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Development of a multidisciplinary approach to compute sustainability index for manufacturing plants - Singapore perspective

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Abstract

The purpose and objectives of this paper is to determine the determinants for computing sustainable footprint for a typical semiconductor manufacturing facility and subsequently to benchmark the sustainability footprint with other semiconductor manufacturing environment. Sustainability index studies have been used by different agencies mostly for public listed companies. Suitable checklist was used to determine the sustainability index of an organization and the results were compared with other similar organization. Using one approach, sustainability index was computed and compared with the other similar organization. By computing the sustainability index for a manufacturing organization, it will help the organization to identify the areas to improve for more sustainable operations. Sustainability index is a function of wellbeing, management, resource and compliance. By using Analytical Hierarchic Process (AHP) model a simple Sustainability index formula was developed for this study SI = (0.375*Wellbeing +0.25*Compliance+0.25*Resource+0.125*Management)/5, Using a structured questionnaire and giving a scoring for each construct, SI for a manufacturing company was computed. For one of the company, Sustainability Index was computed as 80%. Benchmarking can be done with similar industrial sector and will also help shareholders and other interested parties to know better of the organization in terms of their ability to be sustainable. Organizations with low sustainable index will be preferred and will be better recognized in the market. This paper has attempted to define sustainable index and also a method to compute sustainability Index (SI) for a manufacturing organization in Singapore.

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I. INTRODUCTION

The manufacture of any semiconductor requires an ultraclean environment, to ensure the purity of the semiconductor. Many toxic materials are used in the fabrication process (CNET, 2002) These include poisonous elemental dopants, such as arsenic, antimony, and phosphorus, Poisonous compounds, such as arsine, phosphine, and silane, highly reactive liquids, such as hydrogen peroxide, fuming nitric acid, sulphuric acid, and hydrofluoric acid. The chemicals that are released in the greatest quantity by the electronics/computer manufacturing industry.

The energy and water demands placed on natural resources in order to produce semiconductors are significant. As the complexity and size of the semiconductor facilities (known as fabs) have grown, so have these demands. New facilities can use 30 to 50 megawatts of peak electrical capacity enough to power a small city. Energy is not the only commodity in high demand for semiconductor facilities. New wafer Semiconductors and integrated circuit manufacturing plants can consume millions of gallons of water every day, enough to supply several thousand households. Water use is inextricably linked to energy use. Water operations, from pumping water through the plant, to making the Ultra Pure Water (UPW) necessary for semiconductor manufacturing requires a great deal of energy. Growing business recognize sustainability as an important concept for survival in the competitive world.

A universally accepted definition of sustainability is elusive at this point. Sustainability is the capacity to endure. Most of the research models (Dow Jones, 2016) on sustainability highlighted the relationships among energy (GRI, 2015), environment, finance, social aspects and governance, especially among those companies where access to company's financial data is available (Ethos, 2005). Following Table 1 is the summary of various relating to sustainability performances and indicators:

Table -1 Summary of sustainabilty indeices used by various agecies

S/N	Agency and Country	Indicator/Indices
1	Sustainable development (SD) strategy, UK	• Environmental Limits • Healthy and just society • Sustainable economy • Sound Social responsibly • Good governance
2	Sustainable Development of the Commission on Sustainable Development (CSD).	• Social • Environmental • Economic and • institutional
3	Dashboard of Sustainability	• economic • social and • environmental issues
4	The Barometer of Sustainability. Developed by IUCN,	• human and • environmental wellbeing
5	Global Reporting Initiative (GRI).	• economic 6environmental and • social need
6	The Sustainability Metrics of the IChemE	• environmental responsibility, • economic return and

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