Systematic Assessment Through Mathematical Model For Sustainability Reporting In Malaysia Context

Wan Nurul Syahirah Wan Lanang[1*], Faiz Mohd Turan[1] , Kartina Johan[1]

[1]Faculty of Manufacturing Engineering, Universiti Malaysia Pahang, 26600 Pekan, MALAYSIA

Corresponding author: w.n.syahirah.w.lanang@gmail.com

Abstract. Sustainability assessment have been studied and increasingly recognized as a powerful and valuable tool to measure the performance of sustainability in a company or industry. Nowadays, there are many existing tools that the users can use for sustainable development. There are various initiatives exists on tools for sustainable development, though most of the tools focused on environmental, economy and social aspects. Using the Green Project Management (GPM) P5 concept that suggests the firms not only needs to engage in mainly 3Ps principle: planet, profit, people responsible behaviours, but also, product and process need to be included in the practices, this study will introduce a new mathematical model for assessing the level of sustainability practice in the company. Based on multiple case studies, involving in-depth interviews with senior directors, feedback from experts, and previous engineering report, a systematic approach is done with the aims to obtain the respective data from the feedbacks and to be developed into a new mathematical model. By reviewing on the methodology of this research it comprises of several phases where it starts with the analyzation of the parameters and criteria selection according to the Malaysian context of industry. Moving on to the next step is data analysis involving regression and finally the normalisation process will be done to determine the result of this research either succeeded or not. Lastly, this study is expected to provide a clear guideline to any company or organization to assimilate the sustainability assessment in their development stage. In future, the better understanding towards the sustainability assessment is attained to be aligned unitedly in order to integrated the process approach into the systematic approach for the sustainability assessment.

1. Introduction

Sustainability is a notion that needs to be addressed not only at the policy level but also in business context: many companies have included sustainability in their mission, also driven by an increasing demand for sustainable products by more aware consumers [1]. Sustainable development has always been an important central point for all decision makers in any organizations. Sustainable development has been defined in many ways, but the most frequently quoted definition is from Our Common Future, also known as the Brundtland Report in 1987:"Sustainable development is development that meets the needs of the present without compromising the ability of future generations to meet their own needs"[2]. Sustainability seems to be agreeable proposal because of its meeting points among environmental concerns, manufacturing, and product design activities [3]. Over the years, the number

of sustainability indicators and their use in decision-making has greatly increased [4]. However, the existing sustainability evaluation still do not integrate a nature-economic-society aspect, some of these tools are focused on just one or two dimension(s) of sustainability, product sustainability perspective [5], environmental aspect [6-7]. Moreover, some others focused on all three dimensions [8-10], but there is a same gap in all of these methods which is limited attempts at bringing Green Project Management (GPM) P5 method to use in sustainability practices. Besides that, there is no present research that has been attempted from the viewpoint of focusing on sustainable parameters toward achieving a more systematic assessment model which can contribute to sustainability reporting.

Encouraged by Bursa Malaysia, sustainability view can be referring as crucial point to a successful business in this present-day. Every companies in the auspices of Bursa Malaysia also required to embed the sustainability concept as a vanguard of their business [11]. Besides, each company also need to provide a sustainability report as a requirement of Bursa Malaysia Securities Berhad. Nowadays, every single company that under the auspices of BURSA Malaysia is required to yield the sustainability reporting. Hence, a systematic sustainable assessment is designed in the advancing of sustainability reporting for promoting sustainability practices. Most of the companies in Malaysia have implemented green practice in their organization management. However, the green practice only emphasizes the environmental aspect, and that causes other important aspects within the company seem to have overlooked. Thus, GPM P5 standard is introduced as one of the sustainability assessment approach to measure the sustainability practices performance thoroughly by considering not only the main 3Ps aspects; planet, people, profit, but also process and product.

The general objective of this research is to propose a mathematical model for accessing sustainability index level in a company by using the selected parameters based on Malaysia industry context and P5 integration matrix. This study will aid the company to determine their level of sustainability compliance in their development and to be documented in their yearly sustainability report.

2. Methodology

The concept of P5 Integration matrix will conclude all major sustainability standard refer to the Triple Bottom Line of sustainability: people (society), profit (financial), and planet (environment), whereas another two are process and product [12]. The research analogy behind this project is that how an organization can move toward sustainable practising using a GPM P5 method for producing a better sustainability reporting. With this methodology, a systematic sustainable assessment for organizations that want to improve their sustainability reporting and ultimately implementing of sustainable practising is provided.

The proposed research has six steps as follows:

- Step 1: Data sources – case company, existing research
- Step 2: Criteria selection – Weighing criteria
- Step 3: Data collection – analysis
- Step 4: Mathematical model evaluation (based on GPM P5 standard)
- Step 5: Calculating current sustainability index
- Step 6: Calculating improved sustainability index

2.1. *"Sampling" / Data sources*.

In this section, the studies from the existing research is done to analyse the frequently used parameters in sustainable assessment and the tools used to measure the sustainability. Furthermore, the details about the case company, product, data collection, and sustainability assessment are presented. The case study will be conducted in any company in Malaysia. Thus, five companies from the manufacturing sector that covers in Nilai, Shah Alam, Pekan, Kuantan and Port Klang is selected during the data collection.

2.2. Criteria selection – weighing criteria.

The scale between +3 – -3 as depicted in Table 1 was developed to ease the respondents' group for rating the evaluation criteria, which initially selected by the design engineers based on technical documents and the results of a prior survey.

Table 1: Scale of "Weighting criteria"

Numerical rating	**Description**
3	Negative Impact High
2	Negative Impact Medium
1	Negative Impact Low
0	Neutral
-1	Positive Impact Low
-2	Positive Impact Medium
-3	Positive Impact High

The other fairly important in this method is where the questions are generated by using the green project management (GPM) that serves as a reference. The green project management (GPM) concept integration matrix is describing below:

a) People – labor practices and decent work, society and customers, human rights, ethical behaviour
b) Planet – material and procurement, energy, water, transport, waste
c) Profit – return on investment, business agility, economic simulation.

2.3. *Data collection – analysis.*

In this case study, owner of the company, chief executive officer, general manager and a system manager were selected as the expert decision makers. This will be assumed as an act of a field study including in-depth interviews with selected experts. The experts' opinions are used for providing a sufficient data to fulfil the research objectives. The GPM P5 checklist is being modified with respect of Malaysia industry context for each parameter before the respective checklist is used in the interview (data collection).

The process of gathering the data has been conducted in several departments of the companies using the same research questions which are: Department of Production (Parts), Department of Production (Assembly), Department of Engineering, Department of Environmental Quality, Department of Quality Control. From here, the questionnaire has been assigned at the stated departments where the results are then transmitted into the scoring board that has used the green project management as the guideline.

Below is the initial result concluded from the data analysis that have been done. The graph consists of people, planet and profit that based on process and product from operational management and environmental management field, showing the relationship between each parameter with sustainability compliance index as stated in scale of 'weighing criteria', Table 1. The data (value) from the graph is already been calculated using min formula in the excel and the equation is developed using linear equation law in excel.

Operational Management

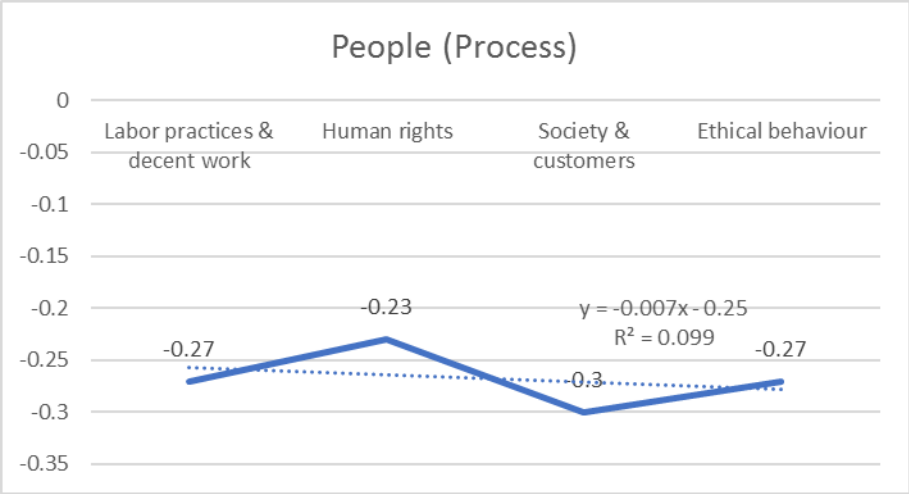

Figure 1: Relationship between min value for peoples' parameter and sustainability compliance based on weighing criteria for process.

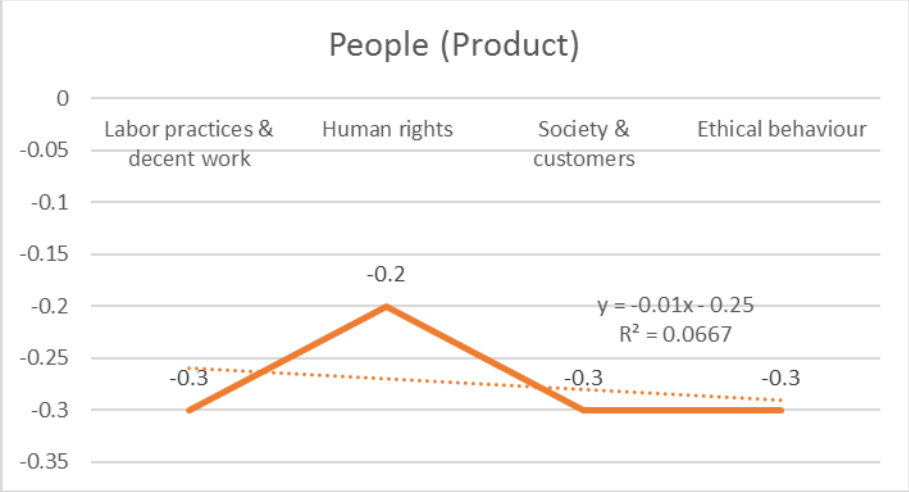

Figure 2: Relationship between min value for peoples' parameter and sustainability compliance based on weighing criteria for product

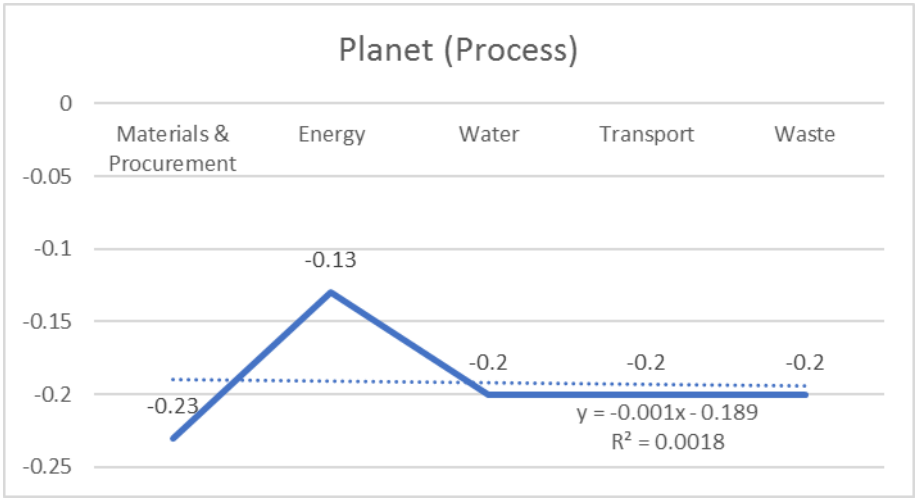

Figure 3: Relationship between min value for planets' parameter and sustainability compliance based on weighing criteria for process

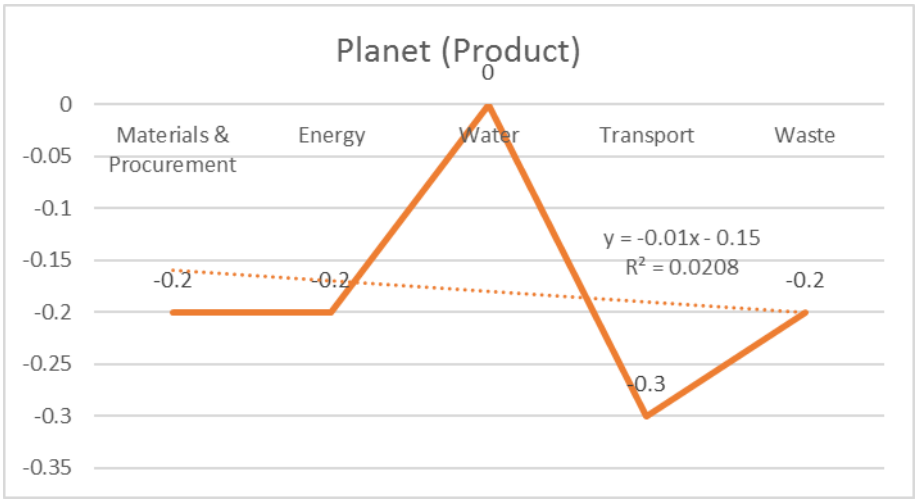

Figure 4: Relationship between min value for planets' parameter and sustainability compliance based on weighing criteria for product

Environmental Management

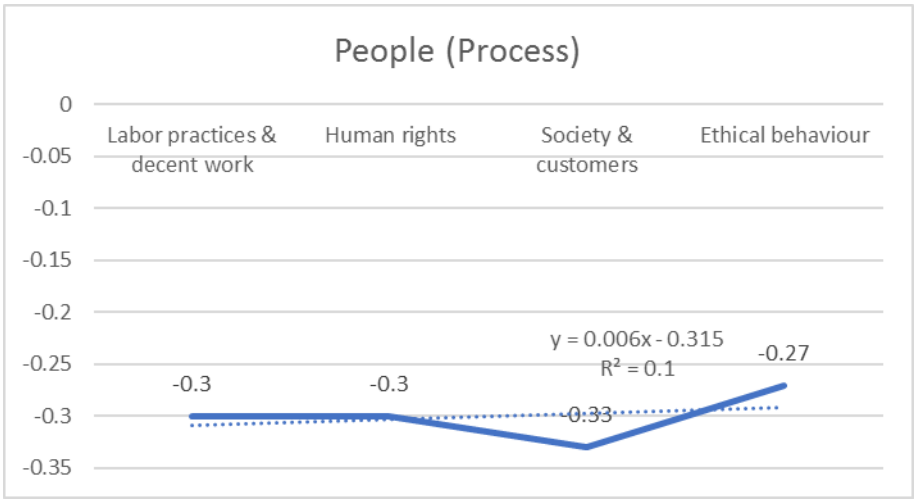

Figure 5: Relationship between min value for people' parameter and sustainability compliance based on weighing criteria for process

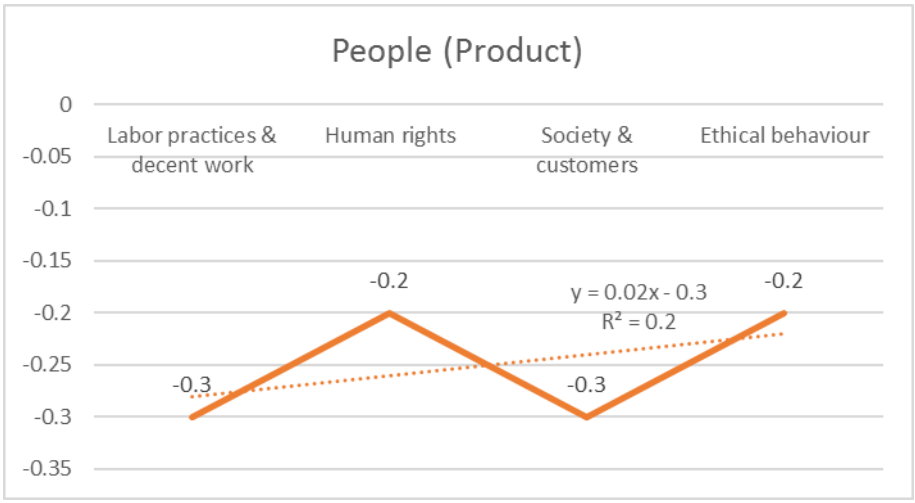

Figure 6: Relationship between min value for people' parameter and sustainability compliance based on weighing criteria for product

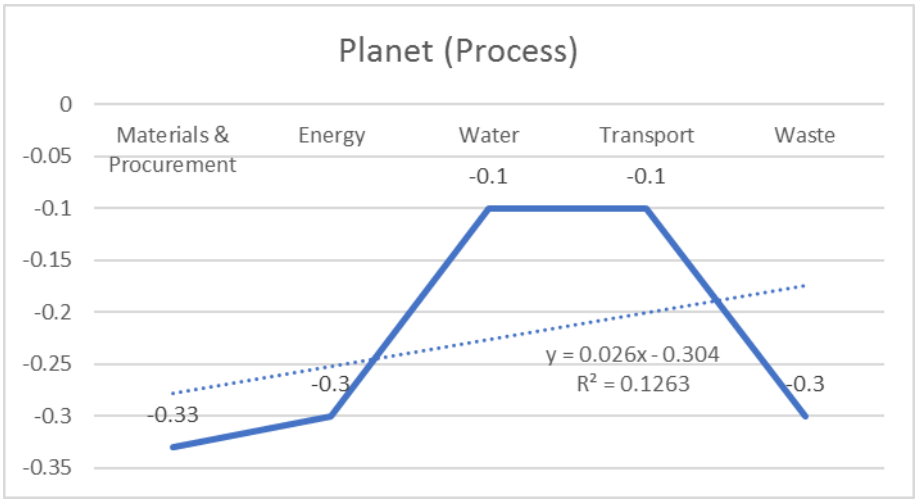

Figure 7: Relationship between min value for planets' parameter and sustainability compliance based on weighing criteria for process

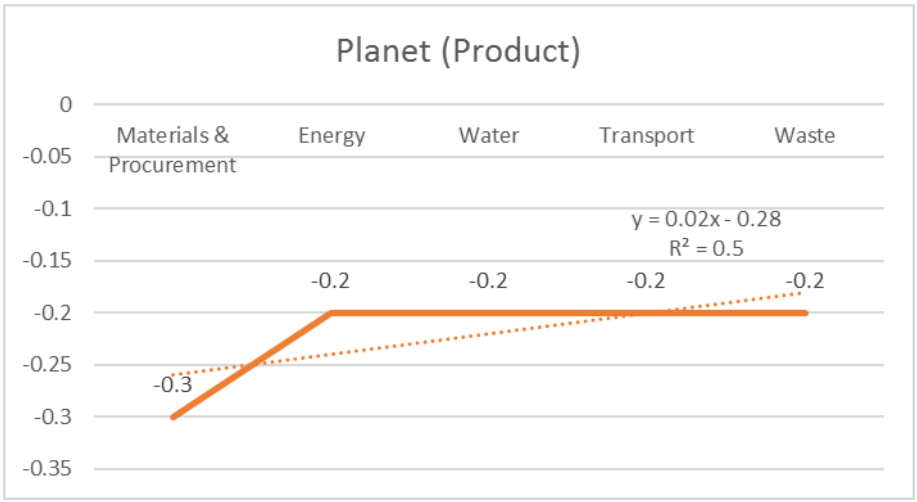

Figure 8: Relationship between min value for planets' parameter and sustainability compliance based on weighing criteria for product

The figures show the min value of all respondents' feedback during the data collection. Each figure contains one linear equation to allow us comparing the relationship between the parameters and sustainability compliances. As for the profit, both result from our two-different fields either based on process or product shows that there is no vary between the data obtained where from this observation, we can conclude that the level of compliance for this aspect is same for each company.

2.4. *Mathematical model evaluation.*

In this step, a new mathematical model that based on P5 Integration is involved in assessing the input data. All crisp data that are gathered in step 3 are transformed and normalize using grey decision table. By principle, there is a point of neutral sustainability for every measured aspect of a system. In the measurement of sustainability, there is a tipping point where a system is either sustainable or unsustainable. When the balance of sustainability is tipped at this neutral point, the aspect of the system that is measured will be considered as either unsustainable or sustainable, depending on the direction of the tipping. The measurement scale of sustainability s with respect to the neutral point is as defined below.

$$s(x): \begin{cases} s(x) > 0 \text{ if sustainable} \\ s(x) = 0 \text{ if neutral sustainable} \\ s(x) < 0 \text{ if unsustainable} \end{cases} \quad (1)$$

Equation 1 will be used as one of the reference in order to measure the sustainability index for each organization.

2.5. *Calculating current sustainability index.*
This step is about the calculation of total current sustainability index which is the aggregate value of the five sustainability elements'; people, profit, planet, process, and product. The following equation (2) and (3) from the previous research are used to obtain the current value sustainability index. These equations maybe differ for future use to accommodate it in the Malaysia context industry.

$$I_i = \sum_i W_{ij} I_{ij} \quad (2)$$

where,
Ij = score of jth sustainability element,
Wij = weight of ith sub sustainability element of jth sustainability element,
Iij = score of ith sub sustainability element of jth sustainability element,
i = 1,., n index of sub sustainability elements,
j = 1,., m index of sustainability elements.

$$I_{sustainability} = \sum_j W_j I_i \quad (3)$$

where,
Ij = score of jth sustainability element,
Wj = weight of jth sustainability element,
Isustainability = total sustainability index.

2.6. *Calculating improved sustainability index.*
This section covers applying the decisions which are made in the previous step into the selected parameters, reassessing the analysis in the perspective of sustainability and obtaining new total sustainability index.

3. Conclusion

Conclusively, this study is expected to ease any organizations including an engineer or project managers in producing a better sustainability reporting based on GPM P5 integration without neglecting the major pillar of sustainability standard. In addition, it represents on how a company can calculate and determine the level of sustainability for their organization. In the meantime, this research has only achieved the raw data and a few analyses to compare the relationship between the parameter and sustainability index. Meanwhile, the existing systems are not still in the insufficiency level thus, it requires a new solution to overcome this recent problem. Due to the diverging understanding about the sustainability compliance gained from the feedback, their ideas regarding this assessment are restricted on the existed sustainability tool. Therefore, since this assessment method not only based on triple bottom line principle, but also include process and product elements, the outcomes of the research surely sweeping of the current assessment in the sustainability practices.

Hopefully, the findings of this study will become a new approach system and as a point of references for the identifications in Malaysian industry especially in determining the sustainability level for the organization.

Acknowledgments
The authors would like to give special thanks to Research & Innovation Department, Universiti Malaysia Pahang for funding this research project.

References

[1] Zamagni A, Pesonen HL, Swarr T. From LCA to Life Cycle Sustainability Assessment: concept, practice and future directions. The International Journal of Life Cycle Assessment. 2013 Nov 1;18(9):1637-41.
[2] Kapor P. PUBLIC FINANCIAL MANAGEMENT FOR THE SUSTAINABLE DEVELOPMENT. Economic and Social Development (Book of Proceedings), 5th Eastern European Economic and Social Development. 2015:85.
[3] Rusinko C. Green manufacturing: an evaluation of environmentally sustainable manufacturing practices and their impact on competitive outcomes. IEEE Transactions on Engineering Management. 2007 Aug;54(3):445-54.
[4] Moldan B, Janoušková S, Hák T. How to understand and measure environmental sustainability: Indicators and targets. Ecological Indicators. 2012 Jun 30;17:4-13.
[5] Ghadimi P, Azadnia AH, Yusof NM, Saman MZ. A weighted fuzzy approach for product sustainability assessment: a case study in automotive industry. Journal of Cleaner Production. 2012 Sep 30;33:10-21.
[6] Bjørn A, Margni M, Roy PO, Bulle C, Hauschild MZ. A proposal to measure absolute environmental sustainability in life cycle assessment. Ecological Indicators. 2016 Apr 30;63:1-3.
[7] Strazza C, Magrassi F, Gallo M, Del Borghi A. Life Cycle Assessment from food to food: A case study of circular economy from cruise ships to aquaculture. Sustainable Production and Consumption. 2015 Apr 30;2:40-51.
[8] Chong YT, Teo KM, Tang LC. A lifecycle-based sustainability indicator framework for waste-to-energy systems and a proposed metric of sustainability. Renewable and Sustainable Energy Reviews. 2016 Apr 30;56:797-809.
[9] Scandelius C, Cohen G. Sustainability program brands: Platforms for collaboration and co-creation. Industrial Marketing Management. 2016 Aug 31;57:166-76.
[10] Hugé J, Waas T, Dahdouh-Guebas F, Koedam N, Block T. A discourse-analytical perspective on sustainability assessment: interpreting sustainable development in practice. Sustainability science. 2013 Apr 1;8(2):187-98.
[11] B. Malaysia. (2015). Sustainability Reporting Guide. Available: http://www.bursamalaysia.com/
[12] G. Global. (2015). The GPM® P5™ *Standard for Sustainability in Project Management*. http://www.greenprojectmanagement.org/the-p5-standard.