# การศึกษาผลกระทบของแนวทางปฏิบัติเพื่อความยั่งยืนทางสังคมแบบลีนต่อประสิทธิภาพความยั่งยืนทางสังคม

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**บทคัดย่อ**

วัตถุประสงค์ของการศึกษานี้คือ เพื่อศึกษาผลกระทบของแนวทางปฏิบัติ เพื่อความยั่งยืนทางสังคมแบบลีนในบรรษัทข้ามชาติที่ดำเนินธุรกิจในภาคการผลิตยานยนต์ต่อประสิทธิภาพความยั่งยืนทางสังคม ใช้วิธีการสำรวจเชิงปริมาณเพื่อรวบรวมข้อมูล โดยใช้แบบสอบถามจากคนงานของสถานประกอบการจำนวน 406 คนในภาคการผลิตยานยนต์ การศึกษาเชิงปริมาณวิเคราะห์โดยใช้เทคนิคการสร้างแบบจำลองสมการโครงสร้าง เพื่อตรวจสอบยืนยันและยืนยันข้อมูลเชิงประจักษ์ของแบบจำลองที่ยอมรับได้ โดยใช้ดัชนีที่ใช้เป็นเกณฑ์ในการประเมิน โดยรวมแล้ว ความถูกต้องของโครงสร้างที่ตรวจสอบโดยใช้การวิเคราะห์องค์ประกอบเชิง สำรวจ และตรวจสอบคุณภาพของเครื่องมือ ด้วยการตรวจสอบความเที่ยงของแบบวัดความสอดคล้องภายใน โดยใช้สูตรสัมประสิทธิ์แอลฟา และการวิเคราะห์องค์ประกอบเชิงยืนยันอันดับที่สอง ผลการทดสอบพบว่า ดัชนีความเหมาะสมของตัวแบบที่ถูกนำมาทดสอบทั้งสามตัวแบบมีความไม่แปรปรวนตามเกณฑ์แสดงให้เห็นดัชนีความพอดีของแบบจำลองที่ยอมรับได้ ผลการวิจัยระบุว่าแนวปฏิบัติด้านความยั่งยืนทางสังคมแบบลีนที่ประกอบด้วยสามตัวแบบ ด้านกำลังแรงงาน ด้านความโปร่งใสของข้อมูล และด้านการสนับสนุนต่อชุมชน ส่งผลในเชิงบวกต่อผลการดำเนินงานของบริษัทด้านความยั่งยืนทางสังคม ตัวแบบที่มีอิทธิพลมากที่สุดต่อความยั่งยืนทางสังคม ได้แก่ ด้านความโปร่งใสของข้อมูล ด้านการมีส่วนร่วมของชุมชน และด้านกำลังแรงงานตามลำดับ มีการหารือถึงความหมายของข้อค้นพบและข้อเสนอแนะสำหรับการวิจัยในอนาคต

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# INVESTIGATING THE ROLE OF LEAN SOCIAL SUSTAINABILITY ON SOCIAL SUSTAINABILITY PERFORMANCE

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**Abstract**

The purpose of this study is to investigate the effect of lean social sustainability practices in MNCs running businesses in the automotive manufacturing sector on social sustainability performance. A quantitative survey methodology was adopted to collect data by using a questionnaire from 406 MNCs' workers in the automotive manufacturing sector. The quantitative study was analyzed with the technique of structural equation modeling (SEM) for verification and confirmation of an acceptable model fit with empirical data using the indices that were used as the criteria for evaluation. Overall, the construct validity investigated by exploratory factor analysis and confirmatory factor analysis demonstrated acceptable model fit indices. The findings indicate that lean social sustainability practice, composed of three dimensions: work force, information transparency, and community contribution, has positive effects on a social sustainability firm's performance. In terms of social sustainability, the most influential dimensions are, in order of importance, information transparency, community contribution, and work force dimension. The implications of the findings and suggestions for future research are discussed.

**Keywords:** Lean Social Sustainability, Social Sustainability Performance, Sustainability, Automotive Manufacturing Firms, MNCs

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**Introduction**

Lean is a relatively recent term used to describe manufacturing process improvement activities and has only been in existence for approximately the past 30 years. The need to improve manufacturing processes. When people think of lean manufacturing, they normally think that it began with Toyota and some go as far back as Ford and his production lines for the Model T Ford, but depending on how we define lean, it has a very long history. Lean provides a way to do with less human effort, less equipment, less time, and less space while coming closer and closer to providing customers with exactly what they want, and also offers a way to make work more satisfying by providing immediate feedback on efforts to convert muda (waste) into value (Womack, Jones, & Roos, 2003).

The lean tools, several performance metrics were developed to evaluate the improvements in lean implementation. However, the need to evaluate the overall leanness has not been fully addressed (Wan & Frank Chen, 2008). Many articles relating to lean assessment measurement tools and frameworks have been developed by leading organizations(Wang & Taj, 2005) such as the lean enterprise self-assessment lean aerospace initiative (LAI) at Massachusetts Institute of Technology , the ISI lean value assessment (Industrial Solutions Inc.), the standard J4000 – identification and measurement of the best practices for implementing lean operations (SAE International 1999), and the evaluation model for the Shingo Prize (Shingo, 1986).

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The most common definition of sustainability is one from the area of sustainable development provided by the World Commission on Environment and Development (WCED), also known as the Brundtland Report, which states "Sustainable development" is development that meets the needs of the present without compromising the ability of future generations to meet their own needs (Tavanti, 2014). In order to live sustainably, the Earth’s natural

resources must be used at a pace that will allow for renewal. However, our consumer-oriented society has placed enormous pressure on the planet (Richardson et al., 2009). Current production models and consumption patterns have contributed to many of today's environmental problems, such as global warming, pollution, the depletion of natural resources, and the loss of biodiversity (Raskin, Electris, & Rosen, 2010).

Many researchers and practitioners have covered the possible integration of lean and sustainability has received increasing attention, focusing on the relationship and links between lean and sustainability and different perspectives. According to Hartini and Ciptomulyono (2015), research about lean and sustainable manufacturing seems to have been the object of growing attention from researchers up to 2020. The number of articles published in the last 20 years has been increasing. Much evidence suggests that lean is beneficial for sustainable manufacturing, dominantly in terms of the environment and economic aspects of manufacturing.

There was an increasing interest in the role of lean thinking processes in achieving sustainability outcomes (G. Fliedner & Majeske, 2010; Garza-Reyes, 2015). The literature of lean management and sustainability related to the three key aspects included in the concept of sustainability (environmental or ecological. Economic and social). According to this definition, three key dimension or elements of sustainability can be identified; integrating economic, environmental a social aspect in a "triple bottom line" (Dyllick & Hockerts, 2002).

There is the positive impact of lean and sustainable manufacturing on three bottom line performance (environmental, economic, and social). However, there are only a few studies that contain empirical evidence regarding social performance in terms of employee perspective. Only a few academic papers have been published on social performance. As a result, it is clear that social performance has been a neglected and under-researched area.(Bocken et al., 2014; Glover et al., 2011). Therefore, the main purpose of this research is to investigate the role of the lean social sustainability model in affecting social sustainability performance. This study helps to improve the social performance of manufacturing through the identification of the effects of lean social sustainable practices in MNCs that are linked to social sustainability performance outcomes.

This research project aims to consider the situations and identify the effects of lean manufacturing applied in social, sustainability dimensions on the social sustainability performance of multinational companies (MNCs). The study further aims to examine how lean manufacturing could create the contributions and implications that lean manufacturing could

bring and help them improve their businesses. In order to answer the questions this research raises; the main objectives are outlined as follows:

To develop the measurement scale of lean manufacturing applied to social sustainability dimensions.

To examine the effects of lean manufacturing applied to social sustainability dimensions on social sustainability performance.

Four hypotheses have been developed by which to investigate lean social sustainability and social sustainability performance in firms. In order to understand the effect of lean social sustainability on social sustainability performance. Hypotheses have been developed as follows:

H1. Practicing in work force has positive effect on lean social sustainability.

H2. Practicing in information transparency has positive effect on lean social sustainability.

H3. Practicing in community contribution has positive effect on lean social sustainability.

H4. Lean social sustainability has positive effect on social sustainability performance.

## Literature Review

### Lean social sustainability principles

The objective of social sustainability is to treat your employees' rights as human capital, and it relates to fair and beneficial business practices towards labor and the community and region in which a corporation conducts its business. Workforce issues related to how an organization treats its staff. Four sub-dimensions were identified by (Piercy and Rich 2015). Accordingly, previous studies provide empirical evidence that is related to the relationship between lean and social sustainability contributions, which refer to lean social sustainability in the work force (treating employees' rights), lean social sustainability in information transparency, and finally lean social sustainability in community contributions, as shown in Table 1. Therefore, this research classifies lean social sustainability into three dimensions.

**Table 1** Social sustainability

| Lean Social Sustainability Principles | Authors | Contribution |
|---|---|---|
| 1. Work force & Safety (Treat employee's right) | Savitz and Weber (2006) | The balanced scorecard that captures in numbers under social outcome performance are Labor practices, Community impacts, Human rights and Product responsibility. |
| | Piercy and Rich (2015) | Workforce Issues related to how an organization treats its staff 1) Workplace operational issues 2) Compensation and 3) Union relations |
| | Sisson and Storey (2000) | Improved working conditions are a mutual aim of lean operations and sustainability engaged, empowered, and well-trained workforce |
| | Womack et al. (1990) and MacDuffie and Helper (1997) | Incentive payments and a generally higher level of pay explicitly lean, also serve to clearly create a sustainable working environment. |
| | Taubitz (2010) | Lean operations tend to deliver higher levels of safety through visual management, worker training, and standardized work |
| 2. Organization Transparency of Information | Lamming and Hampson (1996) | Within the firm and across firm boundaries underpins these sustainability issues. The shift toward this transparency is also fundamental in any lean organization. |
| | Womack et al., (1990) | Standardized work routines, and clear communication channels to employees, suppliers, and customers, are all elements of a lean operation |
| | Corbett, Klassen, and Management (2006) | Supports internal governance practices, as well as reducing wastage at the firm boundary as only those resources that are needed are pulled into the firm avoiding the bullwhip effect. |

**Table 1** Social sustainability

| Lean Social Sustainability Principles | Authors | Contribution |
|---|---|---|
| 3. Community Contribution | Lee and Shin (2010) | Community contributions related to the positive impact of the organization in the community in which they operated, for instance, through charitable donation and positively supporting the community. |
| | Maignan and Ferrell (2000) and Turker (2009) | Governance and Ethics concerned issues related to the management of corporate activities, including: socially responsible investment, public disclosure of activities, having a clear and written ethics policy, and ensuring legal compliance. |
| | Womack et al. (2003) | Maintaining a positive reputation in the local community is an explicit part of the strategy setting process within the lean organization. This issue, while often overlooked, has been key to a range of lean organizations. |

**Lean social sustainability practices in work force**

Panizzolo (1998) developed lean social sustainability practices using a research model that conceptualized lean manufacturing with a number of its best lean practices characterizing different areas of the company. Based on the comparison of the three studies, the Panizzolo model was used in this research with minor modifications in practices (Panizzolo, 1998).A research model that conceptualized lean manufacturing with a number of its best lean practices characterized different areas of the company. From Panizzolo, the same mention from the study of Gene Fliedner (2008), firms commonly pursue the seven lean principles referred to through the application of various lean methods and tools. Finally, apply the study of (Piercy & Rich, 2015). Some commonly used methods and tools are identified to give both lean and sustainability benefits. There are four lean social sustainability practices with Kaizen, leveled production, standardization, and visual management that are related to the sustainability dimension of the work force.

**Table 2** Lean Social Sustainability practices in Work Force

| Principles | Areas | Practices | Impact to Lean Social |
|---|---|---|---|
| Work force | Process | 1.Kaizen | Improve employee attitudes and commitment |
| | Manufacturing | 2.Standardized work | Reduce variations help employee to performed successfully |
| | | 3.Visual Management | Problem visualization to link between data and the people |
| | Human Resources area | 4.Group problem solving | Engage workers improved workplace |
| | | 5.Cross functional team | Engage employees to expansion of tier autonomy and responsibility |
| | | 6.Employee involvement | Contribute to value creation |
| | | 7.Compensation | Establishment to employees |

1. Kaizen - Improve employee attitudes and commitment

Glaver et al. (2011) studied the contribution impact of kaizen on work area employee attitudes and commitment by using methodology in a multi-site field study to the criteria of eight manufacturing companies and found that there was a positive relationship between kaizen event, work area, and post-event characteristics vs. work area attitude and commitment. Kaizen practice conducted in group problem solving engages workers to find solutions to problems and reduces reliance on inspection to enforce quality and safety issues (Gene Fliedner, 2008; Panizzolo, 1998; Piercy & Rich, 2015).

2. Standardized work: Reducing variations to assist employees in performing well

Standard work takes a specific interest in what process operators have to go through to make the process successful (Allwood & Pentland, 2016). According to Dennis (2007) and George (2003), the work should be carried out according to an approved standard in terms of methods used, employee movement, and production rate (takt time, cycle time, work sequence, and in-process stock). Thus, the standardized work forms are the baseline for kaizen, or continuous improvement.

3. Visual Management: Using problem visualization to connect data and people

In lean management, visual management is an absolutely essential tool within the world of lean and can be seen as the link between the data and the people. Visual management uses instinctive visual cues to make succinct, accurate information within a workplace available at all times to those who need to know it. (Shingo, 1986). The visual management includes Jidoka, or autonomation, and Poka-yoke, or error-proof equipment.

3.1 Jidoka – autonomation: Jidoka can be used for visual control. Since equipment stops when a problem arises, a single operator can visually monitor and efficiently control many machines (Association, 1986; Monden, 2011).

3.2 Poka-yoke, or error proof equipment: By taking over repetitive tasks or actions that depend on vigilance or memory, it frees a worker's time and mind to pursue more creative and value-adding activities. These are inexpensive techniques for eliminating or at least reducing defects and the mistakes that cause them to be unsafe working environments (Shingo, 1986; Wilson, 2010).

4. Group problem solving: engage workers to improve the workplace

Group problem solving benefits lean by reducing the reliance on inspection to enforce quality, and it benefits engaged workers and improves workplace sustainability (Panizzolo, 1998; Piercy & Rich, 2015) by reducing the reliance on inspection to enforce quality. One technique in group problem solving in LM is the 5 Whys technique, which was developed and fine-tuned within the Toyota Motor Corporation as a critical component of its problem-solving training. According to Ohno (1988), "the basis of Toyota's scientific approach is that by repeating "why" five times, the nature of the problem as well as its solution becomes clear." In the Toyota culture, a team is encouraged to dig into each problem that arises until they find the root cause. This elementary and often effective approach to problem solving promotes deep thinking through questioning and can be adapted quickly and applied to most problems (Serrat, 2017).

5. Cross-functional team: engage employees in the expansion of tier autonomy and responsibility

Cross-functional teams provide benefits in lean by reducing the reliance on inspection to enforce quality and in sustainability by engaging workers and improving the workplace. (Panizzolo, 1998; Piercy & Rich, 2015). The empirical results confirm the importance of human resources in the implementation of lean production principles. In particular, the involvement of workers in continuous quality improvement programs, the expansion of tier autonomy and

responsibility, and the presence of multi-functional workers have all, in managers' opinions, been crucial for improvements in firms' performances.

6. Employee involvement and commitment contribute to value creation:

Employee involvement provides a benefit in lean to reduce the reliance on inspection to enforce quality and in sustainability benefits by engaging workers and improving the workplace. (Panizzolo, 1998; Piercy & Rich, 2015). Workers' involvement and empowerment contribute to value creation (Worley, 2004). Active involvement of shop-floor workers and participation in improvement activities is required to fulfill the continuous improvement notion (Jørgensen, Boer, & Gertsen, 2004). A decentralized control structure improves personal involvement and moves decision-making downward in the company (Kaplan & Wisner, 2009).

In order to promote employee contributions and to increase employee empowerment, the studies have adopted innovative practices (Rothenberg, Pil, & Maxwell, 2001). Workforce (Florida, 1996; King & Lenox, 2001). Commitment provides a benefit in lean to reduce the reliance on inspection to enforce quality and in sustainability to benefit workers and improve the workplace (Panizzolo, 1998; Piercy & Rich, 2015). Research has previously identified a positive correlation between worker engagement and environmental performance (Florida, 1996; Kitazawa, Sarkis, & Management, 2000; Elnyk, Sroufe, & Calantone, 2003).

7. Compensation for employment of employees:

Compensation included fair wages and payment, diversity issues, and no discrimination in hiring employees (Womack et al., 1990; MacDuffie & Helper, 1997; Piercy & Rich, 2015). Compensation contributes to the long-term sustainability of engaged workers and the improvement of the workplace.

**Information transparency with lean social sustainability practices**

Transparency of information within the firm and across firm boundaries is a sustainability issue. The shift toward this transparency is also fundamental in any lean organization (Lamming & Hampson, 1996). Standardized work routines, and clear communication channels to employees, suppliers, and customers are all elements of a lean operation (Womack et al., 1990). This transparency supports internal governance practices (Corbett et al., 2006; Kainuma & Tawara, 2006).

There are five information-transparent practices in lean social sustainability organizations.

**Table 3** Lean Social Sustainability practices in Information Transparency

| Principles | Areas | Practices | Impact to Lean Social |
|---|---|---|---|
| Information Transparency | Organization Policy | 1. Charitable giving | Provide benefit in lean is Incentivize staff for improvement and in sustainability benefit positive member of community |
| | | 2. Transparency to employee | Employees understand cost/benefits to help improvement |
| | | 3. Sustainability Audit and Public Disclosure | Part of transparency/audit culture |
| | Customer | 4. Customer involvement in quality programs and product design | Provide benefit in lean is trusted company can sell more and in sustainability benefit ethically |
| | Supplier | 5. Transparency to suppliers in open book costing | Engage employees to expansion of tier autonomy and responsibility. |

1. Charitable giving

It is advantageous to provide a benefit in a lean way. Incentivize staff for improvement and, in sustainability, benefit positive members of the community. This related to the positive impact of the organization in the community in which it operated (Lee & Shin, 2010). Maintaining a positive reputation in the local community is an explicit part of the strategy setting process within the lean organization (Womack et al., 2003). Community contributions related to the positive impact of the organization in the community in which it operated (Lee & Shin, 2010). These two practices in the lean social sustainability community are part of the organization's transparency principle.

2. Transparency to employee

The company is transparent to employees and provides benefits in lean terms in terms of employee understanding of cost/benefits to help improvement. For sustainability, the benefit is better business ethics and engagement (Lamming & Hampson, 1996; Corbett et al., 2006; Kainuma & Tawara, 2006; Piercy & Rich, 2015).

3. Sustainability audit and public disclosure

The company's sustainability audit and public disclosure provide benefits in lean terms in terms of transparency and audit culture. For sustainability, the benefit is better business ethics and engagement (Piercy & Rich, 2015). Concerning issues related to the management of corporate activities, including: socially responsible investment, public disclosure of activities, having a clear and written ethics policy, and ensuring legal compliance (Maignan & Ferrell, 2000; Turker, 2009).

4. Customer involvement in quality programs and product design

This activity benefits lean because a trusted company can sell more, and it benefits sustainability ethically because it should be honest with customers. Adopting a lean manufacturing concept also includes establishing innovative relationships with customers (Panizzolo, 1998; Shah & Ward, 2003). Because of the reality that quality and value are determined by customers, it will be necessary for organizations to create a great relationship with them (McDougall & Levesque, 2000; Wong, Wong, & Ali, 2009). Close relationships with customers help organizations sustain customer loyalty (Rothenberg et al., 2001) by recommending customer and supplier interactions and working on mutual research. Customer relationships can contribute to better production flows (Wong et al., 2009). Customer demand can offer a better indication of the connection between environmental manufacturing strategies and performance (Florida, 1996).

5. Transparency to suppliers in open book costing

The company is transparent to suppliers through open book costing, which benefits lean by gaining supplier commitment to long-term relationships.There were no unexpected price rises or problems with low-price bids. For sustainability, the benefit is better business ethics and engagement (Lamming & Hampson, 1996; Corbett et al., 2006; Kainuma & Tawara, 2006; Piercy & Rich, 2015).

**Lean social Sustainability practices in community contributions**

The community contribution is part of the organization's information transparency. Piercy and Rich (2015) demonstrate that lean social sustainability practices in the community can be applied to the study. Some commonly used methods and tools are identified to give both lean and sustainability benefits. There are three practices in lean social sustainability for community contribution (Womack et al., 2003).

**Table 4** Lean Social Sustainability practices in Community Contribution

| Principles | Areas | Practices | Impact to Lean Social |
|---|---|---|---|
| Information Transparency | Organization Policy | 1. Community Engagement and School/Neighbor engagement | Provide benefit in lean is gain reputation as employer of choice and in sustainability benefit to get best workers Positive member of community and being good corporate citizen and in sustainability benefit positive member of community |
| | | 2. Transparency to community | Positive impact of the organization in the community in which they operated, for instance, through charitable donation and positively supporting the community |

1. Community Engagement and School/Neighbor engagement

This activity provides benefits in lean because it gains a reputation as an employer of choice, and in sustainability, benefits by getting the best workers, being a positive member of the community, and being a good corporate citizen, which in sustainability benefits a positive member of the community. The interest in corporate social responsibility, sustainable business practice, corporate governance, business ethics, and integrity and compliance management has grown markedly in the past decade (Waddock & Governance in Global Business, 2005). It is not only stakeholders who expect companies to pay greater attention to norms, values, and principles; companies themselves are acknowledging the importance of responsible business practice (Waddock & Governance in Global Business, 2005). The business codes of multinational firms regarding responsibilities towards stakeholders in the area of society (or local community) can be included (Kaptein, 2004).

2. Transparency to community

Community contributions relate to the positive impact of the organization in the community in which they operate, for instance, through charitable donations and positively supporting the community (Lee & Shin, 2010). Maintaining a positive reputation in the local community is an explicit part of the strategy setting process within the lean organization. This issue, while often overlooked, has been key to a range of lean organizations (Womack et al.,

2003).The company is open to the community and benefits from the community's understanding and support of business. For sustainability, the benefit is better business ethics and engagement (Lamming & Hampson, 1996; Corbett et al., 2006; Kainuma & Tawara, 2006; Piercy & Rich, 2015).

## Research Methodology

The study involves conducting a survey to obtain categorical data for statistical testing of the formulated hypothesis. The survey was conducted in two ways: the first one using the electronically administered questionnaire, as it was the most convenient way of collecting the required information, and the second one using a paper questionnaire. The questionnaire link was sent via e-mail for electrical format and the paper was sent via post, which included a return envelope and pre-paid stamp once returned. The surveyed questionnaire was e-mailed and mailed to the managers of 50 manufacturing facilities; a total of 600 paper questionnaires were sent out and the response rate was 406 (Cochran, 2007). A cover letter was attached with a copy of the questionnaire. The letter explained the nature and benefits of the study and included general instructions on how to complete the questionnaire. The letter also clearly laid down terms of protection on the confidentiality of the information provided. Two weeks after sending the questionnaire, requiring them to send the questionnaire back, a follow-up call has been made to respondents as a reminder and solicited their participation. The data collection was stopped one month after its commencement.

### Sample and data

The total response to the 406 questionnaires was both by email and returned paper questionnaires. The response rate of 68% was achieved from the online survey and hard-copy questionnaire. The population of this study consists of all manufacturing firms who implement lean practices in Thailand's automotive industry. The province includes Bangkok, Ayuthaya, Samutprakarn, Chonburi, Pathumthani, Rayong, Lampoon, and Prachinburi. The term "firm" here refers to both companies as well as individual units or sites within those companies. The population frame for this study was obtained from the Thai Autoparts Manufacturers Association (TAPMA) directory 2020. The list of manufacturing firms consists of electrical, electronic, metal, plastic, rubber, and other automotive components. The manufacturing firms in this study were divided into three categories: those owned entirely by Thais, those owned entirely by foreigners, and those owned equally by Thais and foreigners.This study combines issues related to sustainability, focusing on the lean social sustainability aspect with the

operational aspect of the level of lean implementation. So, the most appropriate respondents are key informants who hold managerial positions in manufacturing firms. Sustainable manufacturing with a main focus on environmental outcomes has been considered, which is identified by quality system certification obtained in their firm at least ISO 9001 and ISO14001 or ISO26000 or OHSAS 18001 or ISO45001. Outcomes are defined as the lean social sustainability model of factors affecting social sustainability performance on a new measurement scale. Measurement items for the outcomes are developed from the literature.

**Research instruments**

The research instrument was used in accordance with the research methods. The employed research instrument in the quantitative study was a questionnaire containing question items obtained from development based on issues highlighted in previous literature. There were 43 question items covering two aspects. The respondents were to respond to those question items by checking their answers on a five-point Likert scale for all dimensions of lean social sustainability practices and social sustainability performance. The scale ranges from 1 to 5, which is referred to as "strongly disagree" for 1 and "strongly agree" for 5. The content validity of the questionnaire items, as verified by five experts, showed an IOC index of not lower than 0.50 for every item. Also, the reliability of the questionnaire, as represented by Cronbach's alpha coefficient, ranged from 0.70 to above 0.90 for lean social sustainability and social sustainability performance. Thus, this questionnaire provides appropriate reliability for respondents (Ursachi et al., 2015).

**Data analysis**

Data from the quantitative study's questionnaires were analyzed using the structural equation modeling (SEM) technique for verification and confirmation of an acceptable model fit with empirical data using the indices that were used as evaluation criteria. Overall, the construct validity investigated by EFA was satisfactory as assured by Kaiser-Meyer-Olkin Measure of Sampling Adequacy (KMO) and Bartlett's test of sphericity values. The first analysis to present the descriptive statistical analysis, the exploratory factor analysis (EFA), and reliability Cronbach's alpha, finally presents the second order CFA demonstrated acceptable model fit indices (Hair, Black, Babin, & Anderson, 2010; Kline, 2011; Loehlin & Martin, 2011; Bollen & Hoyle, 2012).

**Table 5** The indices of appropriate of the model in CFA

| Fit Index | Description | Acceptable Threshold Levels |
|---|---|---|
| $\chi^2$/df | Relative Chi-Square of the discrepancy | <3 good, <5 permissible |
| GFI | Goodness-of-fit | >0.95 good,>0.90 acceptable |
| AGFI | Adjusted Goodness-of-fit | >0.95 good,>0.90 acceptable |
| RMSEA | Root Mean square Error of Approximation | <0.07 good,0.07-0.10 moderate |
| RMR | Root Mean square Residual | <0.09 good |
| CFI | Comparative Fit Index | >0.95 good,>0.90 acceptable |
| NFI | Normed Fit Index | >0.95 good,>0.90 acceptable |

## Research Result

### Descriptive statistical analysis

Lean social sustainability and social sustainability are two terms that are used interchangeably. Performance was perceived at a high level at which there were three latent variables in work force, information transparency, and community contribution appraised as high as in the below table.

**Table 6** Descriptive table: Mean, SD., Skewness, Kurtosis, level of mean

| Variable | Items | Mean | SD | Ske. | Kur. | Level of mean |
|---|---|---|---|---|---|---|
| **Lean Social Sustainability** | 25 | 4.164 | 0.439 | -0.784 | 0.598 | High |
| 1. Work Force | 14 | 4.165 | 0.481 | -0.443 | -0.106 | High |
| 2. Information Transparency | 5 | 4.154 | 0.593 | -0.696 | 0.446 | High |
| 3. Community contribution | 6 | 4.168 | 0.581 | -0.700 | 0.358 | High |
| **Social Sustainability Performance** | 18 | 4.002 | 0.507 | -1.083 | 1.592 | High |

### Exploratory factor analysis EFA and Reliability Cronbach's alpha

EFA result: Lean social sustainability of a total of 25 questions. The result generated using principal component and Varimax rotation found that 7 questions had cross-loadings greater than 0.40 and 5 questions had factor loadings below 0.40 (Hair, et. al., 2010). As such, the decision was made to exclude 12 questions (WFS01, WFS02, WFS04, WFS06, WFS07, WFS12, WFS13, WFS14, CCS01, CCS05, ITS04, ITS05). Finally, the remaining 13 questions are arranged into three groupings as below.

**Table 7** Exploratory factor analysis Rotated Component Matrix of Lean social sustainability

| | Components | | |
|---|---|---|---|
| | **Work force** | **Information Transparency** | **Community contribution** |
| WFS09 | .857 | | |
| WFS10 | .826 | | |
| WFS11 | .697 | | |
| WFS03 | .632 | | |
| WFS05 | .511 | | |
| WFS08 | .476 | | |
| CCS04 | | .830 | |
| CCS02 | | .740 | |
| CCS03 | | .643 | |
| CCS06 | | .583 | |
| ITS02 | | | .725 |
| ITS03 | | | .705 |
| ITS01 | | | .680 |
| **% of Variance** | **22.493** | **17.356** | **12.312** |
| Kaiser-Meyer-Olkin Measure of Sampling Adequacy = 0.660, Bartlett's Test of Sphericity = 374.926, p-value = .000 | | | |

The reliability of the component that concluded from 13 questions informed the internal consistency found that work force and information transparency were good and community contribution, social sustainability as shown below, performance was adequate.

**Table 8** Cronbach's Alpha of Lean social sustainability and Social Sustainability Performance Component

| **Construct** | **Number of items** | **Cronbach's Alpha** | **Internal Consistency** |
|---|---|---|---|
| Work force | 6 | .802 | Good |
| Information Transparency | 4 | .813 | Good |
| Community contribution | 3 | .762 | Acceptable |
| Social Sustainability Performance | 5 | .921 | Excellent |

EFA result: social sustainability performance of a total of 18 questions. The result generated using principal component and Varimax rotation found that 4 questions had cross-loadings greater than 0.40 and 1 question had factor loadings less than 0.4 (Hair, et. al., 2010). As such, the decision was made to exclude 5 questions (S01, S02, S08, S10, S13). There were 4 components out of remaining 13 questions which grouping less than three question (Component 2,3,4,5) as such the final select only component 1 which included five question S16, S15, S17, S18, S14 (Hair, et. al., 2010).

**Second order CFA demonstrated acceptable model fit**

**Lean Social Sustainability**

Lean social sustainability consists of three variables: Work Force, Information Transparency, and Community Contribution, each of which consists of the number of questions: 6, 4 and 3 items, respectively. After modification, the results of CFA demonstrated an acceptable model fit as below in table and figure.

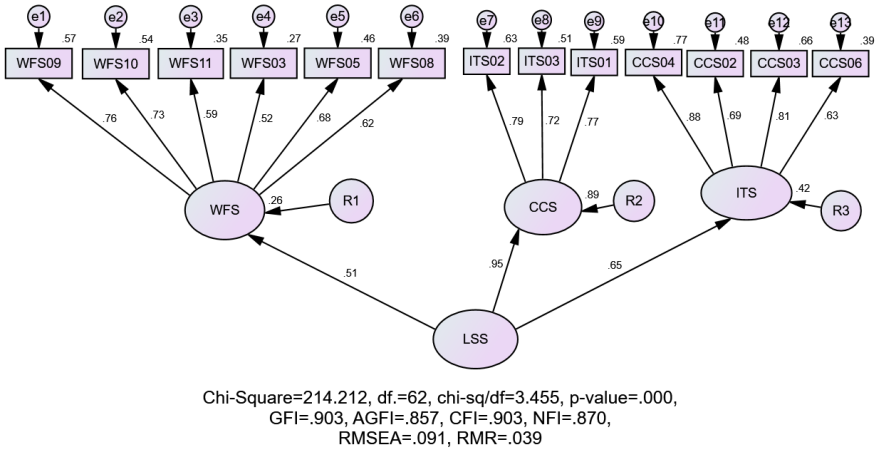



**Figure 1** Initial model of Lean Social Sustainability

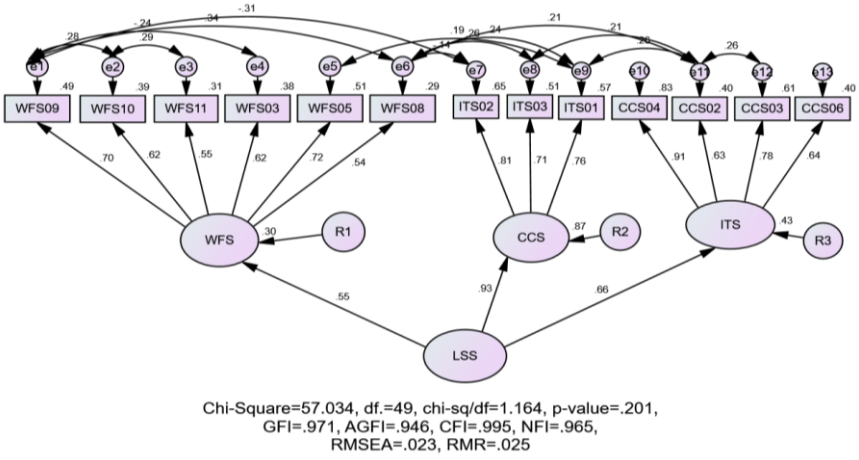



**Figure 2** Final model of Lean Social Sustainability

**Table 9** CFA of Lean Social Sustainability

| | $\chi^2$ | Df | p-value | $\chi^2$/Df | GFI | CFI | NFI | RMSEA | RMR |
|---|---|---|---|---|---|---|---|---|---|
| Criteria | - | - | - | ≤ 3.00 | ≥ 0.90 | ≥ 0.90 | ≥ 0.90 | ≤ 0.07 | ≤ 0.08 |
| Initial model | 214.212 | 62 | .000 | 3.455 | .903 | .903 | .870 | .091 | .039 |
| Final model | 57.034 | 49 | .201 | 1.164 | .971 | .995 | .965 | .023 | .025 |

Note: $\chi^2$ = Chi-squares, Df = Degree of freedom, GFI = Goodness of fit index, CFI = comparative fit index, NFI = Normed Fit Index, RMSEA = root mean square error of approximation, RMR = root mean square residual

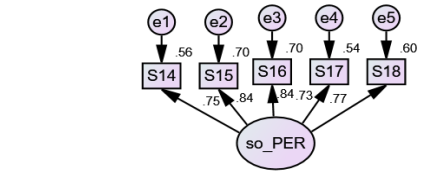
**Table 10** Second order CFA) of Lean social sustainability

| **Construct/Indicators** | $\beta$ | *t*-value | $R^2$ | CR | AVE |
|---|---|---|---|---|---|
| **Lean social sustainability *(α =.858)*** | **-** | **-** | **-** | **.767** | **.535** |
| **Work force *(α =.813)*** | **0.551** | **-** | **0.304** | **.794** | **.394** |
| WFS09 | 0.696 | - | 0.485 | | |
| WFS10 | 0.621 | 9.843*** | 0.386 | | |
| WFS11 | 0.553 | 7.647*** | 0.306 | | |
| WFS03 | 0.619 | 7.836*** | 0.383 | | |
| WFS05 | 0.717 | 8.997*** | 0.513 | | |
| WFS08 | 0.541 | 9.388*** | 0.293 | | |
| **Community contribution *(α =.836)*** | **0.934** | **5.002*** ** | **0.872** | ***.832*** | **.559** |
| CCS04 | 0.909 | - | 0.827 | | |
| CCS02 | 0.631 | 11.103*** | 0.398 | | |
| CCS03 | 0.781 | 14.067*** | 0.609 | | |
| CCS06 | 0.635 | 11.394*** | 0.404 | | |
| **Information Transparency *(α = .801)*** | **0.656** | **6.100*** ** | ***0.430*** | ***.805*** | **.580** |
| ITS02 | 0.809 | - | 0.655 | | |
| ITS03 | 0.714 | 11.837*** | 0.509 | | |
| ITS01 | 0.758 | 12.441*** | 0.575 | | |

**Note**: all indicators are significant at p < 0.001, the path of WFS09, CCS04, and ITS02 were fixed to 1 (not estimated). $\alpha$ = Cronbach's alpha coefficient, CR = construct reliability or composite reliability, AVE = average variance extracted

**Social Sustainability Performance**

Social sustainability: five questions are asked during the performance. After modification, the results of CFA demonstrated an acceptable model fit as below in the table and figure.




Chi-Square=42.379, df.=5, chi-sq/df=8.476, p-value=.000,
GFI=.944, AGFI=.832, CFI=.954, NFI=.949,
RMSEA=.158, RMR=.027

**Figure 3** Initial model of Social Sustainability Performance

**Table 11** CFA of Social Sustainability Performance

| | $\chi^2$ | Df | p-value | $\chi^2$/Df | GFI | CFI | NFI | RMSEA | RMR |
|---|---|---|---|---|---|---|---|---|---|
| Criteria | - | - | - | ≤ 3.00 | ≥ 0.90 | ≥ 0.90 | ≥ 0.90 | ≤ 0.07 | ≤ 0.08 |
| Initial model | 42.379 | 5 | .000 | 8.476 | .944 | .954 | .949 | .158 | .027 |

Note: $\chi^2$ = Chi-squares, Df = Degree of freedom, GFI = Goodness of fit index, CFI = comparative fit index, NFI = Normed Fit Index, RMSEA = root mean square error of approximation, RMR = root mean square residual

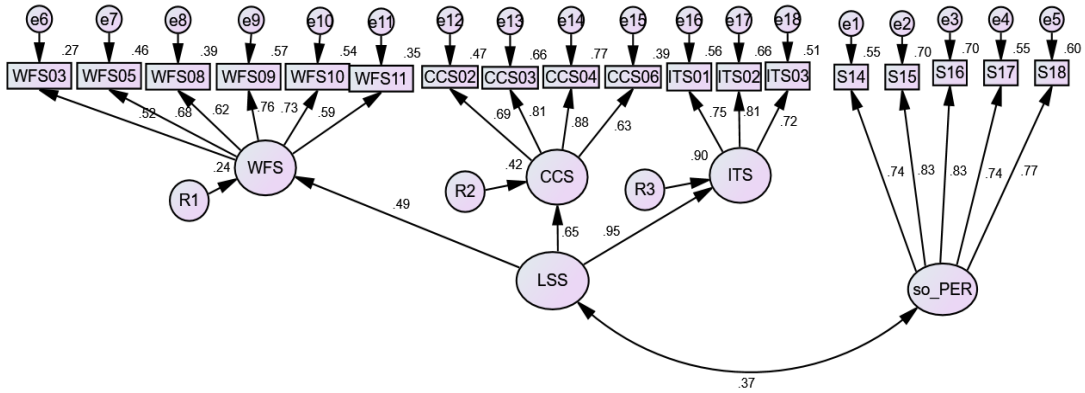
**Table 12** Second order CFA of Social Sustainability Performance

| Construct/Indicators | $\beta$ | *t*-value | $R^2$ | CR | AVE |
|---|---|---|---|---|---|
| Social Sustainability performanace *($\alpha$ = .921)* | - | - | - | .889 | .617 |
| S14 | 0.735 | | 0.540 | | |
| S15 | 0.836 | 15.078 | 0.698 | | |
| S16 | 0.839 | 12.176 | 0.704 | | |
| S17 | 0.765 | 10.723 | 0.585 | | |
| S18 | 0.746 | 11.491 | 0.557 | | |

**Note**: all indicators are significant at p < 0.001, the path of S14 was fixed to 1 (not estimated). $\alpha$ = Cronbach's alpha coefficient, CR = construct reliability or composite reliability, AVE = average variance extracted.

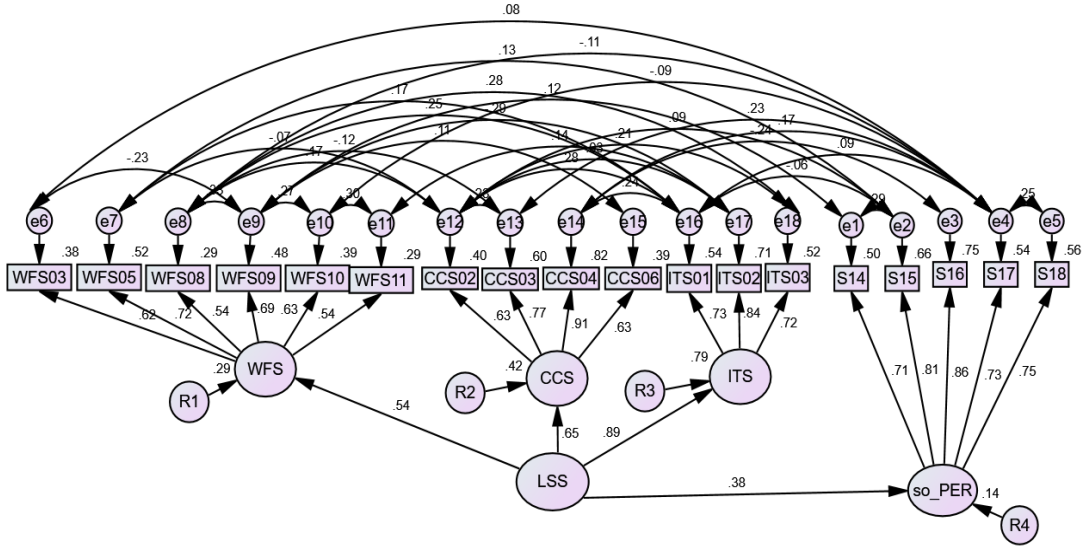
**Lean social sustainability influence to social sustainability performance**

From the above result, lean social sustainability consists of thirteen questions in three variable constructs: 1) employees, 2) contributions to the community, and 3) transparency of information. Social sustainability performance consists of the remaining five questions. From a total sample size of n = 406, the objective of this study is to find out if Lean Social Sustainability practices influence social sustainability performance. After modification, the results of CFA demonstrated an acceptable model fit as below in the table and figure.




Chi-Square=365.223, df.=131, chi-sq/df=2.788, p-value=.000,
GFI=.882, AGFI=.846, CFI=.905, NFI=.860,
RMSEA=.077, RMR=.041

**Figure 4** Initial model of Lean Social Sustainability to Social Sustainability Performance




Chi-Square=110.158, df.=100, chi-sq/df=1.102, p-value=.229,
GFI=.962, AGFI=.935, CFI=.996, NFI=.958,
RMSEA=.018, RMR=.033

**Figure 5** Final model of Lean Social Sustainability to Social Sustainability Performance

**Table 14** CFA of Lean Social Sustainability influence to Social Sustainability Performance

| | $\chi^2$ | Df | p-value | $\chi^2$/Df | GFI | CFI | NFI | RMSEA | RMR |
|---|---|---|---|---|---|---|---|---|---|
| Criteria | - | - | - | ≤ 3.00 | ≥ 0.90 | ≥ 0.90 | ≥ 0.90 | ≤ 0.07 | ≤ 0.08 |
| Initial model | 365.223 | 131 | .000 | 2.788 | .882 | .905 | .860 | .077 | .041 |
| Final model | 110.158 | 100 | .229 | 1.102 | .962 | .996 | .958 | .018 | .033 |

Note: $\chi^2$ = Chi-squares, Df = Degree of freedom, GFI = Goodness of fit index, CFI = comparative fit index, NFI = Normed Fit Index, RMSEA = root mean square error of approximation, RMR = root mean square residual

**Table 15** Second order CFA of Lean Social Sustainability influence to Social Sustainability Performance

| **Lean Social Sustainability influence to Social Sustainability Performance** | | | **Estimate** | **S.E.** | **C.R.** | **P** | **β** |
|---|---|---|---|---|---|---|---|
| Social Sustainability Performance | <--- | Lean Social Sustainability | 0.961 | 0.23 | 4.171 | *** | 0.381 |

**Discussion**

The dimension of the work force: the study shows that H1. practicing in the work force describes lean social sustainability in four activities. The first is standardized work, which forms a baseline for kaizen to take a specific interest in what process operators have to go through to make the process successful (Panizzolo, 1998; Dennis, 2007; Gene Fliedner, 2008; Piercy & Rich, 2015), as well as if a company tries to find the best ways of operating in safety conditions from standard methods used with production rate (takt time, cycle time, and work sequence). The second is that visual management practices improve safety by making the equipment stop when a problem arises. A single operator can visually monitor and efficiently control many machines because of visual management (Shingo, 1986; Monden, 1998). Third is the 5-Why technique, which if the company uses it to analyze the phase approach to problem solving, promotes deep thinking through questioning and is applied to most problems to engage workers in finding solutions to problems. Because of using the 5 whys technique in

problem solving, the company can increase the cross-skill of workers to work across plants (Ohno, 1988; Panizzolo, 1998; Piercy & Rich, 2015). And finally, cross-functional teamwork with working muti-functional involvement in continuous quality improvement programs to improve firms' performances. (Gene Fliedner, 2008; Panizzolo, 1998; Piercy & Rich, 2015). Thus, this is the confirmation of hypothesis 1.

According to the study's findings, H2. practicing in information transparency describes lean social sustainability in three ways.First is charitable giving to incentivize staff for improvement and, in sustainability, benefit positive members of the community. This related to the positive impact of the organization in the community in which it operated (Panizzolo, 1998; Womack et al., 2003). The second step is for the company to disclose employee practices in order for them to understand the costs and benefits and help them improve in their work areas (Panizzolo, 1998). Finally, the practice of sustainability audit at the company leads to public disclosure of activities, having a clear and written ethics policy, and ensuring legal compliance. Thus, this is the confirmation of hypothesis 2.

For the dimension of community contribution, the result of the study shows that H3. practicing in community contribution describes lean social sustainability in four practices. First is employee participation in community and civic affairs as the company. Second, it is an explicit part of the strategy setting process to maintain a positive reputation in the local community through charitable donations. Third, is a clear performance metrics practice to maintain a positive reputation in the local community. Finally, it is the practice dedicated to raising standards of health, education, product safety, workplace safety, and prosperity (Lamming & Hampson, 1996; Womack et al., 2003; Kaptein, 2004; Waddock & Governance, 2005; Piercy & Rich, 2015). The results show that the study has a positive effect on social sustainability performance. Thus, this is the confirmation of hypothesis 3.

The result of the study shows that lean social sustainability practices have a positive effect on the social sustainability performance of the adopting firms. The activities that describe social sustainability performance include four activities: a number of community-company partnerships; activity to improve the percent of products consumed locally; measuring the ratio of company wages compared to the local minimum wage; and activity to invest in human rights clauses. To confirm hypothesis 4, that this result is in line with the findings of commonly used methods (Panizzolo, 1998; Gene Fliedner, 2008; Piercy & Rich, 2015).

**Conclusion and suggestions from the research**

In this research, a theoretical model was developed to study the effect of lean social sustainability practices in manufacturing firms on social sustainability performance. The results of the study indicate that lean social sustainability practices in three dimensions, including work force, information transparency, and community contribution, were found to have a significant effect on social sustainability firm performance. The most influential dimensions on social sustainability are, in order of importance, information transparency, community contribution, and work force dimension.

In terms of information transparency, the most influential practice on a firm's social sustainability performance is the disclosure of cost and benefits to employees to understand the cost and benefits to help them improve in their work areas, which has been supported by (Piercy & Rich, 2015). In community contribution, the most influential practice is that the firm has clear performance metrics to maintain a positive reputation in the local community. This fact has been supported by Womack et al. (2003), who emphasized that this issue, while often overlooked, has been key to a range of lean organizations. For instance, at Toyota, since the 1950s, there has been a clear focus on community issues focused directly on the operating communities of current and former sites and employees. These issues are not just statements of principle but are associated with clear performance metrics.

In the work force dimension, the most influential practice is the firm's applied 5 Whys technique to analyze the phase approach to problem solving. This promotes deep thinking through questioning and is applied to most problems to engage workers in finding solutions to problems. This fact has been supported by Oliver, Delbridge, and Lowe (1996), who emphasized that this issue". In the Toyota culture, a team is encouraged to dig into each problem that arises until they find the root cause.

The five practices that effect the measurement of social sustainability performance are: a number of community-company partnerships; activity to improve the percent of products consumed locally; measuring the ratio of company wages compared to the local minimum wage; investing in human rights clauses; and activity for community spending and charitable contributions.

Thus, managers of manufacturing firms need to consider these practices more diligently to improve the social sustainability performance of their firms. This shows that manufacturing firms in the automotive industry most probably focus on information

transparency to disclose to employees the cost/benefits to help them improve in their work areas.

The results of this study are subject to some limitations that need to be taken into account for generalizing the results. Data was collected at a single point of time. As the study is a cross-sectional study, the findings of the research could only reflect the situation at a particular point of time regarding the relationship between lean social sustainability practices and social sustainability performance outcomes. So, a longitudinal study that examines lean social sustainability practices in a manufacturing firm for an extended period of time can provide a more precise picture of the casual relationship between lean social sustainability practices and social sustainability performance.

The study focuses on automotive manufacturing firms in Thailand, which means the study excluded manufacturing firms in other industries. Therefore, the issue of whether the study results can be applied to other industries needs to be considered. Moreover, according to effects of lean social sustainability practices, the study sought the opinions of practicing managers and operation personnel that are considered experts in this field, so the possibility of a certain level of bias may exist as it relied on single respondents, which from this study found out different job roles such as workers in the offices that responded to the questionnaires. Bias occurs as a result of respondents' knowledge of particular facts related to their job function.

**Suggestions for future research**

This study is considered one of the first attempts to empirically investigate the impact of lean social sustainability practices on different dimensions of firms, with the main focus on social sustainability performance. It is suggested that future studies focus on the following points: First, the current study investigates the lean social sustainability practices of firms with regard to social sustainability performance. Further research can explore a firm's lean sustainability practice implementation level to measure it in different stages of lean adoption. Also, we can use longitudinal analysis in studying the effects of sustainability performance. For example, the study may compare the sustainability performance before and after implementing lean social sustainability practices. Second, the lean social sustainability practices have been chosen based on the frequency of areas in the literature. So still, there are other lean practices areas that might have a significant effect on social sustainability performance that need to be considered. Finally, the extent and focus of implementation of

lean social sustainability practices vary among different industrial segments. Future research can duplicate this study by using a specific context, such as different sectors in industry.

Therefore, the overall findings indicate that lean social sustainability practices in three dimensions, including work force, information transparency, and community contribution, were found to have a significant effect on a social sustainability firm's performance. Future studies are encouraged to make use of this study for further investigation of the effects of lean social sustainability practices on other areas of a firm's performance and also in integrating them with other practices that are most suitable for this type of manufacturing industry.

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