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Examining barriers to organizational change for sustainability and drivers of sustainable performance in the metal manufacturing industry

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ABSTRACT

Traditionally, the metal manufacturing industry in China is focused only on economic growth and just in the past decade, environmental regulatory policies have started to emphasize organizational sustainable improvements. Thus, the metal manufacturing industry in China has a high potential for value addition and organizational change for sustainability. The success of organizational change for sustainability should be based on an in- depth insight into barriers to organizational change for sustainability and drivers which support sustainable performance. In this context, this study employed interpretive structural modeling (ISM) technique and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) to examine the barriers to organizational change for sustainability and drivers which support sustainable performance. Firstly, ISM technique was applied to select the key barriers to organizational change for sustainability based on experts' evaluations in the Chinese metal manufacturing industry. Then, TOPSIS model was applied to assess and prioritize the drivers which support sustainable performance with respect to their influence on the key barriers. Based on the study results, inefficient legal framework, inadequate proactive plans, lack of sustainable waste management and preferences of institutional buyers are the key barriers. Furthermore, enforcing government regulations, integrating sustainability in proactive plans, promoting sustainable products and developing infrastructure support and facility for sustainability were found to be the most influential drivers. This study will enable managers and government bodies to manage their resources in an efficient way so that organizational change management for sustainability can be achieved in the metal manufacturing industry in China.

1. Introduction

Organizations are integral part of modern societies being complex social systems with sets of interrelated units in joint problem- solving to accomplish a goal and classified as civil society, companies and public agencies (Lozano and Haartman, 2018). Usually, organizations are influenced by circumstances that act beyond their boundaries, which influence their strength to acquire and utilize resources to create value. The main aim of organizational change which is generally an anticipated, prepared for and managed opportunity is to transit from a current status quo to a better state. Organizational changes that cause a shift in the status quo are bound to encounter resistance at the various organizational hierarchical levels. Resistance to organizational change and lack of appropriate response to new opportunities can result in unsustainable conditions; thus sustainable performance can be the main justification for organizational change (Lozano, 2012). Organizations have become a main focus of attention in the sustainability debate and perceived as possessing resources, technology and motivation to work towards more sustainable societies (Lozano, 2012). Sustainability is often referred to as the triple- bottom- line because it involves the integration of environmental and social responsibilities with economic goals to create value for the company as well as for society (Rankin et al., 2011). In this context, organizations and managers are increasingly recognizing the interrelationships between economic benefits, social and environmental consequences as well as their short and long term effects on change for sustainability. Long- lasting organizational change for sustainability requires in addition to the development of sustainability visions for the future, the identification and examination of barriers which pose resistance and respective drivers which support sustainable performance. Many managers not only underestimate the causes of resistance to change towards sustainability, but also the drivers which influence organizational change to sustainable performance (Kotter and Schlesinger, 2008). Organizations need to have an explicit approach for addressing and managing change. Furthermore, an insight on the appropriate strategies in order to catalyze change from the unsustainable status quo to a more- sustainable state is crucial (Lozano, 2015). Innovation can provide a solution to the main environmental issues, but often meets resistance thus necessitating adjusting its output to ensure successful adoption (Acciaro et al., 2014). Certain barriers usually hinder organizational change for sustainability; identifying them can help to apply appropriate strategies to overcome them, thus helping to better incorporate and institutionalize sustainability (Lozano, 2012).

Several myriad barriers to change for sustainability and the drivers

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which are the appropriate strategies which support sustainable performance have been recognized for different organizations (Alessandra et al., 2018; Moktadir et al., 2018a,b). While many of the barriers and drivers of change to sustainability are industry- specific, it is, nonetheless, possible to find some that can be associated with more than one industry or organization (Zhu, 2016). Most of the literature on barriers and drivers to change for sustainability has focused on industry groups while few authors have focused on offering a clear panorama of the entire system of the specific industry or organization (Lozano, 2012). In particular, there have been past studies on organizational change to sustainability in the manufacturing sector with focus on analyzing the barriers to change (Trianni et al., 2017; Alessandra et al., 2018; Moktadir et al., 2018a,b; Thomas-Seale et al., 2018). Although, the topic of sustainability has gained increased attention in the manufacturing sector due to the sector's huge environmental and societal impact, most manufacturing firms in China still place more emphasis on economic sustainability than on environmental and social dimensions of sustainability (Trianni et al., 2017). China provides a significant illustration on the negative impacts of climate created by the manufacturing sector and provides potential opportunities for sustainability objectives (Ely et al., 2016; Liu et al., 2016). Government regulations, rapid technology development and economic gains has propelled the Chinese manufacturing sector to consider adopting organizational change management for sustainability (Zhu, 2016). In response to the high incidence of environmental pollution in China and government target to reduce carbon emissions per unit GDP by 40–45%, the manufacturing industry must undertake organizational change management for sustainability. In the context of Chinese metal manufacturing sector, a limited research on organizational change management for sustainability has been reported (Subramanian and Abdulrahman, 2017). The metal manufacturing sector is the largest energy- consuming industrial sector in China (Yu et al., 2017), thus it is important to implement organizational change management for sustainability. Although, there are potential opportunities to implement organizational change for sustainability in the Chinese metal manufacturing industry and government has set ambitious targets, there exists several barriers to change for sustainability. A thorough understanding of the barriers to change for sustainability and drivers which support sustainable performance is necessary to effectively achieve organizational change management for sustainability in the Chinese metal manufacturing industry (Liu and Bai, 2014). There is a crucial need to identify barriers to organizational change for sustainability and prioritize strategies which support sustainable performance in the Chinese metal manufacturing sector. Hence, this study takes the initial step to address the following research questions:

- Based on the survey of experts in the Chinese metal manufacturing industry on the identified barriers, what are the key barriers which hinder organizational change management for sustainability?
- Using the responses from experts in this study, what are the most influential drivers which encourage sustainable performance?

In the following section, the literature review on organizational change for sustainability, the Chinese metal manufacturing industry and research methodology is outlined. The proposed analytical framework in the study, study design, identified barriers of change to sustainability and drivers which support sustainable performance are presented in Section 3. In Section 4, the results of the study which indicates the key barriers to organizational change for sustainability and prioritized drivers which support sustainable performance are summarized. Also, theoretical and managerial implications are presented in Section 4. The conclusion of the study is presented in Section 5.

2. Literature review

In this section, a detailed literature review on organizational change management for sustainability, the China metal manufacturing industry and the proposed research methodology are discussed.

2.1. Organizational change management for sustainability

Sustainability includes a group of actions taken to meet the needs of the present moment with committing to future capacity, thus striking a balance between increasing economic gains while minimizing environmental and social consequences (Helleno et al., 2017). Sustainability has been emphasized in many business organizations due to competitive advantage and pressures from government and customers. Organizational change management for sustainability involves an anticipated and managed opportunity to transit from an unsustainable status quo to a sustainable state (Acciaro et al., 2014). Organizational change management for sustainability is highly vital and have been widely discussed, hence motivated industrial organizations are modifying their activities and considering the environmental, social and economic impacts of their operations (Zhu, 2016; Moktadir et al., 2018a,b). In this context, organizational change for sustainability can aid in modifying traditional operations in firms and their supply chains. This modification actually accrues to the focus on sustainability in business organizations. The focus on sustainability can bring advantages such as better quality, reduced costs, improved image and opening of new markets (Gabzdylova et al., 2009). Given the impending necessity to transit towards focus on sustainability, the main political, economic and societal actors are looking for innovative solutions to aid organizational change for sustainability (Ivanaj et al., 2017). The adoption of sustainable operations involves strategies to produce manufactured products that are sustainable and tends to pave way for employment, community and product safety and security, thereby ensuring organizational change for sustainability (Moktadir et al., 2018a,b). In fact, many manufacturing firms are increasingly aware of the numerous benefits associated with adopting sustainable operations which includes financial, social and environmental benefits (Yu et al., 2017; Alessandra et al., 2018). Sustainable operations have the capability to increase organizational competitiveness and assess performance in the manufacturing industry. Sustainable consumption and production, sustainable manufacturing, green supply chain and reverse logistics are all integrated parts of sustainable operations which are relevant to manufacturing firms (Zhu and Geng, 2013; Saavedra et al., 2018). Moreover, organizational change for sustainability increases operational efficiency, creates new customers and increases competitive advantage through protecting brand image and building public trust (Moktadir et al., 2018a,b).

Pressures and resistances in the form of barriers are bound to exist for firms pursuing organizational change for sustainability. Challenges and barriers usually hinder organizations from effective implementation of organizational change management in business to achieve sustainability objectives (Uyarra et al., 2014). The barriers to organizational change for sustainability can only be overcome through drivers which support sustainable performance. According to Lozano (2012), planning organizational changes through applying appropriate strategies to overcome barriers to change for sustainability could help companies to overcome the resistance to organizational changes and integrate their efforts to sustainability more holistically. A holistic perspective on the different drivers of corporate sustainability can catalyze change from the unsustainable status quo to a more sustainable- oriented state (Lozano, 2015). It is important to recognize the barriers and drivers of sustainable performance which have the highest influence for each type of organization, in order to foster them and achieve organizational change management for sustainability (Lozano and Haartman, 2018). A summary of the existing literature on organizational change management for sustainability in the manufacturing industry is shown in Table 1.

Table 1
Research on Organizational change management for sustainability in the manufacturing sector.

Authors	Nature of contribution	Nature of the methodology
Gabzdylova et al. (2009)	Drivers, stakeholders and practices of sustainability	Qualitative and quantitative methods
Hamalainen et al. (2018)	Barriers to sustainability research on distributed production	Empirical case study
Thomas-Seale et al. (2018)	Barriers to the progression of additive manufacture	Logic models
Moktadir et al. (2018a,b)	Drivers of sustainable manufacturing practices and circular economy	Graph theory and matrix approach (GTMA)
Neri et al. (2018)	Drivers and barriers industrial sustainability	Integrated framework
Trianni et al. (2017)	Barriers to adopting industrial sustainability measures	Integrated conceptual approach
Dunuwila et al. (2018)	Drivers which support sustainable performance	Novel methodology
Zailani et al. (2017)	Barriers to sustainability	Partial Least Square (PLS)
Aboelmaged (2018)	Drivers to sustainable manufacturing practices	Partial Least Square and Structural Equation Modelling (PLS- SEM)
Gardas et al. (2018)	Barriers to sustainability	Delphi- DEMATEL
Shao et al. (2018)	Barriers to environmentally friendly products and consumers	Grey- DEMATEL

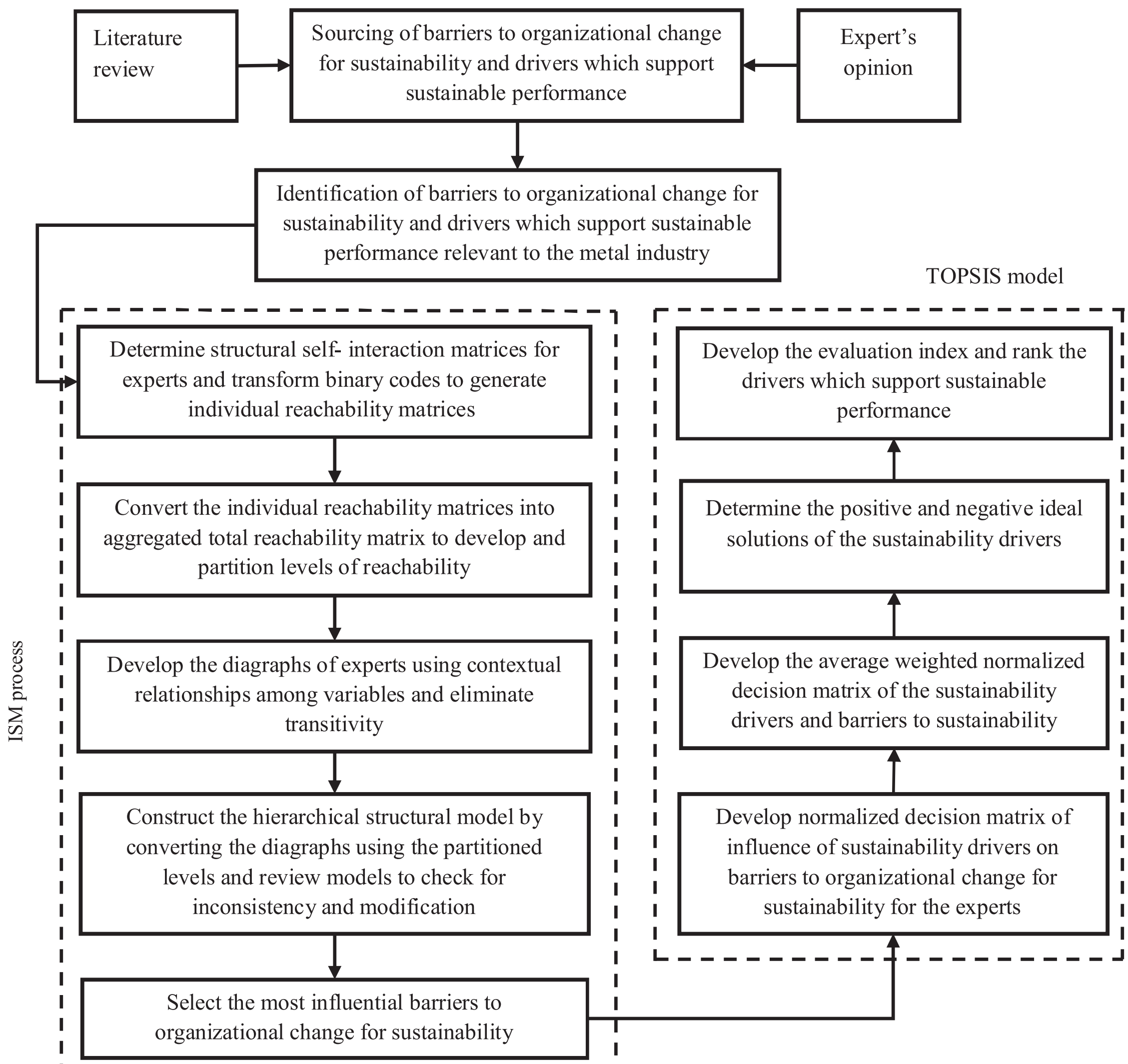

Fig. 1. Research modeling framework.

2.2. The China metal manufacturing industry

The China manufacturing industry can benefit from the long- term business viability and benefits associated with organizational change management for sustainability to increase organizational competitive advantage. This is because, China's manufacturing industry, driven by industrialization, accounted for 42–44% of the country's total CO2 emissions every year from 1992 to 2012, based on CO2 emissions from the use of fossil fuels (Tian et al., 2018). Also, about 31–33% of the total GDP in China within the same time period is accounted for by the manufacturing industry in China (World Bank, 2018). The Chinese manufacturing industry drives its economic growth and has been developing rapidly; presently, China is referred to as a global factory and also projected to continuously expand its manufacturing activities. The government has declared the manufacturing industry in China a top priority having potential to create employment and entrepreneurship by developing business opportunities which are export- inclined. Based on the China Statistical Yearbook, the sales of the manufacturing industry increased from 459.0 billion yuan in 1990 to 98,793.9 billion yuan in 2015, with average growth rate of up to 24% (Lin and Xu, 2017). The rapid growth rate of the industry has also led to environmental degradation and resource depletion. Most particularly, the China's metal industry accounts for around 36.65% of the total energy consumption and undoubtedly labeled by "high emissions and high energy consumption" and thus have constituted threat to sustainability (Feng et al., 2018). The focus in metal industry in China has traditionally been on economic growth and just in the past decade, environmental regulatory policies have started to emphasize organizational sustainable improvements (Zhu et al., 2010). Thus, the metal industry in China has a high potential for value addition and organizational change management for sustainability.

Due to decreasing resource and increasing environmental problems, both central and regional governments in China have released many environmental regulations (Zhu and Geng, 2013). The metal manufacturing firms in China been the main polluters and resource consumers have experienced huge pressures from regulatory bodies to comply with these environmental regulations. Moreover, this will help to achieve organizational change for sustainability and improve the brand image of global market. In this context, the metal manufacturing industry in China requires to implement organizational change for sustainability to improve performance in social, technical, environmental and commercial aspects up to set international standards, and to increase competitive edge in the global market.

2.3. Research methodology

Firstly, the barriers to organizational change for sustainability and drivers which support sustainable performance were sourced from relevant literature before applying the proposed research framework to a real- life situation. Based on extensive literature review and inputs of experts in the Chinese metal manufacturing firm, 12 barriers to organizational change for sustainability and 8 drivers of sustainable performance were deduced for subsequent analysis using the proposed modeling framework. The proposed research methodology which comprises of interpretive structural modeling (ISM) technique and Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) to examine the barriers to change for sustainability and drivers which support sustainable performance is shown in Fig. 1.

3. Solution methodology

The interpretive structural modeling (ISM) technique is an effective methodology for dealing with complex issues which was first proposed by J. Warfield in 1973 to develop a map of complex relationships between the many elements in a complex situation (Ansari et al., 2013). ISM has been applied extensively in many prestigious organizations including NASA and comprises of three modeling languages viz: words, diagraphs and discrete mathematics to provide framework for solving a problem. ISM usually operates without knowing any prior history of the system and imposes rank to the elements (Sindu et al., 2016). The Technique for Order Performance by Similarity to Ideal Solution (TOPSIS) is a simple and popular ranking method which selects the options that have the shortest distance from the positive ideal option and farthest distance from the negative ideal option at the same time (Azimifard et al., 2018). TOPSIS was originally introduced by Hwang and Yoon to solve multi- criteria decision-making problems and has been applied in diverse areas due to its comprehensibility and simplicity (Sun et al., 2018). The procedure for the ISM- TOPSIS research methodology applied in this study is described as follows:

Step 1: Identify the system variables for the interpretive structural model. In this study, the system variables are the barriers to organizational change for sustainability.

Step 2: Develop the structural self- interaction matrix (SSIM) by examining the pair- wise contextual relationships among system variables by utilizing four symbols to depict the type of interrelationships that exists between them as shown below:

- *W*: Variable *i* leads to variable *j* not in both direction
- *P*: Variable *j* leads to variable *i* not in both direction
- *Y*: Variable *i* leads to variable *j* in both direction
- *O*: Both variable *i* and *j* are unrelated

Step 3: Prepare the reachability matrix from the SSIM for the ten experts in our study by substituting the symbols (*W*, *P*, *Y* and *O*) in the structural self- interaction matrix by 1 and 0 based on the following rules:

- (*i*, *j*) entry in the initial reachability matrix is substituted with 1 and (*j*, *i*) is substituted with 0, if (*i*, *j*) in the structural self- interaction matrix is *W*.
- (*i*, *j*) entry in the initial reachability matrix is substituted with 0 and (*j*, *i*) is substituted with 1, if (*i*, *j*) in the structural self- interaction matrix is *P*.
- (*i*, *j*) entry in the initial reachability matrix is substituted with 1 and (*j*, *i*) is substituted with 1, if (*i*, *j*) in the structural self- interaction matrix is *Y*.
- (*i*, *j*) entry in the initial reachability matrix is substituted with 0 and (*j*, *i*) is substituted with 0, if (*i*, *j*) in the structural self- interaction matrix is *O*.

Then, check for transitivity based on the assumption that if a variable X is related to variable Y and variable Y is related to variable Z, then variable X is necessarily related to variable Z.

Step 4: Partition the obtained matrix into different levels to get the importance level of each system variable.

Step 5: Convert a designed directed graph (diagraph) based on the contextual relationships in the reachability matrix and eliminating the transitive links into an interpretive structural model by replacing nodes with statements. Then, review the ISM to check for inconsistency, make necessary modifications and select the key barriers to organizational change for sustainability.

Step 6: Develop the decision matrix of the influence of the drivers which support sustainable performance on the key barriers to organizational change for sustainability based on the expert's feedback using the linguistic scale. The linguistic scale is shown in Table 2 while the decision matrix of influence scores is shown in Table 3.

Where, R_i represents barriers to organizational change for sustainability in the metal manufacturing industry, S_j represents drivers which support sustainable performance and B_{ij} represents influence of drivers which support sustainable performance on the barriers to sustainability; $i = 1,2\ldots n$ and $j = 1, 2\ldots m$.

Step 7: Develop the normalized decision matrix. Eq. (1) was applied to normalize the decision matrix for the influence of drivers which support sustainable performance on barriers to organizational change for sustainability.

$$P_{ij} = \frac{B_{ij}}{\sqrt{\sum_{i=1}^{m} B^{ij}}} \quad 0 < \mathrm{B_{ij}} > 1 \tag{1}$$

Where, P_{ij} represents the normalized evaluation index for the drivers which support sustainable performance with respect to the barriers to

Table 2
Linguistic scale.

Linguistic term	Score
Very weak influence	1
Weak influence	2
Medium influence	3
Good influence	4
Very good influence	5

Table 3
Influence of drivers which support sustainable performance on barriers to organizational change or sustainability.

Drivers which support sustainable performance	Barriers to organizational change for sustainability			
	R_1	R_2	R_3	R_n
S_1	B_{11}	B_{12}	B_{13}	B_{1n}
S_2	B_{21}	B_{22}	B_{23}	B_{2n}
S_m	B_{m1}	B_{m2}	B_{m3}	B_{mn}

organizational change for sustainability in the metal manufacturing industry.

Step 8: Design the weighted normalized decision matrix by firstly computing entropy measures D_j as shown in Eq. (2).

$$D_j = -K \sum_i [P_{ij} - \ln P_{ij}] \quad (2)$$

Where, K represents a constant and the inverse of the natural logarithm of total drivers which support sustainable performance in the metal manufacturing industry. Then, the divergence through e_j of each barrier to organizational change for sustainability was computed from the entropy measures D_j as shown in Eq. (3). Subsequently, the normalized weighted indexes α_{ij} were computed using the divergence through e_j as indicated in Eq. (4). Then, the weighted normalized decision matrix was designed using Eq. (5).

$$e_j = 1 - D_j \quad (3)$$

$$\alpha_{ij} = \frac{e_i}{\sum e_j} \quad (4)$$

$$V_{ij} = P_{ij} X \alpha_{ij} \quad (5)$$

Where, V_{ij} is the weighted normalized index.

Step 9: Determine the positive and ideal solutions and compute the evaluation index based on relative proximity of drivers which support sustainable performance to ideal solution as shown in the equations below:

$$V^+ = \{v_1{}^+, \ldots, v_n{}^+\} = \{\max(v_{ij}) \text{ if } j \varepsilon J'\}, j = 1 \ldots n \quad (6)$$

$$V^- = \{v_1{}^-, \ldots, v_n{}^-\} = \{\min(v_{ij}) \text{ if } j \varepsilon J'\}, j = 1 \ldots n \quad (7)$$

$$d_{ij}^+ = \left\{\sum_{j=1}^n (v_{ij} - v_{ij}^+)^2\right\}^{1/2}, \ i = 1 \ldots m \quad (8)$$

$$d_{ij}^- = \left\{\sum_{j=1}^n (v_{ij} - v_{ij}^-)^2\right\}^{1/2}, \ i = 1 \ldots m \quad (9)$$

$$L_i = \frac{d_i^-}{d_i^- + d_i^+} \quad 0 \le L_i \le 1 \quad (10)$$

Where, V^+ is the positive separation measure, V^- is the negative separation measure, L_i is the evaluation index based on relative proximity of drivers which support sustainable performance, d_i^+ is the positive ideal solution and d_i^- is the negative ideal solution.

4. Application of the proposed research framework

The proposed research framework was applied to a metal manufacturing industry in South of China. The company is a global- oriented metal manufacturing firm which serves customers within and outside China, was selected as a representative case of the implementation of organizational change management for sustainability. Due to its contribution to economic growth, it becomes imperative that the company consider adopting sustainability in their operations to achieve organizational change management. To ensure sustainable performance in their operations is a recent concern and has prompted this study. The company is interested in organizational change for sustainability to increase the competitive edge of their business in the global market and have strived to identify the barriers to organizational change for sustainability and the drivers which support sustainable performance. This study aids to achieve this objective.

4.1. Data collection

In the process of data collection, a team of ten experts from the metal manufacturing industry in China was formed and data collected from the industry professionals. Data collection was carried out in two stages, as outlined below:

Stage 1: Finalizing the barriers to organizational change for sustainability and drivers which support sustainable performance

Initially, twelve barriers to organizational change for sustainability were identified from a literature review which are applicable to the metal manufacturing industry and developing country like China. The experts were requested to scrutinize the barriers and they agreed to the identified barriers as being relevant to the metal manufacturing industry in China. These barriers were further analyzed using expert's input to ascertain the key barriers. The experts considered in the metal manufacturing industry are four production managers, four supply chain managers and two logistics executives. They experts were deemed knowledgeable to provide feedback on the questionnaires due to their high level of experience being over 15 years in the metal manufacturing industry. Questionnaires were distributed to the experts and information further consolidated through personal contacts and telephone conversations.

Stage 2: Analyzing the drivers which support sustainable performance with regards to key barriers to organizational change for sustainability

The objectives and methodology of this research were communicated to the expert panel who were then requested to fill a pair- wise comparison matrix, which is the first step of developing the ISM-TOPSIS modeling framework. The identified drivers which support sustainable performance that were considered in this study, their general definitions and related literature, is summarized in Table 4.

The application of the proposed research methodology in the metal manufacturing industry is explained as follows:

Step 1: The summary of the barriers to organizational change for sustainability that were considered in this study are shown in Table 5.

Step 2: Experts assisted in evaluating the contextual relationships between the barriers to organizational change for sustainability. Ten 12 × 12 structural self- interaction matrices (SSIM) matrices were formulated based on four symbols (*W*, *P*, *Y* and *O*). Table 6 shows the SSIM for the system variables in this study.

Step 3: In this step, the 12 × 12 structural self- interaction matrices (SSIM) matrices of the ten experts were substituted by 1 and 0 to develop the reachability matrices based on the rules stated in the proposed research methodology. A mean of the reachability matrices was obtained for all the experts in this study. Subsequently, transitivity was checked in the developed reachability matrices of the experts based on the relationships of the barriers to organizational change for sustainability. The computed reachability matrix for one of the experts in this study is shown in Table 7. The obtained matrix after transitivity check for all the experts in this study is depicted in Table 8.

Step 4: The final reachability matrix for the barriers to organizational change for sustainability were partitioned into different importance levels. The determined levels of importance for each of the barrier to organizational change for sustainability are shown in Table 9. According to the determined levels of importance, inefficient technology, financial constraints and lack of employee welfare package occupy the 1st level. On the 2nd level is lack of awareness amongst stakeholders. Insufficient commitment of top management, wide communication gap and insufficient environmental competencies occupy the 3rd level of importance. On the 4th level is lack of worker's training.

Table 4
Identification of drivers which support sustainable performance in the metal industry.

Drivers which support sustainable performance	General definition	Relevant literature
Sufficient budget	Budgetary allocations for sustainable operations is sufficient	Almeida et al. (2013), Blok et al. (2015), Luthra et al. (2016)
Develop infrastructure support and facility for sustainable operations	Infrastructure support and facility for sustainable operations are developed	Tseng et al. (2013), Allais et al. (2017), Kavilal et al. (2017), Luthra et al. (2017)
Access to advanced technology for sustainable operations	Advanced technology such as renewable energy technologies and green technologies for production, waste management and recycling are accessible	Kaushik et al. (2014), Lorek and Spangenberg (2014), Luthra et al. (2016), Mangla et al. (2015)
Enforce government regulations and effective legislation	Government regulations which support sustainable development are enforced	Lorek and Spangenburg (2014), Luthra et al. (2016), Luthra et al. (2017), Adnan et al. (2017), Hoeksma et al. (2017)
Promote public awareness on sustainable products	The customers are provided with sufficient information to create awareness on sustainable products	Islam et al. (2016), Guo et al. (2017), Cherry and Pidgeon (2018), Smol et al. (2018), Wang et al. (2018)
Integrating sustainable operations in proactive plans	Sustainability objectives and operations are incorporated proactively in organizational plans and strategies	Almeida et al. (2015), George et al. (2016), Allais et al. (2017), Machado et al. (2017), Wijethilake (2017)
Implement sustainable waste management	Waste management systems that are sustainable are implemented	Orji and Wei (2015), Wu (2015), Ameknassi et al. (2016), Kikuchi-Uehara et al. (2016), Orji and Wei. (2016), Tan et al. (2016), Kavilal et al. (2017)
Ensure environmental competencies	Workers are trained to ensure their skills and competencies in environmental issues are improved	Wu (2015), Ameknassi et al. (2016), 6), Orji and Wei. (2016), Tan et al. (2016), m et al. (2017)

On the 5th level of importance are preference of suppliers/ institutional buyers, inadequate proactive plans, inefficient legal framework and lack of sustainable management.

Step 5: The ISM model was developed based on the contextual relationships between barriers to organizational change for sustainability in the final reachability matrix and eliminating transitive links. The developed ISM is shown in Fig. 2. According to the ISM model in Fig. 2, the system variables that occupy the 5th level which is the highest level in the ISM model affect each other and are namely 'inadequate proactive plans', 'preference of suppliers/ institutional buyers', 'inefficient legal framework' and 'lack of sustainable management'. The system variables on the 5th level of the ISM model affect the variable on the 4th level which is 'Lack of worker's training'. Likewise, 'Lack of worker's training' affects the system variables on the third level which in turn influence each other and 'Lack of awareness amongst stakeholders' on the 2nd level. The variables on the 1st level of the ISM model influence each other and are in turn influenced by 'Lack of awareness amongst stakeholders'.

A further analysis was carried out to classify the system variables in this study based on their driving and dependence power computed on the total reachability matrix of the experts. A diagram of the driving and dependence power of system variables were constructed with the driving power plotted on the horizontal axis while the dependence power was plotted on the vertical axis as shown in Fig. 3. According to Fig. 3, the autonomous system variables have weak driving power and weak dependence power and thus are disconnected within the system. In this study, the autonomous system variables are 'Inefficient technology', 'Insufficient commitment of top management' and 'Lack of worker's training'. There also exists the linkage variables which are the system variables with strong driving power and strong dependence power and are referred to as being unstable since any action on them will influence themselves and others. The linkage system variables in this study are 'Financial constraints' and 'Wide communication gap'. The dependent system variables have weak driving power and strong dependence power. In this study, 'Lack of awareness amongst stakeholders', 'Insufficient environmental competencies' and 'Lack of employee welfare package' are the dependent system variables. The independent variables are those which exhibit strong driving power and

Table 5
Identification of barriers to organizational change for sustainability in the metal industry.

Barrier to organizational change for sustainability	General definition	Relevant literature
Insufficient commitment of top management	Adequate information to achieve sustainability objectives are not readily available to top management	Tseng et al. (2013), Orji and Wei (2015), Blok et al. (2015), Chkanikova and Mont (2015)
Financial constraints	Providing insufficient budgetary allocation for investment in sustainable operations	Blok et al. (2015), Dubey et al. (2016), Mangla et al. (2015), Lukman et al. (2016), Orji and Wei (2016)
Inefficient technology	Technological tools to adopt sustainable operations are inefficient	Lorek and Spangenberg (2014), Luthra et al. (2016), Mangla et al. (2015)
Inefficient legal framework	There is lack of effective legislation to ensure promulgated government laws on sustainability are enforced	Almeida et al. (2015), Tseng et al. (2013), Lorek and Spangenberg (2014), Blok et al. (2015), Mueller (2017)
Lack of awareness amongst stakeholders	Stakeholders are not aware of benefits of implementing sustainability	Blok et al. (2015), Mangla et al. (2015), Luthra et al. (2016), Al-Marri et al. (2018)
Preferences of suppliers/ institutional buyers	Suppliers/ institutional buyers may have preferences which are not sustainable	Bai et al. (2016a,b), Al-Marri et al. (2018), Hemmert et al. (2016), Soundararajan and Brammer (2018)
Insufficient environmental competencies	Workers not sufficiently trained on environmental issues are incompetent	Amin and Zhang (2012), Prakash and Barua (2015), Mangla et al. (2015)
Lack of sustainable waste management	Appropriate waste management practices to actualized sustainability objectives are not readily available	Tan et al. (2016), Faham et al. (2017), Kavilal et al. (2017)
Inadequate proactive plans	Proactive plans to ensure sustainable development are inadequate and not adhered to	Parent et al. (2013), Schroeder (2014), Orji and Wei. (2015), Adnan et al. (2017)
Wide communication gap	There is lack of effective information flow amongst stakeholders on sustainability issues	Sharma and Rani (2014), Guo et al. (2017), Cherry and Pidgeon (2018), Smol et al. (2018), Wang et al. (2018)
Lack of worker's training on sustainable operations	Workers are not adequately trained to adopt sustainable operations	Orji and Wei (2015), Luthra et al. (2016), Adnan et al. (2017)
Lack of employee welfare package	Employee welfare package and remuneration is not attractive to boost productivity on sustainable issues	Dubey et al. (2016), Luthra et al. (2016), Adnan et al. (2017), Hoeksma et al. (2017)

Table 6
Structural self- interaction matrix for barriers to organizational change for sustainability.

	Barriers to organizational change	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	B_{10}	B_{11}	B_{12}
B_1	Inefficient technology	–	P	O	W	P	P	P	O	W	W	W	O
B_2	Insufficient commitment of top management		–	X	O	P	P	P	O	P	W	W	O
B_3	Financial constraints			–	P	P	P	O	O	W	O	W	O
B_4	Wide communication gap				–	P	P	P	P	X	W	W	W
B_5	Inadequate proactive plans					–	X	P	P	X	W	W	O
B_6	Lack of worker's training						–	P	O	X	W	W	O
B_7	Inefficient legal framework							–	P	P	W	W	O
B_8	Lack of awareness amongst stakeholders								–	O	O	W	W
B_9	Preferences of suppliers/ institutional buyers									–	W	W	O
B_{10}	Insufficient environmental competencies										–	W	O
B_{11}	Lack of sustainable waste management											–	O
B_{12}	Lack of employee welfare package												–

weak dependence power and are regarded as the key variables. Thus, in this study, the key barriers to organizational change for sustainability are 'Inadequate proactive plans', 'Lack of sustainable waste management', 'Inefficient legal framework' and 'Preferences of suppliers/ institutional buyers'.

Step 6: Experts helped to analyze the direct influence of each drivers of sustainable performance on the key barriers to organizational change for sustainability based on linguistic scores. Ten initial 8 × 4 comparison matrices were formulated based on the linguistic scale ratings. Table 10 shows the decision matrix of the influence scores of the drivers which support sustainable performance for one of the experts.

Step 7: The influence scores of the drivers which support sustainable performance on the barriers of organizational change for sustainability were determined based on the feedback of the expert panel in this study. Eq. (1) was then applied to normalize the determined influence scores of the drivers which support sustainable performance with regards to the key barriers of organizational change for sustainability in the metal industry. Table 11 shows the normalized influence scores decision matrix.

Step 8: Using Eqs. (2)–(5) and data on Table 11, the weighted normalized decision matrix was calculated and depicted in Table 12.

Step 9: The positive and negative separation measures of drivers of sustainable performance were determined using Eqs. (6) and (7). Then, the ideal solutions were computed using Eqs. (8) and (9). The ideal solutions were applied to Eq. (10) to calculate the relative closeness to ideal solutions of the drivers of sustainable performance L_i.

According to the results on Table 14, the ranking of the drivers which support sustainable performance is as follows: $S_2 > S_1 > S_4 > S_3 > S_5 > S_8 > S_7 > S_6$. The highest ranked driver which support sustainable performance is 'Enforce government regulations and effective legislation'. However, a threshold value of the L_i scores on Table 13 was computed to be 0.589 by dividing the sum of the L_i scores by the total number of drivers of sustainable performance. The most influential drivers which support performance have L_i scores above the threshold value. Thus, the influential drivers which support sustainable performance in the metal manufacturing industry are 'Enforce government regulations and effective legislation', 'Integrating sustainability objectives in proactive plans' and 'Promote public awareness of sustainable products'.

4.2. Sensitivity analysis of TOPIS process

To ensure feasibility and robustness of the TOPSIS process and its results to the utmost extent as possible, sensitivity analysis can be performed by changing criteria weights (Han and Trimi, 2018). In this study, 4 scenarios were conducted to evaluate the ranking of the drivers which support sustainable performance by varying the weight of the barriers to organizational change for sustainability. As shown in Table 15 the weight of a barrier to organizational change for sustainability is varied while keeping the weight of the other barriers in each scenario. As shown in Table 15, in Sc_1 (Scenario 1), the barrier 'Inefficient legal framework' is regarded as having highest influence while the weight of other barriers remains constant. Also shown in Table 15, in Sc_2 (Scenario 2), the weight of the barrier 'Lack of sustainable waste management' is varied while the weight of other barriers remains constant; in Sc_3 (Scenario 3), the weight of the driver 'Inadequate proactive plans' is varied while the weight of other barriers remains constant; in Sc_4 (Scenario 4), the weight of the barrier 'Preferences of suppliers/ institutional buyers' is varied while the weight of the other barriers remains constant.

The results of the sensitivity analysis are further illustrated by the variation in the ranking of drivers which support sustainable performance shown in Fig. 4.

According to the sensitivity results depicted in Fig. 4, the ranking of the drivers which support sustainable performance changed a bit with variations in weights of barriers to organizational change for sustainability. The sensitivity results show that 'Enforce government

Table 7
Initial reachability matrix for the barriers to organizational change for sustainability.

	Barriers to organizational change	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	B_{10}	B_{11}	B_{12}
B_1	Inefficient technology	1	0	0	1	0	0	0	0	1	1	1	0
B_2	Insufficient commitment of top management	1	1	1	0	0	0	0	0	0	1	1	0
B_3	Financial constraints	0	1	1	0	0	0	0	0	1	0	1	0
B_4	Wide communication gap	0	0	1	1	0	0	0	0	1	1	1	1
B_5	Inadequate proactive plans	1	1	1	1	1	1	0	0	1	1	1	0
B_6	Lack of worker's training	1	1	1	1	1	1	0	0	1	1	1	0
B_7	Inefficient legal framework	1	1	0	1	1	1	1	0	0	1	1	0
B_8	Lack of awareness amongst stakeholders	0	0	0	1	1	0	1	1	0	0	1	1
B_9	Preferences of suppliers/ institutional buyers	0	1	0	1	1	1	1	1	1	1	1	0
B_{10}	Insufficient environmental competencies	0	0	1	0	0	0	0	0	0	1	1	0
B_{11}	Lack of sustainable waste management	0	0	0	0	0	0	0	0	0	0	1	0
B_{12}	Lack of employee welfare package	0	0	0	0	0	0	0	0	0	0	0	1

Table 8
Final reachability matrix for the barriers to organizational change for sustainability.

	Barriers to organizational change	B_1	B_2	B_3	B_4	B_5	B_6	B_7	B_8	B_9	B_{10}	B_{11}	B_{12}	Driving power
B_1	Inefficient technology	1	1	1	1	1	0	0	0	1	1	1	1	9
B_2	Insufficient commitment of top management	1	1	1	1	0	0	0	0	1	1	1	1	8
B_3	Financial constraints	0	1	1	1	1	1	1	1	1	1	1	0	10
B_4	Wide communication gap	0	1	1	1	1	0	0	0	1	1	1	1	8
B_5	Inadequate proactive plans	1	1	1	1	1	1	0	0	1	1	1	1	10
B_6	Lack of worker's training	1	1	1	1	1	1	1	1	1	1	1	1	12
B_7	Inefficient legal framework	1	1	1	1	1	1	1	0	1	1	1	1	11
B_8	Lack of awareness amongst stakeholders	1	1	1	1	1	1	1	1	1	1	1	1	12
B_9	Preferences of suppliers/ institutional buyers	1	1	1	1	1	1	1	1	1	1	1	1	12
B_{10}	Insufficient environmental competencies	0	1	1	0	0	0	0	0	1	1	1	0	5
B_{11}	Lack of sustainable waste management	0	0	1	1	0	0	0	0	0	1	1	0	4
B_{12}	Lack of employee welfare package	0	0	0	0	0	0	0	0	0	0	1	1	2
	Dependence power	7	10	11	10	8	6	5	4	10	12	12	9	

Table 9
Various levels of importance for barriers to organizational change for sustainability.

S/ No.	Levels No.	Barriers to organizational change for sustainability
1	1	Inefficient technology
	1	Financial constraints
	1	Lack of employee welfare package
2	2	Lack of awareness amongst stakeholders
3	3	Insufficient environmental competencies
	3	Wide communication gap
	3	Insufficient commitment of top management
4	4	Lack of worker's training
5	5	Preferences of suppliers/institutional buyers
	5	Inefficient legal framework
	5	Lack of sustainable waste management
	5	Inadequate proactive plans

regulations' ranks the highest in 3 scenarios (Scenario 1–2,4), by 75%. Also, 'Integrating sustainability in proactive plans' ranks second highest in 3 scenarios (Scenario 1–2, 4), by 75%. In addition, 'Promote public awareness of sustainable products' is the third highest ranked in 3 scenarios (Scenario 1–3), by 75% while 'Develop infrastructure support' is the fourth highest ranked in 2 scenarios (Scenario 1,4), by 50%. Hence, the sensitivity analysis shows that the developed TOPSIS process and results are robust and feasible since the influential drivers which support sustainable performance S_2, S_1, S_4 and S_3 are relatively insensitive to the variations in criteria weights.

4.3. Theoretical and practical implications

This study presents some implications and practical insights for decision makers and practitioners to achieve sustainable performance in the metal manufacturing sector. Based on the research findings of this work, it is suggested that the metal manufacturing industry in China comply with 'Enforcing government regulations and effective legislation', 'Integrating sustainability objectives in proactive plans' and 'Promote public awareness of sustainable products' to overcome key barriers and support sustainable performance. This research finding complement literature (He et al., 2016) suggesting that enforcing government regulations have a significant positive driving effect on implementing sustainable practices in the metal manufacturing industry. There is high prevalence of non- compliance to corporate social responsibility in the metal manufacturing sector thus necessitating enforcing government laws which support organizational change for sustainability (Keskin et al., 2010). Sustainable policies are gaining attention in metal manufacturing firms due to government regulations and perceived organizational competitiveness (Mangla et al., 2015).

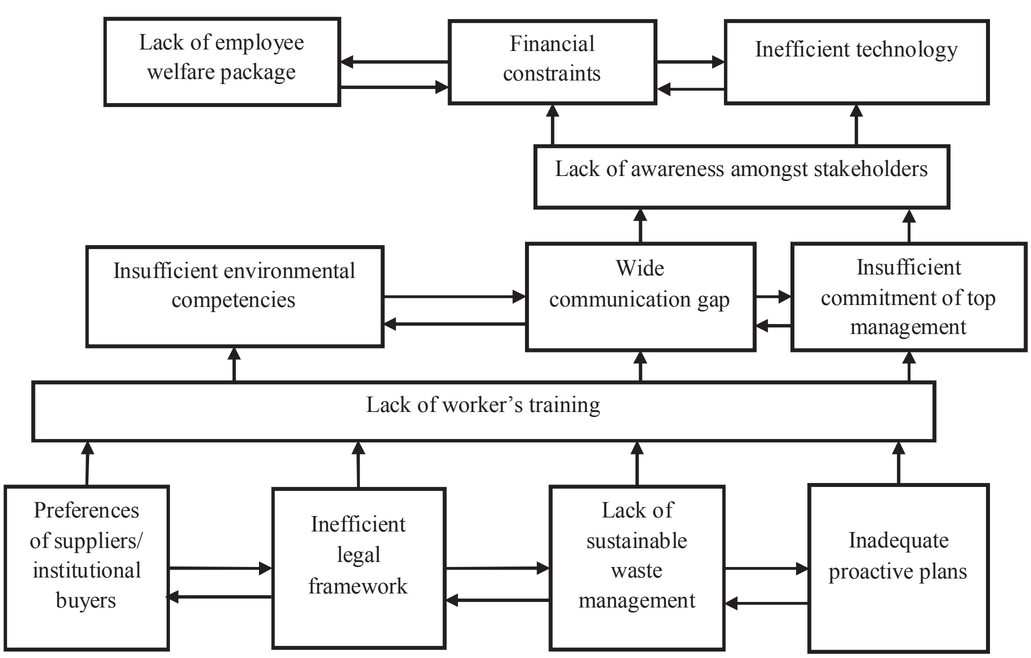

Fig. 2. ISM model of barriers to change for sustainability in the metal manufacturing industry.

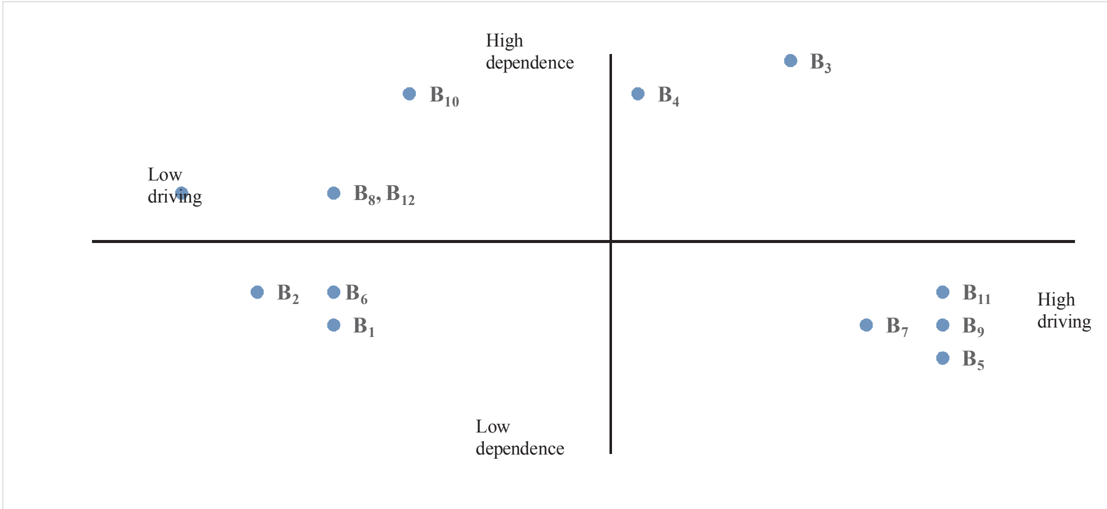

Fig. 3. Driving and dependence power diagram for barriers to organizational change for sustainability.

Some of the research findings are in line with Mueller (2017) regarding the shortage of proactive plans and policies to implement organizational change for sustainability. The metal manufacturing sector requires a lot of policy reforms to effectively implement sustainable initiatives in their organizational operations (Luthra et al., 2016). Sustainable initiatives are strategic decisions that require appropriate inclusion during organization's proactive planning which can support organizational change for sustainability through encouraging competency and reliability.

Contrary to Luthra et al. (2016), our results indicate that providing sufficient budget is not highly influential to support organizational change for sustainability. This might be because of government financial subsidies to encourage the manufacturing sector to reduce environmental pollution (Yuyin and Jinxi, 2018). Additionally, this study contradicts Prakash and Barua (2015) in that it does not consider lack of commitment of top management as being a key barrier to organizational change for sustainability in the metal manufacturing industry. A plausible explanation could be because operations to achieve sustainability objectives are implemented in the tactical and operational levels of the metal manufacturing industry in China without much support from top management. Moreover, this study corroborates literature which encourages the development of infrastructure support and facility to implement organizational change for sustainability (Kaushik et al., 2014; Blok et al., 2015). Developing infrastructure support and facility can encourage diversity, reliability and knowledge sharing to aid organizational change for sustainability. This research also complements studies which infer that the concept of sustainable product promotion can positively influence customers' attitude through reducing their reluctance towards sustainable products (Adnan et al., 2017). Promoting public awareness of sustainable products is essential to ensure implementation of organizational change for sustainability in the metal manufacturing industry. The reality is that sustainable performance will be achieved with effective awareness of sustainability. The consumers should be educated on the long- term benefits of buying sustainable products and adopting sustainable consumption patterns. There is crucial need to develop an organized approach to promote sustainable products in the society (Lorek and Spangenberg, 2014).

Furthermore, this study complements other published studies (Hamalainen et al., 2018; Moktadir et al., 2018a,b; Neri et al., 2018; Shao et al., 2018; Thomas-Seale et al., 2018) which evaluate barriers and drivers of organizational change for sustainability in the manufacturing sector. However, the approach and context in this study differ from published works because of its application of ISM- TOPSIS to analyze the barriers to change for sustainability and drivers which support sustainable performance in the metal manufacturing industry in China. This study evidences the high influence of 'Enforcing government regulations', Integrating sustainability in proactive plans', 'Promoting sustainable products' and 'Developing infrastructure support' on overcoming the key barriers to organizational change for sustainability in the metal manufacturing sector. The influential drivers

Table 10
Decision matrix of influence scores for an expert.

Drivers which support sustainable performance	Barriers to organizational change for sustainability			
	Inefficient legal framework (B_1)	Lack of sustainable waste management (B_2)	Inadequate proactive plans (B_3)	Preferences of suppliers/ institutional buyers (B_4)
Integrating sustainability in proactive plans (S_1)	1	5	5	4
Enforce government regulations and effective legislation (S_2)	5	5	5	5
Develop infrastructure support and facility for sustainability (S_3)	2	3	3	2
Promote public awareness of sustainability products (S_4)	3	4	4	5
Access to efficient technology for sustainability (S_5)	2	5	4	4
Implement sustainable waste management (S_6)	2	5	5	4
Sufficient budget (S_7)	2	4	2	2
Ensure environmental competencies (S_8)	1	3	2	3

Table 11
Normalized decision matrix of influence scores for all the experts.

Drivers which support sustainable performance	Barriers to organizational change for sustainability			
	Inefficient legal framework (B_1)	Lack of sustainable waste management (B_2)	Inadequate proactive plans (B_3)	Preferences of suppliers/ institutional buyers (B_4)
Integrating sustainability in proactive plans (S_1)	0.937	0.915	0.569	0.882
Enforce government regulations and effective legislation (S_2)	0.807	0.851	0.909	0.905
Develop infrastructure support and facility for sustainability (S_3)	0.91	0.932	0.671	0.942
Promote public awareness of sustainability products (S_4)	0.749	0.88	0.378	0.854
Access to efficient technology for sustainability (S_5)	0.807	0.288	0.418	0.243
Implement sustainable waste management (S_6)	0.671	0.312	0.685	0.352
Sufficient budget (S_7)	0.409	0.346	0.634	0.432
Ensure environmental competencies (S_8)	0.703	0.308	0.829	0.548

Table 12
Weighted normalized decision matrix of influence scores for all the experts.

Drivers which support sustainable performance	Barriers to organizational change for sustainability			
	Inefficient legal framework (B_1)	Lack of sustainable waste management (B_2)	Inadequate proactive plans (B_3)	Preferences of suppliers/ institutional buyers (B_4)
Integrating sustainability in proactive plans (S_1)	0.0277	0.0241	0.0166	0.0188
Enforce government regulations and effective legislation (S_2)	0.0329	0.0164	0.0014	0.006
Develop infrastructure support and facility for sustainability (S_3)	0.0383	0.0089	0.0061	0.015
Promote public awareness of sustainability products (S_4)	0.0274	0.011	0.0286	0.0086
Access to efficient technology for sustainability (S_5)	0.0353	0.0307	0.0016	0.0138
Implement sustainable waste management (S_6)	0.0114	0.0099	0.0029	0.0021
Sufficient budget (S_7)	0.0139	0.0121	0.0023	0.0027
Ensure environmental competencies (S_8)	0.0283	0.0429	0.0034	0.0335

Table 13
Positive and negative separation measures of the drivers of sustainable performance.

	S_1	S_2	S_3	S_4	S_5	S_6	S_7	S_8
V^+	0.0383	0.0429	0.0286	0.0335	0.026	0.0346	0.0359	0.0432
V^-	0.0033	0.0044	0.0014	0.0021	0.0024	0.0022	0.0028	0.0027

which support sustainable performance can remove the key barriers to organizational change for sustainability which lead to the removal of maximum number of the barriers to organizational change for sustainability in the metal manufacturing industry in China. Hence, this study will encourage managers to comply with the influential drivers to support sustainable performance to remove the key barriers to organizational change for sustainability and increase competitive advantage. The developed modeling framework in this study can be applied in any metal manufacturing firm to evaluate the key barriers and drivers of organizational change for sustainability.

5. Conclusion

In this research study, an attempt has been made to identify and analyze the barriers to organizational change for sustainability and drivers which support sustainable performance in the metal manufacturing industry in China using the ISM- TOPSIS modeling framework. Twelve barriers to organizational change for sustainability in the metal manufacturing industry in China have been identified and interpretive structural modeling (ISM) methodology has been used for finding contextual relationships among them. Inefficient legal framework, inadequate proactive plans, lack of sustainable waste

Table 14
Relative proximity to ideal solutions of drivers of sustainable performance.

Drivers which support sustainable performance	d_i^+	d_i^-	$d_i^+ + d_i^-$	L_i	Priority ranking
Integrating sustainability in proactive plans (S_1)	0.0631	0.211	0.2741	0.769	2
Enforce government regulations and effective legislation (S_2)	0.0623	0.212	0.2743	0.772	1
Develop infrastructure support and facility for sustainability (S_3)	0.0612	0.726	0.1338	0.542	4
Promote public awareness of sustainability products (S_4)	0.0859	0.16	0.2459	0.650	3
Access to efficient technology for sustainability (S_5)	0.0764	0.0891	0.1655	0.538	5
Implement sustainable waste management (S_6)	0.0921	0.0731	0.1652	0.442	8
Sufficient budget (S_7)	0.0811	0.0741	0.1552	0.477	7
Ensure environmental competencies (S_8)	0.0854	0.0936	0.179	0.522	6

Table 15
Sensitivity analysis scenarios for TOPSIS process.

Drivers which support sustainable performance	Changes in L_i values for the drivers which support sustainable performance as weight of each barrier to organizational change for sustainability varies while other barriers remain constant in different scenarios			
	SC_1	SC_2	SC_3	SC_4
S_1 (Integrating sustainability in proactive plans)	0.769	0.723	0.711	0.671
S_2 (Enforce government regulations and effective legislation)	0.772	0.741	0.705	0.689
S_3 (Develop infrastructure support and facility for sustainability)	0.542	0.507	0.571	0.385
S_4 (Promote public awareness of sustainable products)	0.650	0.560	0.586	0.431
S_5 (Access to efficient technology for sustainability)	0.538	0.512	0.485	0.472
S_6 (Implement sustainable waste management)	0.442	0.359	0.412	0.379
S_7 (Sufficient budget)	0.477	0.367	0.475	0.344
B_8 (Ensure environmental competencies)	0.522	0.432	0.321	0.557

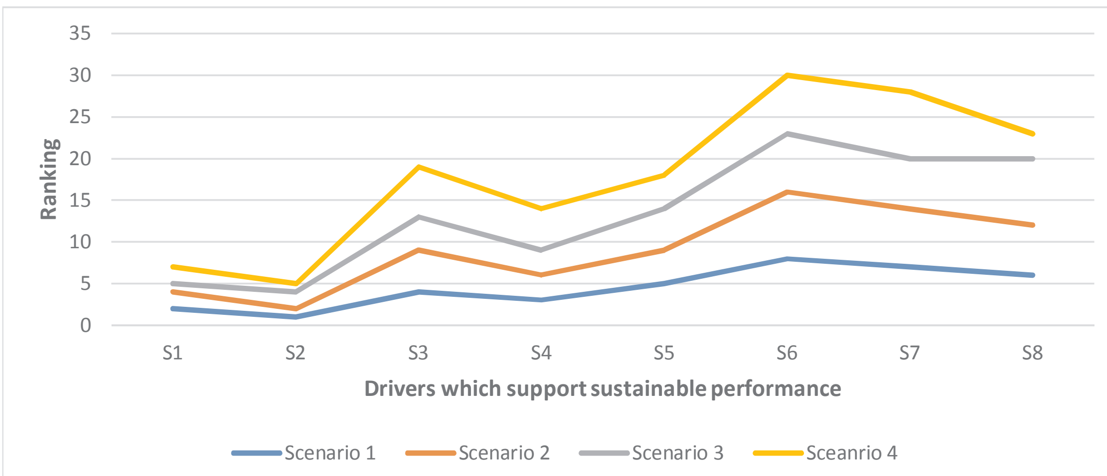

Fig. 4. Result of sensitivity analysis (ranking).

management and preferences of suppliers/ institutional buyers are coming at the bottom of the structural model while financial constraints, inefficient technology and lack of employee welfare package are coming at the top of the structural model. The barriers to organizational change for sustainability which are coming at the bottom level of ISM model are also the key barriers. This means that they are the highly powerful barriers and removal of the barriers will remove maximum of the other barriers. In addition, eight drivers which support sustainable performance has been identified and TOPSIS has been used to study their influence on the key barriers to organizational change for sustainability, thereby prioritizing the drivers. Enforcing government regulations, integrating sustainability in proactive plans, promoting sustainable products and developing infrastructure support and facility for sustainability were found to be the most influential drivers which support sustainable performance. The highly influential drivers which support sustainable performance can overcome the key barriers to organizational change for sustainability, thus removing maximum of the other barriers.

The hypothetical modeling framework of the barriers to organizational change for sustainability and drivers of in the metal manufacturing industry in China developed in this study may be tested in other manufacturing firms in an industrialized or even another developing country. There is also possibility to identify additional barriers to organizational change for sustainability and drivers which support sustainable performance. In the current research, 12 barriers to organizational change for sustainability and 8 drivers which support sustainable performance, but in the future, more barriers to organizational change for sustainability and drivers which support sustainable performance may emerge.

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