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Chapter 13
Adoption, Implementation, and Performance of Green Supply Chain Management: The Case of Coal Power Generation Industry in Indonesia

Caroline H. Santoso, Marzieh Khakifirooz, Mahdi Fathi, and Jei-Zheng Wu

Introduction

The awareness of sustainability among SCs has been increasing since the World Commission on Environment and Development (WCED) presented its report at a press conference in London, England on 27 April 1987 entitled as "Our Common Future" [4]. "Our Common Future" is identified as a starting strategy for landing sustainable future and warned the world about the importance of natural properties for making progress toward economic development. Later on, in 2007, the Irish National Climate Change Strategy [8] outlined the global challenge as the global warming fetch up by human-made greenhouse gas emissions. The economic consensus can prove that the costs of inaction against the global warming will significantly be higher than costs of actions in the long term. Therefore, innovative and progressive climate change policies consorted with low-carbon technology are required to design and enforce for consistency of global economic growth with sustainability.

Sustainability is required the long-term policy. Several targets need to be defined to tackle long-term sustainability-related issues. For instance, adopt new

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M. H. Amini et al. (eds.), *Sustainable Interdependent Networks II*,
Studies in Systems, Decision and Control 186,
https://doi.org/10.1007/978-3-319-98923-5_13

policies, construct/reconstruct/equip the infrastructures, develop innovative clean technologies, redesign SCs, and redefine business models. Therefore, organizations are required to enhance their strategy to sustain their business and profitability while remaining competitive in the marketplace. Although, many companies identify the sustainability in the SC as one of the most critical and challenging activities, such that the United Nation states the sustainability in practice through the SC management (SCM) (https://www.unglobalcompact.org/what-is-gc/our-work/supply-chain).

SCM has required a multi-criteria decision-making (MCDM) system, which allows structuring a complex decision process for obtaining a solution based on (semi) quantitative criteria and the power of each criterion on SCM. More specifically where environmental, economic, and social goals are assessed at the same time, specific decisions are demanded to emphasize the influence of each criterion. Therefore, studying the inner dependencies and outer dependencies among and between the criteria is relevant for decision-makers to capture and represent the concepts of influencing or being influenced.

One of the inevitable phenomena for sustainability is activities and businesses related to energy systems. Among all energy providing resources, fossil fuel has the highest adverse effect on the development of green supply chain (GSC). In addition in most developing countries, the fossil fuel has the highest percentage of utilization.

Therefore, regarding the geographical factors and growth in economical aspect, we developed a sustainability index for the supply change management of coal industry in Indonesia as one of the largest coals producer in the world which located in the center of economic growth in Asia. To address the effect of each factor on interdependency of SC network in Coal Industry of Indonesia, the analytical hierarchy process (AHP) has been used in this study.

Background of GSCM

According to the [25] green SCM (GSCM) has included the internal GSCM, external GSCM and "corporate social responsibility" (CSR).

The internal GSCM is associated with environmental performance, environmental collaboration with customers, and staff involvement, that can improve the operational performances [27]. The "internal GSCM" is required the "internal green management" and "sustainable product design" as the foundation for implementation, when directly will effect on economic performance [26]. Internal GSCM practice on ISO14001 certification.

The external GSCM is associated with partners or stakeholders such as suppliers and customers and required the strong "diversity management," accurate "safety management" plus "community development and involvement." Governmental demand is a crucial driver moving the external GSCM implementation [23]. External GSCM is also seeking the international trade communities for environmentally

friendly operations. "Green purchasing," "customer cooperation," and "investment recovery" are three customer related factors for practicing the external GSCM [28]. In addition, Fang & Zhang [10] are considered the "eco-design" for "external GSCM" to exert significant influence on firm performance.

Along with the internal GSCM and external GSCM, the CSR brings the moral management in the business horizon of a firm [5]. The Carroll's pyramid of CSR [5] has underlined the economic profitability as the result of obeying the law, where the ethical behavior is the requirement for legal intendance, and that is the outcome of a good cooperative relationship.

This research bounded all factors of "internal GSCM," "external GSCM," and "CSR" into the principle of "Adoption" [14], "Implementation" [3, 6, 6, 9], and "Performance" [21] (A.I.P) of GSCM to explore the fundamental factors or criteria of GSCM for adjusting the sustainability benchmark. Following this section, we investigate each factor and its relevant contents.

Market Forces

- Consumers, retailers, and financial stakeholders may demand products considered green from the suppliers and require that the company follow sustainable practices.
- In the close future access to capital markets may be restricted only to businesses that are deemed to be ethical or environment-friendly.
- Companies expected suppliers to perform GSCM practices based on environmental (e.g., ISO 14001) and social (SA 8000) standards.
- a competition in the marketplace may require a company to offer products considered as socially responsible, green, or sustainable.

Policy and Regulations

- Governmental policy and regulations factors are requiring that companies adhere to certain environmental standards.
- Environmental regulation for manufacturers concerns a standard target of pollutants generated by products and manufacturing process to eliminate environmental hazards.
- The industry standards such as ISO 14001, ISO 14040, EuP, RoHS, and WEEE require suppliers to carry audits and certifications.

Internal Factors

- Push business to engage in green sourcing practices or forcing suppliers to adopt or adapt processes to be more environment-friendly and initiative.
- The leading private sector or top management vision can demonstrate significant movement toward greening procurement practices.
- Treatment of labor force, protecting and preserving the fundamental rights of employees, including their health and safety and human rights can bring employees commitment.

Marketing and Public Relations

- Putting more efforts of companies to create a value proposition for the customers, especially when the "environment-friendly" product is more expensive to increase the sale as the nature of the business.
- Create awareness of the practices through the use of logos and co-branding, to convince customers to buy green products.
- Non-Governmental Organizations (NGOs) can run boycotts or adverse publicity campaigns designed to shame the company into offering more sustainable products.

Waste Reduction

- Includes reuse, remanufacturing, and recycling of materials into new materials or other products.
- Change the supplied product and trying to manage the by-products of supplied inputs.
- Managing the short-term financial results, and risk factors such as harm resulting from products, environmental waste, and worker and public safety.

International Certificates

- Firms that implement sustainability in their corporate culture also request suppliers to develop and maintain an environmental management system (EMS) even though a buyer does not require its supplier to certify the system.
- Firms require suppliers to have an EMS that is certified as fully compliant with one of the recognized international standards, such as ISO 14001 or European Union Eco-Management and Audit Scheme (EMAS).
- Supplier's information about their environmental aspects, certification, activities, and management systems are also necessary for GSCM.

Eco-Design

- Includes green procurement practices (purchasing environment-friendly materials/products), total quality environmental management (internal performance measurement), and transportation.
- Environmental technologies are broadly defined to include design, equipment, and operating procedures that limit or reduce negative impacts of products or services on the natural environment.
- Greening of the existing product (e.g., using more recycled content, using biodegradable materials or alternative sources of fuels) and developing new green sustainable products (e.g., reverse logistics, design for disassembly, and using renewable resources).

Pollution Prevention

- Eliminate or minimize waste (energy, emissions, chemical/hazardous, solid wastes)

- Reducing carbon footprint, product lifecycle cost management and reducing transportation costs.
- Adopted green procurement practices for specific products such as recycled-content office paper, renewable energy, paints, cleaners, etc.

Operational Aspects

- GSCM could give the benefit of cost savings due to the use of reusable materials while at the same time reducing and minimizing ecological footprint.
- Flexibility is defined as having the capability to provide products or services that meet the individual demands of customers.
- By flexibility, companies can achieve rapid response to meet individual customer requirements. SC directly impacts on customer's delivery. Then customer satisfaction by measuring and improving delivery can increase the competitiveness of companies.

Economic Aspects

- Long-term profits are required by the high quality of logistics services and customer satisfaction.
- Quick responsiveness of companies to introduce a new product as well as product deliveries could help to evaluate the level of competitiveness.
- Efficiency is expressed by measurements such as the return on investment, inventory, total logistic cost, truck fill rate, delivery cost, process time, resource utilization, production management, etc.

Environmental Aspects

- Environmental performance is focusing on the company's activities in lowering negative impact on the natural environment.
- How company influences the environment which includes CO2 emission, energy use from natural resources (e.g., fuel, water, and land use), and waste and recycling.
- Environmental performance can enhance the financial performance by minimizing both hazardous and non-hazardous waste, which leads to better utilization of natural resources, reduces operating costs, and improves efficiency.

Social Aspects

- Health and safety involve the number and type of work-related accidents (e.g., fatal and major injuries).
- Employment can be considered as overall job creation or reduction, and the organizational culture inside the company reflects working conditions and employees morale.
- Noise emission is included in social aspects which is the most disturbing factor in residential areas and makes the timing of operational industry more important (day or night shift).

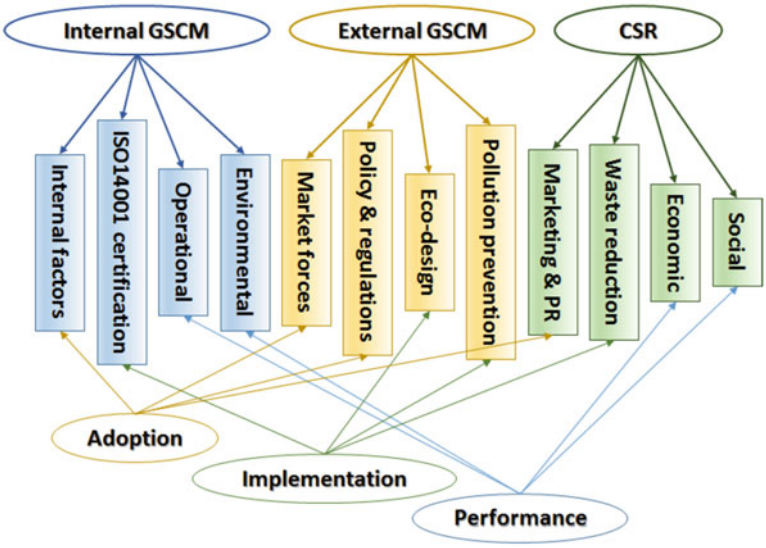

Fig. 13.1 Classification scheme of A.I.P for "internal GSCM," "external GSCM" and CSR

Figure 13.1 designs the classification scheme of A.I.P and its involvement of "internal GSCM," "external GSCM," and CSR.

Sustainability Analysis in SC Network

According to Seuring [22], there are four modeling techniques that could be used to assess GSCM such as life-cycle assessment (LCA) models [12], equilibrium models [19], MCDM [20], and analytical hierarchy process (AHP) [13]. LCA models assessed environmental impacts on the wide network of SC. The purpose of LCA is to minimize the effect of environmental impacts on SC. Equilibrium models balanced environmental and economic factors and finding an equilibrium or optimal solution. This model evaluates the overall equilibrium among given set of networks but does not directly aim at their decisions. MCDM model is usually not so much focus on the optimization of economic and environmental criteria or reaching an equilibrium situation but rather dealing to balance trade-off among multi objective problems. AHP is also an MCDM technique, but it allows structuring a decision process thereby obtaining a solution based on semi-quantitative criteria and respective weights. AHP allows evaluating not only complex decision situations, where environmental and economic goals are assessed at the same time but also more specific decisions, such as looking at the role of hazardous substance management and supplier development practices. In comparison with MCDM and equilibrium model, the aims of AHP are not so much reaching an equilibrium but rather focusing

on toward the complexity of decision making and emphasizing the influence of the decision makers. Based on Seuring [22] modeling approaches for GSCM, equilibrium and MCDM model build trade-offs situation among environmental and economic goals. According to the Seuring [22] approaches, AHP allows choosing criteria that represent either win-win situations or minimum standards. AHP model allows evaluating performance issues of each company as well as SC in total. Therefore, the generalization of AHP model which is called analytic network process (ANP) [15] is used for the decision-making process in this study.

Analytic Network Process

The components of a decision network are clusters, the clusters' elements, and links between elements. In each cluster there are a parent and children elements, links between the parent and children make up the pairwise comparison set for AHP [1]. These links will express the dependencies, interactions, influences, and feedback in the system. Links between elements within the same cluster are called inner dependencies, and between parent elements are called outer dependencies. The inner and outer dependencies are relevant for decision-makers to capture and represent the concepts of influencing or being influenced, between clusters and between elements concerning a specific element.

The traditional ANP method deals with normalization to obtain weighted super-matrix. It is done by cutting each criterion in a column by some clusters so that each column reaches exact unity. In other words, each group has equal weight. Even though this method of normalizing the super-matrix is simple, however, it is irrational to assume equal weights because the effect of one cluster on the other groups may be different in degree [7].

Decision Making Trial and Evaluation Laboratory (DEMATEL) [16] method has been widely used for building and analyzing a structural models involving causal relationships between complex factors [17]. It is used to confirm the relationship between different dimension and criteria to develop our understanding of the complex issues by building a network relationship map. By using this map, the direction and intensity of the direct and indirect relationships that flow between components could be analyzed.

To deal with dependency issue and feedback problems, the traditional ANP with an assumption of each cluster has equal weight is not reasonable. Therefore, the utilization of combining DEMATEL and ANP (DANP) can overcome this limitation. Therefore, DANP technique is used in this study to determine the influential weights of each cluster for building a network relationship map called Influential Network Relations Map (INRM). The results of DANP can contribute INRM for understanding the interaction and interdependency among the dimensions and variables. Therefore, INRM of the GSCM factors can be constructed, by using DANP technique to measure the mutual importance of each dimension and criteria which in turn assists with the decision-making process.

The DANP technique can validate the inter-dependency among variables, and confirm the relation which reflects on the system. Besides, the survey of DEMATEL is less complicated than traditional ANP, hence it helps the respondents to get a better understanding of the questions. Since it offered fewer questions and more straightforward than conventional ANP consequently, it has reduced the time required for respondents to fill in the questionnaires.

DEMATEL Algorithm

The steps for implementation of DEMATEL are explained as follows [7]:

- **Step 1**:
  The measurement of the relationship between factors i and j is made according to the view of the respondents, scaling from 0 to 4 (no influence (0),. . ., very high influence (4)) and is specified by g_c^{ij}. Matrix $\mathbf{G} = \left[g_c^{ij}\right]_{n\times n}$ as the average amount of total individual expert's scores can be obtained as follows:

$$\mathbf{G} = \begin{bmatrix} g_c^{11} & \cdots & g_c^{1j} & \cdot\cdot & g_c^{1n} \\ \vdots & & \vdots & & \vdots \\ g_c^{i1} & \cdots & g_c^{ij} & \cdot\cdot & g_c^{in} \\ \vdots & & \vdots & & \vdots \\ g_c^{n1} & \cdots & g_c^{nj} & \cdot\cdot & g_c^{nn} \end{bmatrix}. \tag{13.1}$$

- **Step 2:**
  The normalized version of matrix **G** is

$$X = vG \tag{13.2}$$

  where

$$v = \min\left\{\frac{1}{\max_i \sum_{j=1}^{n} g_c^{ij}}, \frac{1}{\max_j \sum_{i=1}^{n} g_c^{ij}}\right\} = \frac{1}{\max\left\{\max_i \sum_{j=1}^{n} g_c^{ij}, \max_j \sum_{i=1}^{n} g_c^{ij}\right\}}$$

- **Step 3:**
  The total-influential matrix $\mathbf{T}_c$ can be calculated as follows:

$$\mathbf{T}_c = \mathbf{X}\,(\mathbf{I} - \mathbf{X})^{-1} \tag{13.3}$$

where $\mathbf{I}$ is denoted as the identity matrix, $\mathbf{X} = \left[x_c^{ij}\right]_{n\times n}$, $x_c^{ii} = 0, \forall i = 1, \ldots, n$, $0 \le x_c^{ij} \le 1$, $0 \le \sum_{j=1}^{n} x_c^{ij} \le 1$, and $0 \le \sum_{i=1}^{n} x_c^{ij} \le 1$, and at least the summation of one row or column equals one (not necessarily all). It could be granteed that $\lim_{l\to\infty} \mathbf{X}^l = [0]_{n\times n}$.

- **Step 4:**
  Calculate vector $\mathbf{s} = \left[\sum_{i=1}^{n} t_c^{ij}\right]$ and vector $\mathbf{r} = \left[\sum_{j=1}^{n} t_c^{ij}\right]$, as the column sums and the row sums of the total-influential matrix $\mathbf{T}_c = \left[t_c^{ij}\right]_{n\times n}$, respectively.

  Let $i = j$ and $i, j \in \{1, 2, \ldots, n\}$, the horizontal axis vector $(r_i + s_i)$ represents the importance of the criterion and the vertical axis vector $(r_i - s_i)$ divides the criterion into a causal group and an effect group. Therefore the total influence can be obtained according to each dimension and criterion as summarized in the following rules.

  – Criteria with $(r_i - s_i) > 0$ significantly influence the other criteria (named dispatcher criteria).
  – Criteria with $(r_i - s_i) < 0$, other criteria significantly influence them.
  – Higher values of $r_i + s_i$ cause stronger relationship and lower values of $r_i + s_i$ cause weaker contact among criteria.
  – Criteria with highest $(r_i - s_i) > 0$, concern other criteria much in comparison with other criteria (needs priority for improvement).

  INRM can be obtained by mapping the data set of $(r_i + s_i, r_i - s_i)$. Based on INRM decision makers can determine how the chosen values can be improved in each criterion and dimension. For speeding up the insignificant analysis effects in matrix $\mathbf{T}$ can be filtered, and only criteria with significant effects on matrix $\mathbf{T}$ can represent the INRM. In this study, all factors are considered as an influential criterion.

  After removing insignificant criteria, the m $(m < n)$ dimensions influential matrix $\mathbf{T}_D = \left[t_D^{ij}\right]_{m\times m}$ can be concluded as the representative of significant criterion from $\mathbf{T}_c$.
- **Step 5:**
  $\mathbf{T}_D^{nor} = [t_D^{ij}/t_D^i]_{m\times m}$ is the normalized matrix of total-influential matrix $\mathbf{T}_D$ where $t_D^i = \sum_{j=1}^{m} t_D^{ij}$, $i = 1, \ldots, m$ as sum of each row. Each row of the normalized $\mathbf{T}_D^{nor}$ is equal to one, so that $\sum_{j=1}^{m} t_D^{nor_{ij}} = 1$. Similarly, the normalized $\mathbf{T}_c$ is $\mathbf{T}_c^{nor} = [t_c^{ij}/t_c^i]_{m\times m}$.
- **Step 6:**
  Unweighted supermatrix $\mathbf{W}_c$ is the matrix transposed from $\mathbf{T}_c^{nor}$ and the unweighted supermatrix $\mathbf{O}_D$ is the matrix transposed from $\mathbf{T}_D^{nor}$.
- **Step 7:**
  A weighted supermatrix $\mathbf{W}_c^*$ (to improve the traditional ANP) can be derived by $\mathbf{W}_c$ and $\mathbf{O}_D$, $\mathbf{W}_c^* = \mathbf{O}_c\mathbf{W}_c$.

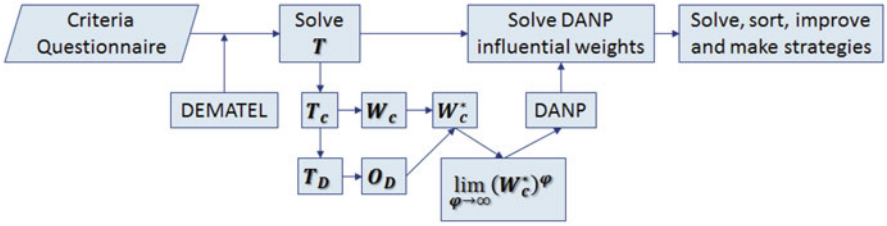

Fig. 13.2 Model procedure of DANP

- **Step 8:**
  DANP is obtained by the converges result of

$$\lim_{\varphi\to\infty}\left(\mathbf{W}_c^*\right)^{\varphi},$$

  as a long-term stable super-matrix.

  The flowchart of proposed DANP is illustrated in Fig. 13.2.

Coal Industry in Indonesia

Coal has been known as a fossil fuel, and source of energy for electricity generation and industry. Regarding global coal reserves, Indonesia currently ranks 5th in global coal reserves according to the most recent BP Statistical Review of World Energy (https://www.bp.com). Indonesia plays a vital role in coal markets since this country is known as a regional supplier and exporters of thermal coal in Asian markets for power plants, for several years. The coal production has grown at a significant rate, and their steam coal trades are valued especially with Asian importers. It is predicted that coal prospects in Indonesia will continue to grow specially for domestic demands [18].

Although the global development is willing to replace the fossil fuel with the green energy, in Indonesia, coal will continue to be a valuable commodity for the domestic economy. Indonesias government also supports the coal usage in the power sector due to their abundant local supply and to reduce the use of expensive oil and diesel. Indonesia consumes around 20% of country's coal output while the remaining is exported. Regarding domestic consumption, about 51% is to generate electricity, and the remaining is for the industrial purpose. The use of coal in industrial sector includes cement and ceramics, pulp and paper, iron and steel, also textiles and food. The growth of coal mining in Indonesia will drive this country's economic but at the same time, the country is facing more challenges due to unfavorable characteristics of coal. In the future, Indonesia can be labeled as the most polluting energy source due to its high proportion of carbon which is

Table 13.1 Questionnaire I

Criteria	Level of importance Considering the importance of A, fill in 0–10 (11 scales) Very unimportant Unimportant Fair Important Very important 0 1 2 3 4 5 6 7 8 9 10
1.1 "Market forces"	
1.2 "Policy & regulations"	
1.3 "Internal factors"	
1.4 "Marketing & PR"	
2.1 "Waste reduction"	
2.2 "ISO14001 certification"	
2.3 "Eco-design"	
2.4 "Pollution prevention"	
3.1 "Operational"	
3.2 "Economic"	
3.3 "Environmental"	
3.4 "Social"	

concerning safety and environmental issues. Environmental association typically from developed countries with their emphasis on greener and environmentally program will bring out tighter policy and regulations.

To develop a theoretical framework for GSCM in coal industry of Indonesia, this study layouts the objective of determining the important criteria and enabling conditions for GSCM. The data was gathered through a questionnaire survey distributed among coal industry-related companies in Indonesia. In total 35 companies were surveyed across a broad spectrum of industries, including distribution, the manufacturing sector, power generation, sales, and service provider. DANP technique has been applied to pattern critical connections among criteria and dimensions and to build an INRM (Table 13.1).

The questionnaire was asked experts to define the significance of the connections among the criteria (Table 13.2). The average score of 35 questionnaires builds up the matrix $\mathbf{G}_{12\times12}$. Follow by computing the normalized direct-relation matrix $\mathbf{X}$, and total influence matrix T_D and T_c, the INRM of relationships among the dimensions are evoked as shown in Fig. 13.3.

The general finding results interpretation and criteria are summarized in Table 13.3.

Future Research Direction

- **Area 1**: In SC networks, suppliers always try to avoid the buyers' audit. Answering this question "How can buyers prompt suppliers to use more exceptional

Table 13.2 Comparison of the impact of the 12 criteria

Please fill out the compared level of 12 criteria in the following table (0. No impact; 1. Low impact; 2. Medium impact; 3. High impact; 4. Very high impact)												
Dimensions	1.1 "Market forces"	1.2 "Policy & regulations"	1.3 "Internal factors"	1.4 "Marketing & PR"	2.1 "Waste reduction"	2.2 "ISO14001 certification"	2.3 "Eco-design"	2.4 "Pollution prevention"	3.1 "Operational"	3.2 "Economic"	3.3 "Environmental"	3.4 "Social"
1.1 "Market forces"												
1.2 "Policy & regulations"												
1.3 "Internal factors"												
1.4 "Marketing & PR"												
2.1 "Waste reduction"												
2.2 "ISO14001 certification"												
2.3 "Eco-design"												
2.4 "Pollution prevention"												
3.1 "Operational"												
3.2 "Economic"												
3.3 "Environmental"												
3.4 "Social"												

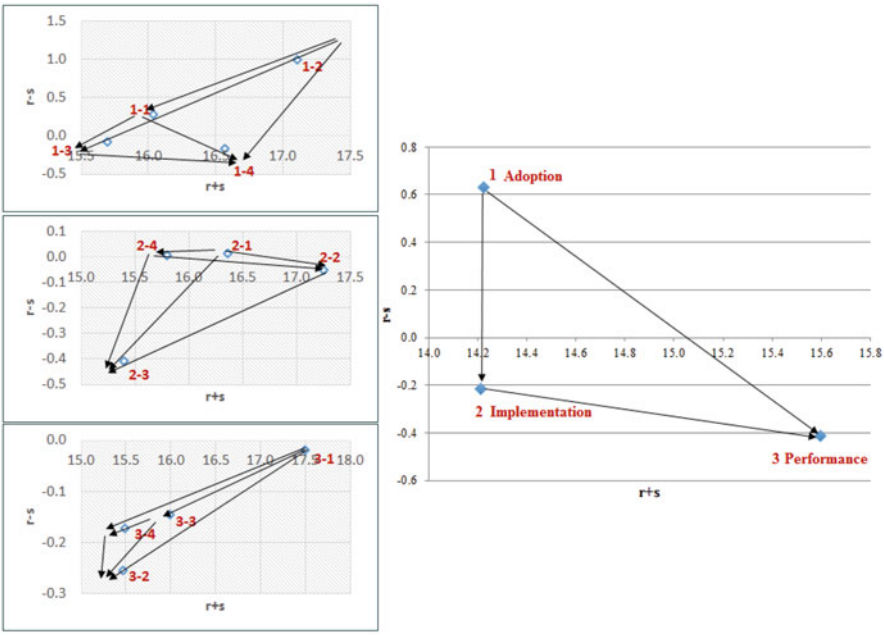

Fig. 13.3 Influential network relations map (INRM)

responsibility to check environmental impact?" opens a new avenue of research. Buyers can control the suppliers' marginal benefits by price reduction or rising salaries for operators which makes the supplier exercise more outstanding care to sustainability issues. Moreover, buyers would like to develop a necessary and sufficient condition for suppliers to avoid hiding information from the auditor. Punishing a supplier for hurting operators or the environment, or for trying to deceive an auditor, and increasing auditing, broadcasting negative audit reports, and giving loans to suppliers motivate them to sustainability. Game theory models such as negotiation and bargaining can be applied for modeling buyer–supplier motivation for environmental and social responsibility in SC contracting.

- **Area 2**: Developing smart Decision Support System (DSS) in sustainability assessment of sustainable interdependent networks. Moreover, group DSS combines communication, computing, and decision maker to formulate and solve unstructured problems by a group of people for sustainability issues in multiplex networks. Developing mathematical models of group decision making integrated with DSS would be a direction for more research in sustainable interdependent networks.

Table 13.3 INRM results and findings for the case study

Panel	Finding
General	Performance is the first in the index of strength of influence given and received ($r_3 + s_3 = 15.598$), factors of adoption ($r_1 + s_1 = 14.223$) is next, and implementation of GSC ($r_2 + s_2 = 14.214$) is the third
	There is a causal relationship between the three factors (adoption, implementation, performance)
	Factors of adoption exhibit a positive influence on the implementation and performance. Implementation of GSC has a positive influence on performance
Performance	Operational (3–1) is the first in terms of the index of strength of influence given received, environmental (3–3) is next, and social (3–4) is the third
	All criteria have $(r_i - s_i) < 0$, it shows that these criteria are influenced by other criteria
Implementation	Waste reduction (2–1) is the first in terms of index of strength of influence given and received, pollution prevention (2–4) is next, and ISO 14001 certification (2–2) is the third
Adoption	Policy & regulations (1–2) is the first in terms of the index of strength of influence given and received, market forces (1–1) is next, and marketing & public relations (1–3) is the third
All	Operational (3–1) is the most important consideration ($r_{3-1} + s_{3-1} = 17.5$) in total sum; eco-design (2–3) is the criteria with the least impact on the other criteria ($r_{2-3} + s_{2-3} = 15.4$) in total sum
	Policy & regulations has the greatest direct impact on others ($r_{1-2} - s_{1-2} = 0.993$) in total difference; eco-design (2–3) is the most easily influenced by other criteria ($r_{2-3} - s_{2-3} = -0.407$) in total difference

- **Area 3**: Using cooperative and noncooperative multi-level programming is a generalized future research direction in control and optimization of collaborative systems in sustainable interdependent networks.
- **Area 4**: Developing scenario analysis models for sustainability implications in the context of the circular economy for interconnected networks as a system of systems.

Summary and Conclusion

In this research, we proposed an analytical structure for GSCM with A.I.P criteria and implemented in the coal power generator industry in Indonesian to verify our methodology. This study practiced the hybrid DANP method to create INRM and substantial weights of criteria. Realizing corresponding weights of the dimensions and criteria for evaluation is important, and our work benefits investors and managers using GSCM to consider the most significant criteria for business.

The result of the case study shows that the most critical and least dimensions to be concerned are performance and adaptation factors. However, adoption factors are

the "boost" for a business enterprise using GSCM. Consequently, without internal or external needs for sustainability practice, SC might not realize it. Adoption factors have a positive influence on GSCM development through green SC implementation. Additionally, green practice in SC affects the performance positively which is the critical factor for a successful company even using GSCM. Refer to [2, 11, 24] for more literature on GSCM in coal industry.

Appendix

Executive Summary

The chapter is divided into six sections (Fig. 13.4). The first section addresses the new and rapidly growing attention to the GSCM. Other topics include the history of sustainability intention; Definition of sustainability; International attention to sustainable manufacturing and services; Influential factors on a sustainable organization.

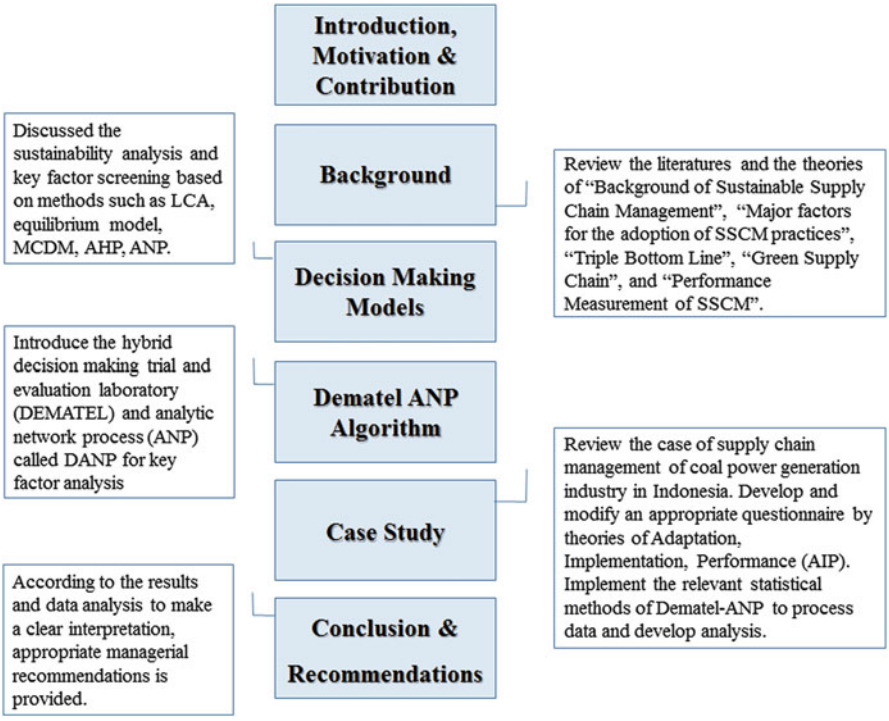

Fig. 13.4 Overview flowchart of the chapter

The second section reviews the background of GSCM. The adoption, implementation, and performance factors for GSCM are discussed with their related contents in this section.

The third section discussed the sustainability analysis and key factor screening. The discussed methods are including life-cycle assessment, equilibrium model, multi-criteria decision making, analytical hierarchy process, analytic network process, decision-making trial and evaluation laboratory, and influential network relations map.

The fourth part focuses on models and applications of proposed hybrid decision-making trial and evaluation laboratory (DEMATEL) and analytic network process (ANP) called DANP on coal power generation industry in Indonesia as the case study.

The fifth section reviews the development and future trend of GSCM for smart management such as implications for motivating supplier social and environmental responsibility.

Finally, in the last section from the gap in the literature, we propose some managerial suggestions, for who are interested in walking into the field of GSCM. The study will be concluded by providing recommendations for further research and align our mindset for the next step.

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