack of communication within the company,” “management not trained enough,” and “other” (25, 21, 17, 17, 17, and 50 percent response frequency, respectively).



**Fig. 3.** Reasons for dissatisfaction with results of Lean implementation

“Other” included, among others, “low sales volume due to the current economic downturn,” “hard to measure results,” “more control needed at mid-management to sustain,” “lack of structured approach,” “changing the culture is challenging and takes time,” and “implementation did not penetrate entire company.”

Also, no significant differences ( $p = 0.6857$ , Wilcoxon rank sum test) in business results from implementing Lean achieved could be detected between the wood products (NAICS 321) and the furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia. Thus, hypothesis 7, that “There is no difference in business results from Lean implementation between sub-segments of the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia,” could not be rejected. Thus, no differences exist between the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia in terms of business results from Lean implementation.

When testing for differences between the wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries of the Commonwealth of Virginia by individual KPI (“lead time,” “on-time delivery,” “inventory turnover,” “cost per unit,” and “sales per employee”), none of the tests were found to be significant ( $\alpha = 0.05$ ). In particular, results for the individual categories were  $p = 0.2367$  for “lead time,”  $p = 0.3219$  for “on-time delivery,”  $p = 0.4734$  for “inventory turnover,”  $p = 0.2183$  for “cost per unit,” and  $p = 0.5360$  for “sales per employee (Wilcoxon rank sum tests).”

Figure 4 shows the answers about the business results from Lean implementation by industry (wood products (NAICS 321) and furniture manufacturing (NAICS 337)) for all five KPIs asked.

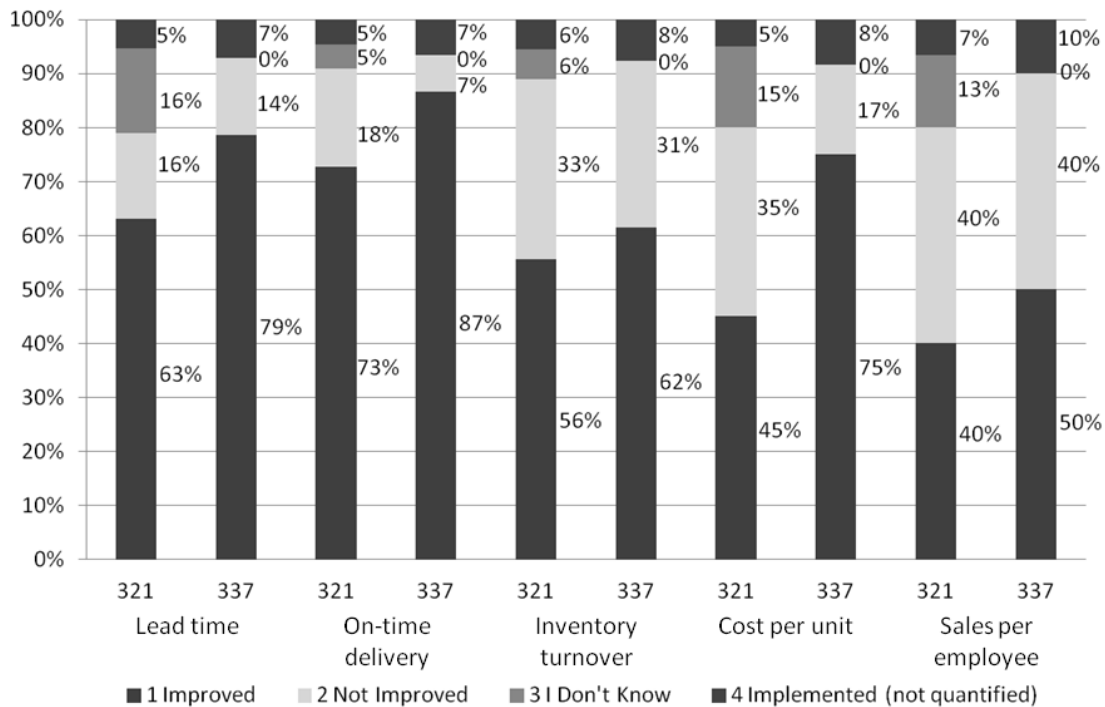


Fig. 4. Answers from survey respondents regarding improvements in business results made through Lean implementation efforts by industry segment (NAICS 321 and NAICS 337)

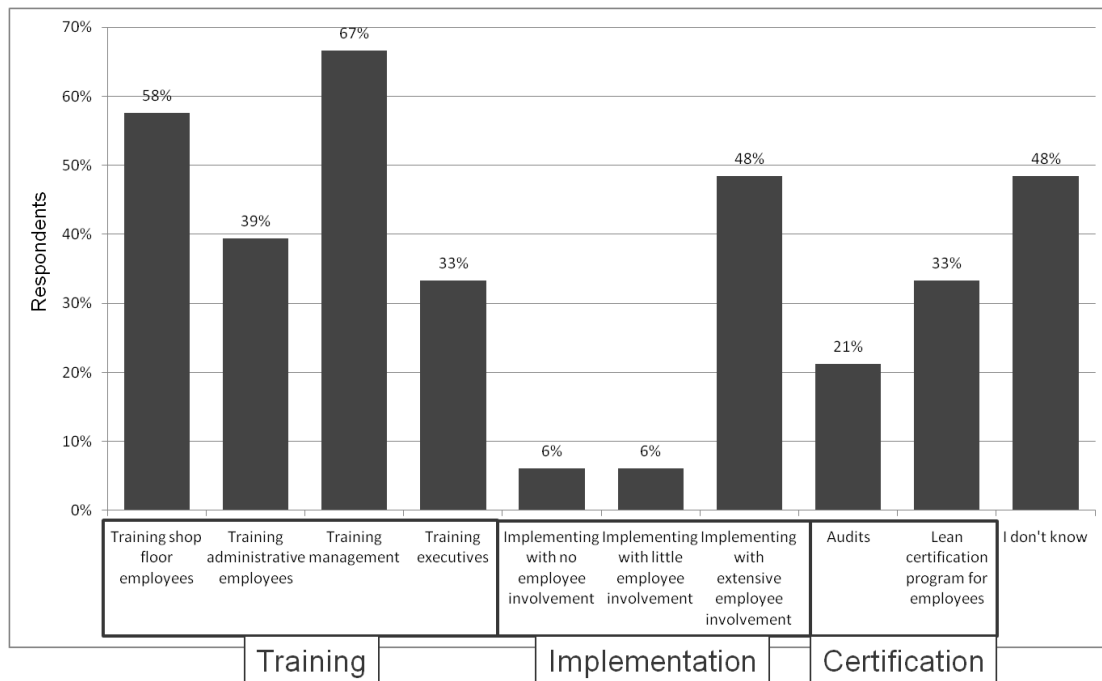


## Need for External Lean Implementation Support

Only 23 percent of all respondents responded affirmatively to the question “Do you have a need for external support in order to improve your organization’s performance?” affirmative. Thus, hypothesis eight, “The majority of the wood products and furniture manufacturing companies in the Commonwealth of Virginia do not need support for their Lean implementation,” could not be rejected. The survey produced insufficient evidence to reject hypothesis nine that “There is no difference in need for external support for Lean implementation between the sub-segments of the wood products and furniture manufacturing industries of the Commonwealth of Virginia ( $p = 0.0509$ , Fisher’s exact test).”

Interestingly, the “need for external support” is influenced by the level of Lean awareness of respondents. Eighty-five percent of respondents indicating a “need for external support” were aware of Lean, while only 15 percent were not aware of Lean. For respondents indicating “no need for external support,” 70 percent were aware and 30 percent were not aware of Lean. Thus, it appears that companies that have investigated Lean, are implementing Lean, or are using Lean have realized the challenges of being Lean and have realized that expert input may be beneficial to their organization.

Survey participants were also asked as to “How should external support look like?” The questionnaire offered respondents nine choices (“training shop floor employees,” “training administrative employees,” “training management,” “training executives,” “implementing certain elements with no company employee involvement,” “imple-menting certain elements with little company employee involvement,” “implementing certain elements with extensive company employee involvement,” “audits,” and “Lean certification program for employees.” Additionally, respondents could mark “other (please specify)” and “I don’t know, I need more information.” Figure 5 shows the results to the question about the kind of external support desired.



**Fig. 5.** Response frequency regarding survey respondents’ need for external support regarding training, implementation, and certification of Lean

Eighteen percent ( $N = 33$ ) of all survey participants answered the question “How should external support look like?” and all of them indicated to have a need for external Lean implementation support. Forty-eight percent of respondents indicated that they “... don't know” what form of support they want or need. This is a surprising result, as it expresses confusion among respondents. Possibly, respondents were unable to envision the best way to help their company improve results from Lean implementation and use. Or respondents already had experience with some of the different forms of support suggested in the questionnaire and found it unhelpful, thereby casting a negative cast over other ways of support. Of the respondents who indicated a form of support they would prefer, “training” was the most important area for support. Two-third of the respondents (67 percent) indicated that “training management” is important and needs external support, a finding consistent with Kandebo's (1999) claim that active management involvement is crucial for successful Lean implementation. “Training shop floor employees” was listed as needed by 58 percent of all respondents to this question, followed by “training administrative employees (39 percent),” and “training executives” (33 percent).

Support for “implementation” ranked highly on the perceived list of needs of respondents, too. Almost half of all respondents (48 percent) indicated a need for external support for “implementing (Lean) with extensive employee involvement.” This preference of respondents for support for Lean implementation “...with extensive employee involvement” indicates a basic understanding of respondents that employee involvement is a fundamental requirement of Lean (Liker 2003; Liker and Meier 2005). Solutions that offered little or no employee involvement received fewer positive answers, with both, “implementing (Lean) with no employee involvement” and “implementing (Lean) with little employee involvement” being selected by only six percent of all respondents to this question.

“Certification” and “audits” were of interest to 33 and 21 percent of respondents, respectively. Certifications, in general, confirm that an individual is capable of competently completing tasks. Confirmation is usually obtained by passing an examination (Wikipedia 2010), while audits are frequently used to establish a Lean culture and to certify a certain level of “Leanness” of the company (Hamel 2010). The results from this survey seem to indicate that respondents have a need for external support of Lean implementation as over half of the respondents indicated a need for “training management” and almost half indicated a need for external support in “Implementing (Lean) with extensive employee involvement (Fig. 5).” However, a majority of respondents did not think that “certification” and “audits” would benefit their company’s Lean efforts.

### **The Case for Lean**

Lean has been shown to have a positive influence on the success of businesses (Womack and Jones 2003; Liker and Meier 2005). This survey showed that there are companies in the wood products and furniture manufacturing industries in the Commonwealth of Virginia who actively pursue and benefit from Lean. However, despite the fact that 72 percent of the respondents have heard of at least one of five Lean terms (Lean Management, Lean Manufacturing, Lean Production, Lean Thinking, or Toyota Production System (TPS)), only 44 percent of the survey respondents have implemented at least one of the 29 Lean elements (see Table 1, Fricke and Buehlmann 2012) used as proxies for Lean implementation in this survey.

A more detailed look on the Lean elements implemented per respondent revealed that only 13 percent of the respondents have implemented more than 10 Lean elements. Also, Lean elements implemented most frequently, such as, for example, “training shop floor employees,” “employee cross-training,” and “mission statement” (46, 40 and 38 percent implementation frequencies, respectively; see Fig. 6 of Fricke and Buehlmann 2012), are in fact concepts practiced by many businesses independent of any Lean effort taking place or not taking place.

Lean elements that are more uniquely associated with Lean (Fig. 6 of Fricke and Buehlmann 2012), such as, for example, "A3-report," "quick changeover (SMED)," "one-piece-flow," "supermarket system," "error proofing (Poka Yoke)," "takt time," "Kanban system," or "PDCA-cycle," have been implemented relatively infrequently (4, 5, 7, 7, 8, 9, 9, and 9 percent, respectively; Fig. 6 of Fricke and Buehlmann 2012). However, even though less than half of the respondents of this survey active in the wood products and furniture manufacturing industries in the Commonwealth of Virginia have implemented Lean, only 23 percent of them indicated having a need for external support to improve their organization's performance.

Thus, this research indicates that future efforts should focus on the dissemination of potential benefits of implementing Lean for the wood products and furniture manufacturing industries. Also, the creation of case studies outlining and quantifying the benefits of Lean for companies of the wood products and furniture manufacturing industries may help convince additional industry participants of the benefits of undertaking the admittedly challenging and expensive Lean journey. Future research should also investigate Lean awareness and implementation status of other industries to establish the relative status of the wood products and furniture manufacturing industries. By being able to assess the relative Lean status of the wood products and furniture manufacturing industries compared to other industries, helpful lessons could be learned from industries with a broader acceptance of Lean and insights into other, potentially beneficial management practices could be gained.

This study focused on companies of the wood products and furniture manufacturing industries in the Commonwealth of Virginia. Empirical observations exist that findings from the industry in the Commonwealth of Virginia are similar or equivalent with the status of the wood products and furniture manufacturing industries in other states, possibly even similar to the status of the industries throughout the United States. Research is currently underway to obtain indications as to the similarities of the findings from the Commonwealth of Virginia with five additional Eastern U.S. states.

As the ultimate measure of business success is survival and growth, Lean might be a way to improve the U.S. wood products and furniture manufacturing industries' success in the future (Buehlmann and Schuler 2002 and 2009; Schuler and Buehlmann 2003).

In any case, the past performance of the wood products and furniture industries in Virginia dominated by plant closures, lay-offs, and unsatisfactory profitability over the past decade or two makes clear that doing nothing is not an option to improve the industry's fortunes. It might, thus, just be the time to give proven management systems like Lean a serious try.

## SUMMARY AND CONCLUSIONS

The past decades have proven challenging for large parts of the U.S. wood products (NAICS 321) and furniture manufacturing (NAICS 337) industries due to economic cycles, rising production and transportation costs, changing buyer habits, and increasing global competition, among other things. Not surprisingly, ideas as to how to make the domestic industry more competitive have been pondered by numerous individuals involved. Making the industry more effective and efficient through the implementation of management practices, such as Lean, is one idea that has been brought forward repeatedly. Lean, originating in the automotive industry in Japan after WWII, has proven successful in improving the effectiveness and efficiency of companies and industries. Thus, this research wanted to know if Virginia's wood products and furniture manufacturing industries are aware of Lean, make use of Lean, achieve positive business results from practicing Lean, and have a need for external support for implementing Lean. Findings pertaining to Lean awareness and implementation have been presented in a first manuscript ("*Lean and Virginia's wood industry – Part I: Awareness and implementation*," Fricke and Buehlmann 2012), while this second manuscript focuses on business results and the need for external Lean implementation support. Based on the analysis presented in the present article, it can be concluded that:

1. With the exception of "sales per employee," a majority of respondents indicated improved business results for "lead time (70 percent of respondents reported improvements)," "on-time delivery (78 percent)," "inventory turnover (58 percent)," and "cost per unit (56 percent)." Improvements reported ranged from 31, 31, 27, and 23, respectively, for "lead time," "on-time delivery," "inventory turnover," and "cost per unit." Respondents indicating an improvement for "sales per employee," indicated, on average, a 22 percent improvement.
2. No differences between the two industry sectors (wood products (NAICS 321) and furniture manufacturing (NAICS 337)) with respect to the business results through Lean implementation could be found. "On-time delivery" scored best for both sectors with 73 percent and 87 percent for the wood products and furniture manufacturing, respectively, responses indicating that improvements were achieved by the implementation of Lean practices in the company.
3. Only 23 percent of respondents claimed to have a need for external Lean implementation support. The respondents indicated a need for external support with the training of management and shop floor employees, as well as implementation support with extensive employee involvement (67 percent, 58 percent, 48 percent positive response rates, respectively). However, forty-eight percent of respondents indicated that they "... don't know" what form of support they want or need.
4. The outcome of this study (part I and II) shows that Virginia's wood products and furniture manufacturing industries are slow in adapting and implementing Lean elements, a finding supported by other researchers. Only a few industry sub-segments, such as, for example, "kitchen cabinets" and "engineered wood products," have "Lean leaders," who have implemented all 29 Lean elements investigated in this study. Also, the low number of respondents indicating a need for external Lean implementation support (23 percent) suggests that companies may not be aware of the potential benefits of Lean.

## IMPLICATIONS

For companies of the U.S. Wood Products (NAICS 321) and Furniture Manufacturing (NAICS 337) industries to survive and thrive in today's highly competitive, global markets subject to economic uncertainty, effective and efficient operations are a must. Lean, a proven management practice focusing on creating value for customers while minimizing waste, can be a powerful tool to help the industry improve its competitive position and thus its profitability and rate of survival. To promote higher adaptation rates of Lean among industry participants and to encourage participants already practicing a limited number of Lean elements to increase their level of Lean implementation, increased efforts need to be made to improve the industries' knowledge of the benefits of Lean implementation for their company. Additionally, more efforts have to be made to help industry participants to understand the kind of support they can take advantage of from external sources, thereby improving the quantity and quality of Lean implementation.

## ACKNOWLEDGEMENTS

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