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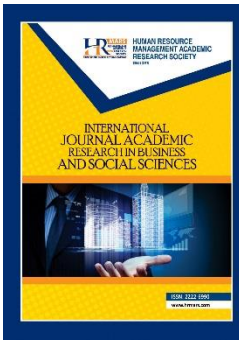
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Abstract

Previous literature proposed various methodologies to integrate and assess sustainable production. Numerous frameworks and indicators for sustainable production were suggested as measurement tools. However, these tools need to be more comprehensive and simpler to apply at factory level to achieve the sustainability goals. This paper mainly aims to analyze the various frameworks of sustainable production as evidenced in previous studies to determine the elements and components of the reviewed frameworks as well as indicators based on their criteria as suggested in the literature. The second objective is to understand the trend of scholars in integrating sustainable performance in manufacturing firms. The scientific literature on sustainable production in manufacturing industries was systematically reviewed. Findings of the study suggest that proposals for sustainable production indictors need to be more detailed to include all sustainable development pillars. Scholars are most likely to propose specific sets of indicators for specific products in industry, and life cycle approach is the most reliable in the case of sustainable production. This review will help to enhance managers' awareness of different frameworks of sustainable production, which can be used in specific contexts.

Keywords: Sustainable Development, Sustainable Production, Life Cycle Approach, Manufacturing Industry, Sustainable Production Indicators.

Introduction

Due to modernization, and rapid population growth, there has been high demand for goods and services, which lead to high consumption and pollution of the planet's environment. Deforestation, loss of species, contaminated water, and air, the hole in the atmosphere's ozone layer, global warming, poverty, and inequity are the major radical changes that the earth has witnessed in past decades. Hence, protecting the environment and society has been very great challenge that all

nations need to focus on (UN, 1992). The notion of sustainable development (SD) is described by the United Nations (UN) as; "the development that meets the needs of the present generation without compromising the ability of future generations to meet their needs." There is general agreement for a delicate equilibrium to be achieved in the way social and economic development is carried out without endangering the conservation of the environment (Veleva & Ellenbecker, 2001). This definition has been explained as follow: " The wheel of development should be driven to associate all three pillars of sustainability (environment, society, and the economy) (Jayachandran et al., 2006) with each other at the same time, as shown in Figure 1. The concept of SD has become a holistic philosophy which clarifies the interrelation between the three pillars of sustainability and explains how the balance between the three pillars can contribute to keeping the earth sustainable.

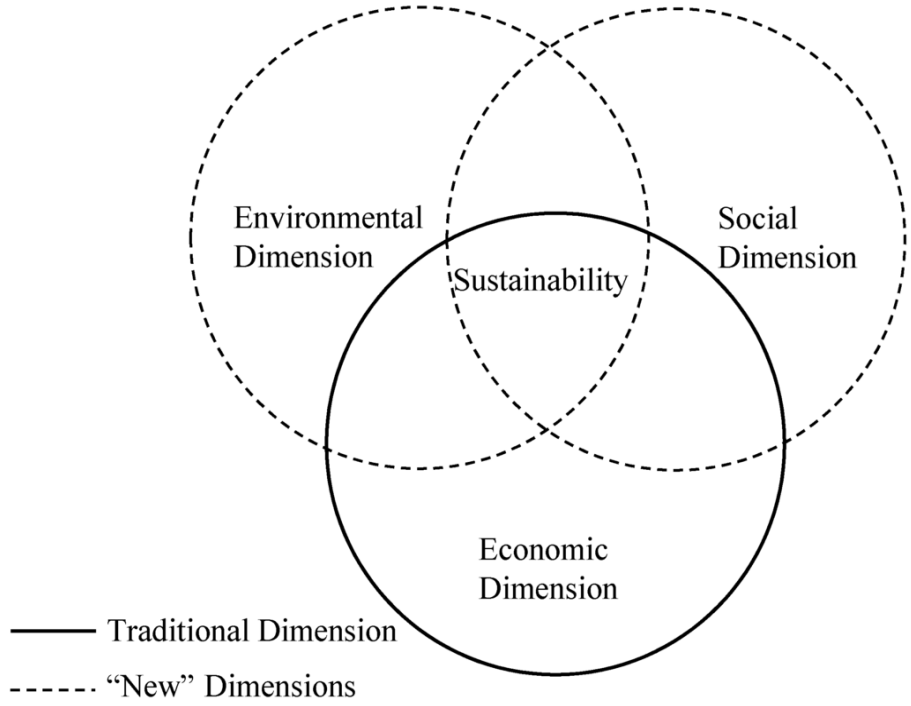

Figure 1: Interrelationship between the three pillars of Sustainable Development

It can be concluded that the sustainability concept is a continuous development in various fields. It is multi-dimensional in its approach and it has three major dimensions which with environmental, social, and economic implications, which must be taken into consideration to guarantee the sustainability of the planet that we live in for future generations.

The United Nations Watercourses Convention (UNWC) focused on non-sustainable paradigms of consumption and production and addressed them as major factors that are environmentally negative, in particular, in industrialized countries. Then, the concept of sustainable consumption and production (SCP) must be combined with the concept of sustainable development (UN, 1992). Consequently, it has become an obligatory goal to implement sustainable production (SP) to reduce the adverse environmental impacts as well as impacts on society as a consequence of producing goods and services.

Industries, as the vital operational units in a free market should take responsibility for the adverse consequences in the environment, society and the economy. There has been an unbelievable rise in company numbers since the 20th century, especially the multinational companies. Unfortunately, this increase has obviously led to a source of unsustainable practices that have polluted the air we breathe, the water we consume, and the environment in which we live. Besides, the depletion of precious natural resources, over-fishing of our seas and river, deforestation and the blatant destruction of ecological systems leading to the displacement and even extinction of countless forms of life. When mass production first emerged in the form of industrialization, there was a belief that the available natural resources would always be available and the environment could deal with the pollution, such as dilution in solving pollution. Therefore, several firms took full advantage of the free ecosystem before the enactment of environmental laws and regulations that served to prevent air, water and land pollution and the environment in general. By the time of the last millennium about two decades ago, our world was in a mess; now our existence is in danger, as various resources we assumed were endless either have disappeared completely or are almost totally depleted. Due to these impacts, companies have been requested to implement and practice sustainable performance (Linke *et al*., 2013).

Veleva and Ellenbecker (2001), argued that, although companies have made the shift towards sustainable performance, it is still in an early stage. Although companies are responding to the market demand, but unfortunately the existing market is not reciprocating with adequate enthusiasm for sustainable development values. As business profitability is directly related to sales, the more goods a company sells mean higher profits. Hence, individual companies cannot accomplish the full execution of sustainability in the context of an unsustainable economic system. However, manufacturers can and should be motivated to effect such a transformation towards business sustainability practice.

Companies are forced by several parties to integrate sustainable production through all product life cycle, such as, Trade Associations, Local Community bodies, Local Authorities, Bankers, Insurers, Shareholders, Customers Unions, Competitors, Suppliers, and Employees. Furthermore, competitors might be aware of sustainable production and this could provide them competitive advantages (de Ron, 1998).

Also, the UN has produced a framework for SD to assist companies in implementing sustainable development policies. However, business decision-makers are reluctant to implement sustainability in their performance, as the concept of sustainability is not expressed in tangible operational terms. In addition, tools do not help managers to make sustainable decisions at all organizational levels (Labuschagne *et al.*, 2005). Vergragt e*t al.* (2014) argued that, even though there has been commitment by governments to SD, often they are misled and support unsustainable business practice under the impression of supporting employment growth and well-being for all.

To enhance and facilitate the implementation of sustainable production, decision-makers need tools, frameworks, and methodologies to assess and measure firms' performances. There are different types of initiatives that measure and assess the implementation of the production process such as; Eco labeling, initiatives to manage the environment, ISO 1400, laws pertaining to the environment, responsibilities of industry, CSR (Tang & Tang, 2012) and guidelines for social sustainability (Perera, 2008), which serve several incentive functions to drive this development, an enhance corporate

image, better bottom lines and motivated employees (Hallstedt *et al.*, 2013) . These initiatives are either related to one dimension of sustainability (environment protection, added social values, or economic growth). Or they have a weakness which makes their implementation non-applicable in all sectors and organizational levels. To accomplish sustainability these initiatives need to be combined with new tools and methods which could be implement to integrate the production model that adequately caters to the needs of the current generation but not at the expense of future generations.

International sustainable development initiatives and frameworks released by international organizations focused on the notion of SD at county or organization level. These initiatives, most likely, are common, large in number, and not easy to be directly applied in small units or organizations. Lee and Lee (2014) argued that most of the existing sustainability indicators in business are not fully supported by the manufacturing industries at the factory level. Gunasekaran and Spalanzani (2012) stated that the absence of sustainability agendas shifted the businesses farther away from balancing the environmental, social, and economic aspects. Therefore, scholars and practitioners need to develop more specific frameworks at organizational level to bridge this gap.

This paper reviewed the literature to study the proposed tools of sustainable production and investigate the extent of the contribution these tools made to the execution of SD goals. From the results and the data analysis this paper will develop the summary of the appropriate methods that can make the implementation of sustainable production a reality.

Tools for Measuring Sustainable Development

The tools of measuring sustainability are derived from basic facts, to justify the criteria and indicators. Criteria usually explain the principle without measuring the performance, whereas, the indicators rely on the criteria and measurement of the performance (Lähtinen *et al.*, 2014).

" Generally, indicators are defined as "the translation of the complicated data into meaningful information that helps decision makers to achieve their goals" (Bossel, 1999; Martinet, 2011; Samuel *et al.*, 2013). Bentley (2008) defined indicators as "tools of measurement, which could be numbers or ratios resulting from a chain of observations that expose the facts about the phenomenon, and show changes that are related to a specific time." Also, indicators are tools that result from gathering raw and processed data to quantify and simplify phenomena and clarify difficult realities."

The UN showed that indicators have different types of functions as; they simplify decision-makers' action, deliver clear information formulate policies; they contribute to provide knowledge to decision-makers in the domains of the physical and social sciences; they gauge improvement towards SD; they are able to deliver an early alert to avoid problems with environmental, social, and economic implications. They are good tools that can facilitate the spread of thoughts, ideas, and values (UN, 2007).

Those involved in product invention as well as manufacturers can contribute significantly to the social revolution towards sustainable development. To enhance and facilitate the implementation of sustainable production, decision-makers need tools, frameworks, and methodologies to assess and measure firms' performances.

The Process of Indicator Selection

To select a suitable set of indicators and frameworks is a consolidated procedure, which involves various considerations. It is necessary to understand the status and condition in which indicators will be applied. Earlier literatures pursued the following common criteria: well-founded, simple and appealing, bound to achievable goals, focused on generally accepted values, in moderate numbers, adaptable to possible modifications, nationwide, significant for the evaluation of SD development, which is widely used by the Agenda 21 and all areas of SD progress, timely integrative, anticipatory and non-destructive (Bossel, 1999; UN, 2007; Bentley, 2008; Samuel *et al.*, 2013; Hai *et al.* 2013). These criteria could be summarized as the follow: strong, applicable, efficient, clear and easily measured, and pragmatic (Wolf *et al.*, 2015).

The Global Report Initiative (GRI) strategies are one of the sustainable development indicators that have been accepted and implemented at organizational level. The first publication of GRI indicators was released in March 1999. At that time the guidelines were tested in 21 pilot companies. Then these guidelines were considered as the GRI framework. First, the GRI started to include only environmental issues. One year later, the social issues were taken into account. Due to this later consideration, imbalance between the environmental issues and social issues was exposed. However, this imbalance was gradually corrected (Bebbington, 1999). Each pillar of sustainability is measured according to several themes that achieve the sustainable development goals.

The GRI is among the most widely-utilised and well-known tools for measuring sustainable development. Thus, this paper considered the main themes of GRI as the standard reference to compare and measure the suggested indicators and framework in the literature. Each dimension of the sustainable development was measured by specific themes as shown in Figure 2. The economic themes are: commercial achievements, marketing initiatives, non-direct economic effects, and the manner in which resources are procured. The themes related to the environment are: resource conservation, natural hazards, and environmental management. The social themes are: labor practice and customers, human rights, and society development.

This paper aims to understand the trend of scholars in integrating sustainable performance in manufacturing firms by analyzing the frameworks and indicators that have been proposed in the literature, to sort out the best methodology that is easy and applicable at the organizational level.

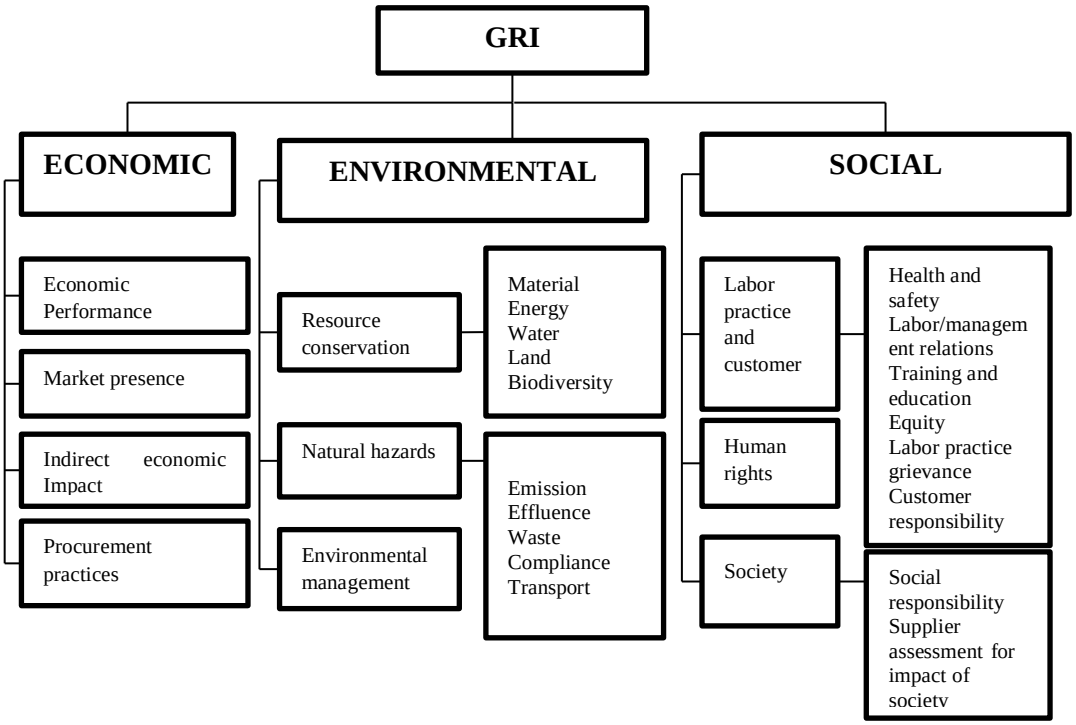

Figure 2: GRI guideline measurements

Categorization of the Framework

The indicators and frameworks were categorized according to the following aspects

- **Sustainability dimensions**: to attain the sustainability objectives, it is required to make sure that all the dimensions of sustainability are designed and constructed properly into the frameworks and tools of measurement.
- **Relevance to GRI themes**: benchmarking the sustainable framework with the GRI guidelines will help practitioners and scholars to (1) govern the basis of the frameworks improvement; (2) recognize comprehensive frameworks.
  The GRI themes were used as standard to benchmark the proposed frameworks. The sustainability dimensions have been measured by different themes to accomplish the sustainable development goals as shown in Figure 2
- **Industry Sectors:** as different sectors of the manufacturing industry require different applications and have different contexts. Therefore, this study focuses on analyzing the framework to sector level.
- **Perspectives and Approach's:** previous studies employed different Perspectives and approaches to integrate the frameworks and indicators. Thus, it is necessary to measure which approach is most preferable and easier to be applied to implement sustainable performance considering the holistic concept.

Materials and Methods

Peer review of the research articles in international journals on sustainable production was embarked on from the years 2000-2015, to find out the materials that focused on the measurement tool, and the assessment of sustainable production. Three electronic databases (Emerald, Science Direct, Taylor & Francis) were reviewed. Advanced search was used to search for words in titles, and abstracts of the studies. Three steps were taken to achieve the research objectives.

Different words and terms combinations were used in the search engines; Emerald, Science Direct, and Taylor & Francis databases. From previous literature, all the words and terms that have the same meaning were figured out. The word combinations used were (Sustainable production indicators, Sustainable production framework, Tools for measuring sustainable production, Sustainable manufacturing indicators, Sustainable manufacturing framework, Tools for measuring sustainable manufacturing, Sustainable indicators for industries, Sustainable framework for industries, Tools for measuring sustainability in industries). These word combinations were used in the search rounds to help in achieving a wide and comprehensive spectrum of search; step one, all titles were checked, to find out the titles related to sustainability and sustainable production. Step two, all the selected titles were refined to pick out the articles related to sustainable production indicators. Step three, the abstracts of the refined articles were studied to figure out the articles that proposed, revised, and applied sustainable production frameworks. Step four, the proposed sustainable production frameworks were analyzed according to the categories in Section 4. The results of this review will clarify scholars' perceptions about integrating and implementing sustainability in the manufacturing industries. Table 1 shows the number of articles found by using different word combinations. According to the key word round review a total of 4,636 articles were found. The titles of the selected articles were categorized to identify 648 articles, which more closely related to the sustainable production assessment, and the final round of the search yielded 138 abstracts that focus on sustainable production framework. Just 34 articles performed the integration of sustainable production specifically.

Table 1: The number of articles found by using different word combinations in the three databases (Emerald, Science Direct, and Taylor and Frances)

Word ' combinations used in research	No of articles in Emerald			No of articles in Science Direct			No of articles in Taylor& Frances		
	K.W	Til	Ab	K.W	Til	Ab	K.W	Til	Ab
Sustainable production indicators	129	36	7	438	42	22	837	19	5
Sustainable production framework	150	39	7	486	74	6	384	6	0
Tools for measuring sustainable production	17	0	0	82	12	7	70	9	0
Sustainable manufacturing indicators	58	18	4	56	21	2	84	20	3
Sustainable manufacturing framework	89	23	5	107	43	4	97	19	3
Tools for measuring sustainable manufacturing	13	3	0	20	5	1	18	7	1
Sustainable indicators for industries	275	43	6	159	65	15	152	31	15
Sustainable framework for industries	337	28	9	373	46	14	100	23	0
Tools for measuring sustainability in industries	35	6	1	37	5	3	33	5	0
Total	1103	196	39	1758	313	74	1775	139	25

KW=Key Word Tit= Title Ab=Abstract

Results

A total of 34 articles were classified to present the materials of this paper. These articles assessed, measured, and integrated the sustainable production of the manufacturing industries. The indicators and frameworks presented in the 34 articles were analyzed based on multiple criteria. These criteria were constructed following the core principle of SD to embrace the environment, society, and economic pillars collectively in the development.

Based on the main objective of the paper, the 34 articles were categorized according to the categories mentioned in Section 1. 4. Table 1 represents the results of the study as follows:

- **Sustainability dimensions**: There were 27 out of the 34 articles which highlighted the three dimensions of SD (the environment, society, and the economy). Five articles focused on the environment and society. Two articles just focused on the environmental issues.
- **GRI themes**: *Environmental themes* (resource conservation, natural hazards, and environmental management): there are eight articles out of the 34 focused on all themes of sustainability dimensions; 18 focused on two themes of the environmental dimension (16 for

resource conservation and natural hazards, one for resource conservation and environmental grievance mechanism, and one for the natural hazards and environmental grievance mechanism). There were seven articles, which focused on just the resource conservation theme, and one article focused on the natural hazards theme as well. That means all articles focused on the environmental issues at different levels.

Social themes (labor practice and customer, human rights, and society**):** were analyzed as follows: 17 articles focused on all the three themes of the society dimension, while, six articles focused on two themes (labor practice and customer, and society), one article focused on (labor practice and customer, and human rights), eight articles focused on one theme (labor practice and customer). There were only two articles, which did not address a social theme.

Economic themes (Economic performance, Market presence, indirect economic impact, and Procurement practice): 21 articles focused on all themes of the economic dimension: two articles focused on the three themes (Economic performance, Market presence, and Procurement practice). Also, one articles focused on (Market presence, indirect economic impact, and Procurement practice themes). Another two articles focused on (economic performance and indirect economic impact themes). Only one article considered economic performance. Seven articles did not focus on economic themes. Thus, a total of 26 articles focused on economic themes.

- **Perspectives and approaches**: This pertains to the category related to perspectives and approaches followed to integrate the indicators/frameworks on business sustainable performance. The results were as follows; 9 articles used Life Cycle (LC) approach, 6 used Analytical Hierarchy Process (AHP), and 2 for Top Bottom approach (TBL). Different articles used one of the following perspectives and approaches; holistic approach to sustainability, micro level, from lowest level up to highest level, general sustainable development index, bottom-up approach, the process of analyzing material flow (MFA), multi criteria analysis, the social construction of technology, analytical approach, a systems approach, normalization approaches, exponential function approach, linear function, sustainable mass customization (SMC), top-down approach, qualitative & quantitative , supply chain, short and long term approaches.
- **Industry sector**: For the industry sector category, there are 20 frameworks proposed for specific types of sectors and 15 proposed for all sectors in general, Table 3 shows the different perspectives, approaches, and industry sectors for the 34 studies.

Table 2: Themes conducted in the reviewed papers

No	Author	Environmental Themes			Social Themes			Economic themes			
		Resources conservation	Natural hazards	Environmental management	Labour practice &customer	Human rights	society	Economic performance	Market presence	Indirect economic impact	Procurement practice
1	(Adams & Ghaly, 2006)	*	*	*	*	*	*	*	*	*	*
2	(Amrina & Vilsi, 2011)	*	*		*			*	*		*
3	(Azapagic & Perdan, 2000)	*	*	*	*	*	*	*	*	*	*
4	(Azapagic, 2004)	*	*	*	*	*	*	*	*	*	*
5	(Azkarate et al., 2011)	*			*			*	*	*	*
6	(Bautista et al., 2016)	*	*		*	*	*	*	*	*	*
7	(Chen et al., 2014)	*	*		*			*	*	*	*
8	(Garbie, 2014)	*	*	*	*	*	*	*	*	*	*
9	(Gerbens-Leenes, Moll, & Uiterkamp, 2003)	*									
10	(Giljum et al., 2011)	*			*	*	*	*	*	*	*
11	(Gopal & Thakkar, 2014)	*	*	*	*	*	*	*	*	*	*
12	(Harris, 2007)	*	*		*						
13	(Hayashi et al.,2014)		*		*						
14	(Henry & Kato, 2011)	*	*		*	*	*	*	*	*	*
15	(Kocmanová & Šimberová, 2014)	*		*	*		*	*	*	*	*
16	(Kozlowski & Bardecki, 2015)	*	*	*	*	*	*				
17	(Krajnc & Glavič, 2005)		*	*	*	*	*	*	*	*	*
18	(Labuschagne et al., 2005)	*			*		*	*	*	*	*
19	(Linke et al., 2013)	*	*		*	*			*	*	*
20	(Manuilova et al., 2005)	*	*	*							
21	(Marnika et al., 2015)	*	*		*			*		*	
22	(Medini et al., 2015)	*	*		*		*	*		*	
23	(Myllyviita et al., 2013)	*	*	*	*	*	*	*	*	*	*
24	(Nordheim & Barrasso, 2007)	*	*	*	*	*	*	*	*	*	*
25	(Okongwu et al., 2013)	*	*		*	*	*	*	*	*	*
26	(Singh et al., 2007)	*	*		*	*	*	*	*	*	*

27	(Sureeyatanapas et al., 2015)	*	*	*	*		*	*	*	*	*
28	(Turi et al., 2014)	*	*		*		*				
29	(Varsei et al., 2014)	*	*		*	*	*	*	*		*
30	(Veleva & Ellenbecker, 2001)	*	*	*	*	*	*	*	*	*	*
31	(Ventura & Saenz, 2015)	*			*		*	*			
32	(Vermeulen et al., 2012)	*			*	*	*	*	*	*	*
33	(Vinodh & Jayakrishna, 2014)	*			*						
34	(Yakovleva et al., 2012)	*	*		*			*	*	*	*

No	Author	Perspectives & Approach	Industry sector
1.	(Adams & Ghaly, 2006)	LC	agro industries
2.	(Amrina & Vilsi, 2011)	AHP	cement industries
3.	(Azapagic & Perdan, 2000)	LC	general
4.	(Azapagic, 2004)	LC	mineral and metallic industries
5.	(Azkarate *et al.*, 2011)	LC LC	Machine tool
6.	(Bautista *et al.*, 2016)	(TBL+),	biodiesel
7.	(Chen et al., 2014)	Holistic approach to sustainability	SMEs
8.	(Garbie, 2014)	Micro level From Lowest level to up to highest level General sustainable development index	general
9.	(Gerbens-Leenes, Moll, & Uiterkamp, 2003)	bottom-up approach	food production industry
10.	(Giljum *et al.*, 2011)	Material flow accounting and analysis (MFA)	General in all levels Organizational Country
11.	(Gopal & Thakkar, 2014)	AHP	automobile
12.	(Harris, 2007)	LC	General production
13.	(Hayashi *et al.*,2014)	Multi Criteria Analysis	bioenergy
14.	(Henry & Kato, 2011)	The Social Construction of Technology	Concrete
15.	(Kocmanová & Šimberová, 2014)	Analytical approach	general

16.	(Kozlowski & Bardecki, 2015)	A systems approach	Apparel industry
17.	(Krajnc & Glavič, 2005)	AHP	general
18.	(Labuschagne *et al.*, 2005)	LC	general
19.	(Linke *et al.*, 2013)	Normalization approaches	grinding industry
20.	(Manuilova *et al.*, 2005)	LC	Assessed different existing tools
21.	(Marnika *et al.*, 2015)	Exponential function approach Linear function	Mining and mineral process
22.	(Medini *et al.*, 2015)	Sustainable mass customization (SMC)	General
23.	(Myllyviita *et al.*, 2013)	AHP	wood-based bioenergy production
24.	(Nordheim & Barrasso, 2007)	Top-down approach	aluminum
25.	(Okongwu *et al.*, 2013)	TBL	General production
26.	(Singh *et al.*, 2007)	AHP	Steel and iron industry
27.	(Sureeyatanapas *et al.*, 2015)	Qualitative & quantitative	Sugar industry
28.	(Turi *et al.*, 2014)	Supply chain	food industries
29.	(Varsei *et al.*, 2014)	Supply chain	general production
30.	(Veleva & Ellenbecker, 2001)	LC	general
31.	(Ventura & Saenz, 2015)	CSR	Mining /sector
32.	(Vermeulen *et al.*, 2012)	Short and long term approach	general
33.	(Vinodh & Jayakrishna, 2014)	LC	General Production
34.	(Yakovleva *et al.*, 2012)	AHP	Food industry

Table 3: Perspectives, approaches, and sectors conducted by the reviewed papers

Discussion

The purposes of this review are: to investigate the proposed frameworks of sustainable production as evidenced by previous studies to determine the elements and components of the proposed frameworks and indicators based on four categories – sustainability dimensions, GRI themes, perspectives and approaches employed, and the organization level. It was also to investigate the scholars' trends to integrate sustainable performance in manufacturing firms. The finding of the study

will help decision-makers and managers to understand in details the elements of different tools of sustainable production, so that they will be able to apply these tools at the organizational level.

Scholars argued that Brundlandt definition is too generalized to represent the common pathway of the development required to achieve the sustainable development goals. Firms' sustainable performance is addressed as the capability of the firm to achieve an equilibrium between the dimensions of the environment, the community, and the economic achievements (Okongwu *et al.*, 2013). As such, for firms to integrate sustainable production in their performance, they are required to use comprehensive tools to measure the three dimensions of sustainability collectively. For that reason, this paper segregated the proposed frameworks in terms of the number of sustainability dimensions it comprises. The results of the study show that the majority of scholars are taking into account all the dimensions to measure the firms' sustainable performance. Some of the articles focused on two dimensions and one dimension, which does not address the sustainability concept. This denotes that the awareness of the scholar about the sustainability issue is comprehensive and can accomplish the sustainability requirements. However, there is still a need to know the extent of which these three dimensions are properly analyzed to the elements that really make them undertake the sustainability issues collectively. Academicians, practitioners, decision-makers, and stakeholders in general are well aware of the overall notion of sustainability. However, commonly scholars do not incorporate all the elements of sustainability that are addressed by the GRI initiative. This discussion leads to the question of how to measure the sustainability dimensions themselves. There is still debate about the best elements that can be used to analyze the sustainability dimensions (Isaksson & Steimle, 2009). This study tries to find an answer for this question by categorizing the proposed framework due to relevancy to GRI themes of each sustainability dimension. The GRI is used as a standard to measure the proposed indicators and framework in the literature. Benchmarking the framework and indicators of SD will affirm that the tools employed appropriately present the sustainability issues. For the environmental dimension, the GRI divided this dimension into three themes - resource conservation, natural hazards, and environmental management - according to the results; all proposed tools consider the environmental dimension. This reflects the general perspective of the scholars that sustainable performance relies mainly on integrating positive environmental practices. However, not all the environmental themes have the same concern. Most of the articles considered the resource conservation and natural hazards. Few articles focused on the environmental management element. Other observations show that, not all the elements of the GRI environmental themes are taken into consideration in the same set of indicators. The consideration of those elements varies from one framework to another.

The themes and the elements of the GRI guidelines are illustrated in Figure 2. For resource conservation theme the elements are: materials, energy, water, land, and biodiversity. For the natural hazards, the elements are; emission, effluence, and waste. For environmental management, the elements are; products, services compliance, suppliers, evaluation of the environment, and procedures to attain environmental grievances. Even though most of the suggested tools for measuring sustainable production consider the environmental aspects, but they do not involve all the elements of GRI.

According to the results the social dimension and the economic dimension received less consideration than the environmental dimension. The themes of those dimensions were analyzed to

many elements as well. Many scholars do not involve all these elements in the proposed frameworks of sustainable production. Tseng et al, (2009; Zhang and Haapala (2015) argued that proposed model needs to assess all sustainable production dimensions to accomplish the firm's objectives. Thus, for the proposed sustainable production tools, it is important to consider all three sustainable production dimensions collectively with all their themes and elements. To accomplish sustainability, these initiatives should be all combined in new tools and methods, to innovate new production processes that meet the present generation but not at the expense of the generations that follow.

Based on, the industry sector category, most of the tools are designed to assess specific types of industry. This denotes that, there is an urgent need to develop sustainable production indicators (SPIs) on sector and product organizational level to facilitate the integration of sustainable development. The common trend of scholars in initiating and proposing sustainable production indicators is to present specific indicators to each sector. This will lead to make implementation of sustainable production possible and applicable in all product types and sizes of organizations.

With regard to the perspectives and approaches category, the result shows that the most popular approach is the LC approach, followed by AHP and TBA. Application of life cycle in the production process starts at the phase of material harvesting or extracting, and then these materials go through some manufacturing process and operations to be transformed into products that will be delivered to consumers. After using the product consumers will dispose of it or return it for recycling, reuse, or remanufacturing. As, LC approach is simple, practical, and includes all the stages of the manufacturing process. It has become the most popular and recommended approach.

Conclusion

This paper reviewed the literature to analyze the proposed sustainable production framework and indicators. The purpose of the analysis is to determine the elements and components of these tools according to four categories, and to understand the trend of scholars in integrating sustainable production. This study concluded that although, most of the sustainable production indicators considered the three dimensions of sustainability; they were not comprehensively comprises all GRI themes. Scholars are most likely to propose specific sets of indicators for specific sectors. This trend will help decision-makers in facilitating the implementation of sustainable production. LC approach is considered one of the most convenient approaches to be employed in sustainable production integration.

This paper reviewed and analysed the sustainable production indicators, which proposed in the literature. This analysis adds to the body of knowledge a clear picture to the themes that are required to comply all sustainability criteria. The themes used as a measurement for the analysis fulfills the main concept of sustainable development by including all-environmental, social, and financial issues that encompassed in GRI guidelines. This analysis provides appropriate guidelines to the government, managers, and decision makers to understand how to select the appropriate tools to measure and implement sustainable production for the manufacturing industries.

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