Online Platform for Measuring the Lean/Green Maturity Level Based on the Slg Method

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1. Introduction

Environmental concerns and pressures are contributing to make organizations more proactive in the designing products, services, and processes, while making them less aggressive to the environment (GARZA-REYES, 2015). There is an increase in environmental responsibility, which has led to the implementation of Green initiatives in addition to the Lean initiatives (DHINGRA, KRESS and UPRETI, 2014) developed by Japanese companies after the Second World War, and disseminated worldwide.

Companies can simultaneously adopt the Lean and Green strategies, towards to achieve a cost reduction, increase in profits, and improvement in corporate image (FERCOQ, LAMOURI and CARBONE, 2016). The Lean system has as one of its main premises the reduction of waste. According to Simpson and Power (2005), this contributes to environmental management.

Despite being a relatively new approach (GARZA-REYES, 2015), the combined use of the Lean and Green production systems is being adopted by many companies (GALEAZZO, FURLAN and VINELLI, 2014, JABBOUR et al., 2013). In the academic field, these systems have been the object of study for the development of models of evaluation of their synergy (CABRAL, GRILO and CRUZ-MACHADO, 2012; VERRIER et al., 2014; FAULKNER and BADURDEEN, 2014; FERCOQ, LAMOURI and CARBONE, 2016, VERRIER, ROSE and CAILLAUD, 2016).

ROBECOSAM (2017), in strategic partnership with S & P Dow Jones Indices, has a sustainability assessment method based on the social, environmental and economic pillars. This is an important sustainability assessment tool that, despite not directly using the Lean/Green terms, has the ability to evaluate companies within these two fields. This evaluation model is based on a set of 80 to 120 questions applied annually to more than 3,400 companies worldwide. Through this data, more than 600 indicators have been analyzed in more than 4000 companies. The complexity of this extensive evaluation system, and the fact that it is used only by a select group of companies, limits its use.

Being in an early stage of studies, the use of software to facilitate the evaluation of the Lean/Green synergy is still little used. Among the models mentioned above, only ROBECOSAM (2017) has an evaluation method supported by a software platform. The lack of a systematized support is a limitation for the already developed models, since it is not feasible to perform complex calculations manually. On the other hand, it is difficult to perform a reliable evaluation without the use of calculations with a higher level of complexity.

To solve some of these difficulties, the SLG platform was thought to be a tool accessible to every company. SLG is an evaluation model that allows to establish the level of maturity of a company through the use of consolidated metrics in the literature. The SLG is divided into two parts, the first one collects the values of a set of 20 performance indicators specifically selected for the industrial sector to which the company belongs, and in the second part a questionnaire is

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applied to identify some points relevant to this type of analysis. All questions in the questionnaire are multiple choice and have a weight, according to the degree of Lean/Green synergy. The sum of the values of all the answers generates a value considered as an additional indicator, of equal importance that the others. The 21 values are normalized and later a radial graph is generated that indicates the level of maturity through a percentage of area. In other words, the surface between the center of the graph and the outer ring formed by its axes represents 100% of the area. Dividing this area into five equal parts, we obtain the maturity levels proposed by the SLG model.

To facilitate the application of the SLG model, this work proposes an online tool that enables the data collection, performs the normalization of the values, generates the radial graph, and calculates its area, thus establishing the level of maturity of the company. Section 2 presents an overview of the SLG methodology, section 3 describes the functionalities of the platform and the conclusions of the study are presented in section 4.

2. Overview of the SLG methodology

The SLG methodology was developed through an extensive literature review and also the support of specialists from the Lean/Green areas. This methodology considers that the most efficient metrics for evaluating the level of maturity of a company are the performance indicators appropriate to the industrial sector of the company and the application of structured questionnaires.

Brown, Amundson and Badurdeen (2014) suggest that we should work with a small amount of metrics. For this reason, the SLG considers that for each industrial sector, 20 performance indicators must be selected and a questionnaire drawn up in order to extract the additional information needed to establish the maturity of the company.

In SLG, the questionnaire is composed of multiple choice questions and each of the response options has a weight. The sum of the values of all the questions is considered an indicator. In this way the SLG has 21 values for the evaluation of the maturity level. All these values are normalized and later are arranged in a radial graph.

For the definition of Lean/Green maturity, the SLG considers a 5-level system adapted from the structure proposed by the CMMI institute (CMMI PRODUCT TEAM, 2017). Each level corresponds to 20% of the area of the radial graph generated by the model. In other words, the SLG calculates the area covered by the radial graph and establishes the percentage in relation to the maximum area that can be obtained and thus indicates the level of Lean/Green maturity.

3. SLG software platform

The development of the online platform described in this study is based on the Lean/Green maturity model, SLG. The platform works with two types of users. One of them is the administrator user who has access to some advanced functionalities of the platform, possibility to include or modify indicators and questions of the questionnaire, as well as to register new users and companies. The other is the conventional user that has access to the module of evaluation of the maturity level of the company, which is linked to a history of the assessments previously made, thus allowing to visualize the evolution of the company.

The platform has a password entry security system, which allows to protect the information of each company, avoiding the access of third parties to the confidential information of an organization. This study will focus on the functionalities of the platform from the point of view of a conventional user. Initially, a user already registered, when entering in the platform has the possibility to select two different actions, the first is the visualization of the history of evaluations that the company has done previously (Figure 1); In this history we can see the evaluation date, the level in which the company was at this date and the percentage of area covered by the graph generated by the platform.

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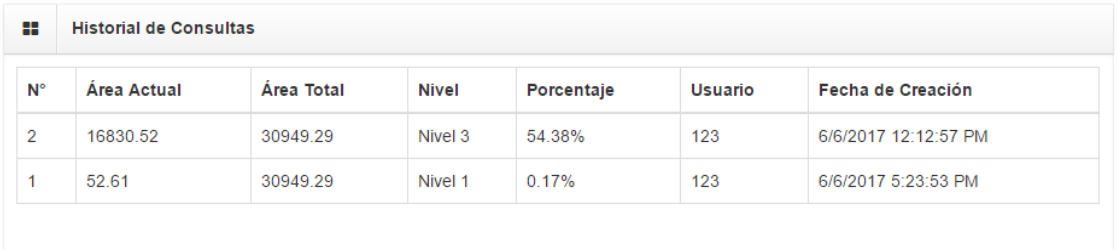

Historial de Consultas

N°	Área Actual	Área Total	Nivel	Porcentaje	Usuario	Fecha de Creación
2	16830.52	30949.29	Nivel 3	54.38%	123	6/6/2017 12:12:57 PM
1	52.61	30949.29	Nivel 1	0.17%	123	6/6/2017 5:23:53 PM

Figure 1. Example of a history interface of a company's maturity assessments.

The second action that can be made is the evaluation of the maturity level, which in turn is divided into 3 steps. In the first, the user selects the industrial sector to which his company belongs. When making this selection, will showing a list of 20 performance indicators, with description and calculation formula. At this stage is necessary to include the values measured by the company for each of the indicators within the established measurement period. This period can be monthly or annual, depending on the indicator. If the company does not measure any of the indicators, the platform considers the minimum value for the indicator. Figure 2 shows some of the indicators that are generated when the user selects the coffee area. The platform will always present the name of the indicator, a brief description, the minimum and maximum values that can be entered, a field to fill the value measured by the company in the last evaluation period and the calculation formula of the indicator.

Formulario para analizar el nivel de Madurez Empresarial.

Seleccionar Área

Área Cafetera

Nombre	Descripción	Mínimo	Maximo	Valor	Fórmula
Waste per unit of production	Mide el residuo generado por el proceso productivo.	0	100	0	Residuo generado en un mes (Kg)/Unidades producidas
Emissions per unit of production	Mide la cantidad de CO2 generado por el proceso productivo.	0	100	0	CO2 producido en un mes (Ton) /Unidades producidas en un mes
Water consumption	Mide la cantidad de agua utilizada por el proceso productivo.	0	100	0	Cantidad de agua consumida (m^3)/Unidades producidas
Energy consumption	Mide la energía consumida por el proceso productivo.	0	100	0	Consumo mensual de energía (KWh)/Unidades producidas en un mes
Material consumption	Mide el costo con materia prima en un proceso de producción.	0	100	0	Valor total gasto con materia prima en un mes/Unidades producidas
Percentage of materials used that are recycled input materials	Mide la proporción de uso de materiales reciclados en el proceso de producción.	0	100	0	(Valor total de materiales reciclados utilizados en un mes/Valor total de materiales

Figure 2. First step of assessing maturity level

The second step refers to filling a questionnaire (Figure 3), which aims to extract some information considered relevant by authors of the area (BAE and KIM, 2008; PARVEEN, KUMAR and RAO, 2011; MOLLENKOPF et al. 2010; KURDVE et al., 2015; NG, LOW and SONG, 2015; FAULKNER and BADURDEEN, 2014) to establish the level of maturity. Each response option of the questionnaire has a weight, therefore, the sum of all responses is a value equivalent to a performance indicator.

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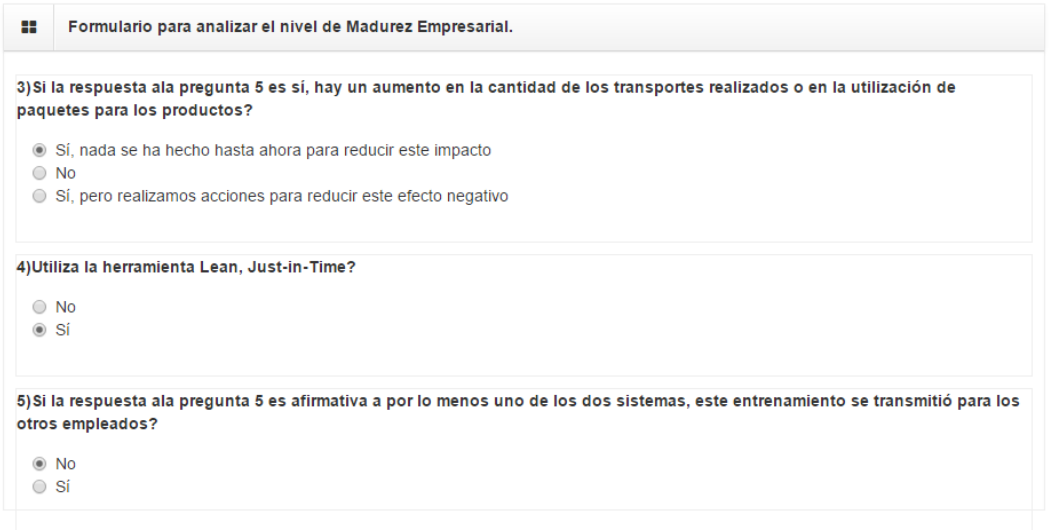

Figure 3. Second step of assessing maturity level

Finally the third step presents a radial graph with the normalized values of the indicators and the questionnaire (Figure 4). The area between the center of the graph up to the outer ring, formed by its axes, is considered the total area. Thus, each 20% area corresponds to a maturity level, completing the five proposed levels

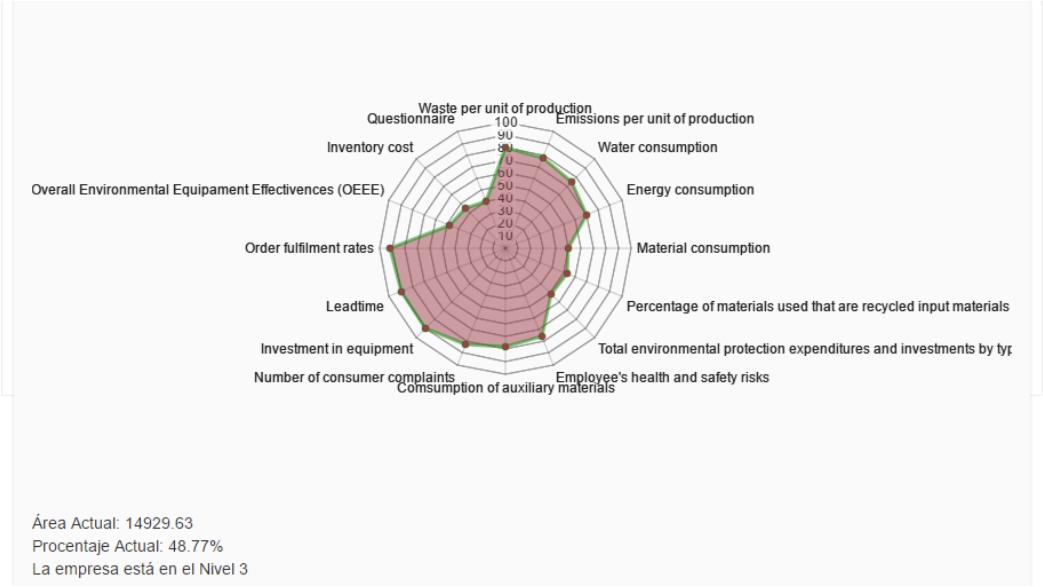

Figure 4. Third step of assessing maturity level

In the first two steps the user enters the information that the platform needs to calculate the Lean/Green maturity level and in the third step the result obtained through the calculations made by the platform is presented to him. Through the graph, the user can easily identify the critical points where his company needs to improve to advance to the next level of maturity.

In the example of figure 4, in accordance with the evaluation performed, the company is in the level 3 of maturity, since the shaded area obtained by the provision of the normalized values of the performance indicators and the questionnaire represents 48,77% of the total area of the chart (This is the area between the center point and the outer ring of the graph).

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4. Conclusions

The combined use of the Lean and Green production systems is a trend and has aroused the interest of many authors. However, Lean/Green maturity assessment models are at an early stage and need further study to provide a reliable response for the companies.

The SLG model makes an important contribution to this area of research by presenting a set of metrics that are easy to implement by companies of different sizes and industrial sectors. The SLG metrics are based on the literature and the model recommends that its can be validated by specialists. The small number of metrics as well as the simple set of variables that compose them makes possible the adoption of the SLG model by a wide set of companies.

The online platform that is presented in this study makes possible the use of SLG, since this model uses calculations with a higher level of complexity, which increases the reliability of the model, but makes it difficult to use it without a support tool. The radial graph that the platform generates also allows the quick visualization of the critical points that the company must address in order to increase its level of Lean/Green maturity.

For future studies we suggest improvements in the tool interfaces, to make its use easier and more intuitive. In addition, together with the radial graph, the tool can provide indications about what needs to be improved for the company reaches the next level of maturity, according to the result obtained through the analysis. Evaluations of both the SLG model and the platform should be conducted through case studies in companies of different sizes and industrial sectors to bring to light possible failures and make possible the improvement of both.

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Biography

Lucas Vinícius Reis is a master's student in Systems and Industrial Processes at the University of Santa Cruz do Sul - UNISC located in the state of Rio Grande do Sul - Brazil. Actually is doing the double degree through an agreement with the University of Quindío located in the state of Quindío - Colombia in the master's degree in Engineering with emphasis on software engineering. The area of interest of his research are the Lean and Green production systems.

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