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Evaluating pressures for green supply chain management adoption by grey theory approach

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A B S T R A C T

Green supply chain management (GSCM) has become an emerging concept among the environmental management topics during the last few years. There are some pressures that push industries to adopt GSCM like: governmental regulations, tough market competition for green image, pressure from Non-governmental organizations, media pressures and other pressures for environmental actions. These pressures can be more considerable for special industries like mining and mineral industries, because of their activities which can cause more damages to environment. As it is not possible to respond to all of the pressures at the same time, identifying and ranking the most important pressures can be very useful for managers' decisions. This study aims to identify and evaluate the pressures for GSCM adopting according to Iranian mining experts' opinions by using grey methodology.

1. Introduction

Green supply Chain Management (GSCM) encompasses all phases of product's life cycle from design to end and its disposal at the end of product's life cycle (Luthra et al., 2011). Due to increased awareness of environmental concerns on sustainability, organizations have to reinforce the green image of their own companies (Tseng et al., 2012; Lin, 2013). GSCM and Sustainable Supply Chain Management (SSCM) concepts ensure that environmental activities are applied by all departments in the industry (Govindan et al., 2015; Mathiyazhagan et al., 2015). By applying reverse logistics practices, industries can efficiently use the resources and prevent from pollution (Prakash & Barua, 2015). Because of great advantages, GSCM and SSCM concepts have attracted attention among practitioners and researchers in recent years (e.g. Muduli et al., 2013a; Abdallah et al., 2013; Xu et al., 2013).

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There are some pressures like: governmental regulations, nongovernmental organizations pressures, customers' demands, tough market competition for a green image, media, etc. regarding to environmental concepts (Jia et al., 2014; Mathiyazhagan et al., 2013). Transition from traditional supply chain management to GSCM is influenced by many factors, known as pressures, and industries are adopting GSCM practices based on these indirect motivations (pressures) from different directions (Mathiyazhagan et al., 2014). Different industries have different opinions about pressures for GSCM adoption (Zhu & Sarkis, 2006). Facing with these pressures for some industries would be more highlighted (Muduli et al., 2013b; Jia et al., 2014; Govindan et al., 2014; Sivakumar et al., 2014; Mathiyazhagan et al., 2015). Mining and mineral industries face pressures and challenges to adopt GSCM practices due to nature of their work (Mathiyazhagan et al., 2014; Mathiyazhagan et al., 2013; Zhu et al., 2007; Mathiyazhagan et al., 2015).

Past literature have been performed mostly in the aspects like: GSCM barriers (Mudgal et al., 2010; Luthra et al., 2011) and GSCM drivers (Zhu & Sarkis., 2006; Walker et al., 2008; Bhool & Narwal, 2013; Govindan et al., 2014); and there are fewer works regarding to GSCM pressures (Wu et al., 2012; Mathiyazhagan et al., 2013). Mathiyazhagan et al. (2014) carried out a benchmark study to rank pressures for GSCM adoption in Indian industries with help of MCDM approaches. They considered 65 pressures for GSCM adoption under six categories and concluded that global competiveness (GC) and market competiveness had the most pressures for Indian industries. One of the existed works about GSCM pressures in mining and mineral context was accomplished by Mathiyazhagan et al. (2015), which considered fifteen pressures under four categories from Indian mining and mineral industries view. By using analytical hierarchy process (AHP), the first rank obtained for the Pressure from Non-governmental organizations (NGOs) and also, their results showed that external source category had a key role in the pressure category. This area still needs more extension in the number of pressures perceived in various countries, so in this paper, above two mentioned studies are used and extended in an Iranian context for the adoption of GSCM and to rank the pressures based on experts' opinion through Grey theory approach. Decorative stone mines in Fars province of Iran were selected for a case study, because Fars province, is ranked first in extraction of marble in Iran but it needs more attention to environmental issues for better controlling the target markets and better facing with competitors and creating a good green image in society, also their experts are interested in getting environmental certifications.

The remainder of the paper is structured as follows: The next section presents a review of the related literature. A case study for research in the mining and mineral industry of Iran and problem description is explained in section 3. The solution methodology and grey systems theory is presented in section 4. Section 5 considers the suggested approach. Finally, section 6 summarizes the obtained conclusions through Grey theory approach and would be discussed in detail. The final section summarizes conclusions and future scope of study.

2. Literature review

Because of consumer and government's concern about environment, producers make more attention to the concept of GSCM and supplying more energy efficient products (Rao & Holt, 2005; Jen Lin et al., 2011). Zhu et al. (2008) found significant positive relationships between organizational learning mechanisms and the adoption of GSCM practices, but they controlled a number of other influences including regulations, marketing, etc. Porter and Van der Linde (1995), Seuring (2004), Zhu and Sarkis (2006); Chien and Shih (2007), Seuring and Müller (2008) and Wang et al. (2012) respectively concluded that competitive and regulatory pressures, external stakeholders and domestic regulations, corporations' environmental missions and pressure from consumers and Non-governmental organizations (NGOs) are important sources of pressures for improving environmental activities. Chien and Shih (2007) declared that a customer demand is the most important type of external pressure. The pressure from globalization is more important than the pressure from localization (Sarkis &

Tamarkin 2005; Chien & Shih 2007). Chien and Shih (2007) declared that organizations would affect to adopt GSCM practices because of regulatory pressures which according to Darnall et al. (2008), are from penalties and fines of not using GSCM practices and required to expose information publicly on toxic chemical releases. Chan et al. (2013) claimed that this might have forced Chinese firms to implement GSCM. Muduli et al. (2013a) evaluated behavioral variables role in the adoption of GSCM. In the following section we will discuss some of studies about GSCM drivers, practices and barriers which are done in different Iranian industries:

Shekari et al. (2011) in alloy steel industry of Iran and Khaksar et al. (2015) in petrochemical industry, Pishdar et al. (2014) in Saipa Automotive Manufacturing Group and Rajabzadeh Ghatari, Hosseini, and Shekari, (2012) in Cable Industry, Fallahian-Najafabadi et al. (2013) and RostamiFard et al. (2014) in Tile industry, determined important GSCM drivers as: internal environmental management, environmental regulations, green purchasing, cleaner production, recovery, eco-design and pollution, reverse logistic, green supplier, cooperation with customers, return on investment (Return Investment) and green innovation. Hashemi Petrudi et al. (2014) in Iranian Gas Engineering and Development Company and Hashemzadeh et al. (2014) in rail industry resulted that; external drivers as ‘governmental regulations’ and ‘pressures from stakeholders’ are the most influencing factors to implement sustainable practices. Chaghooshi and Zereshki (2014), Mohammadjafari et al. (2014) and Abbasnejad et al. (2015) analyzed barriers for the implementation of GSCM by using different techniques ISM and AHP. Mehregan et al. (2014) found that external drivers as ‘governmental regulations’ and ‘pressures from stakeholders’ are the most influencing factors to drive suppliers to implement sustainable practices in the supply chain of Iranian Gas Engineering. Miremadi et al. (2013) examined various types of GSCM drivers by factor analysis and showed that green purchasing, cleaner production, reverse logistic and some other items are important GSCM drivers in Iran Alloy Steel Co and also AHP and grey relational analysis (GRA) was used to find the best green supplier according to GSCM. Kahanaali et al. (2015) showed that green procurement is important GSCM driver in cement factories of Fars province in Iran. Oroumieh (2015) applied fuzzy inference system for evaluating and assessing the supply chain risk of the Iranian mining industry and showed that the proposed model had a high accuracy for assessing the risk of mining industry.

3. Problem description

Recent literatures found that still lack of researchers’ studies on pressures for GSCM adoption and implementation based on Iranian context. Although creating waste in minerals industry is inevitable but it can be controllable (Mozaffari, 2013), some companies have issued standards that control the use of certain materials like toxic chemicals or that prescribes product design parameters such as recyclability. These standards generally are enforced through the procurement process (Lipmann, 1999). Iran is one of the most important mineral producers in the world ranked among 15 major mineral-rich countries and holds about 68 types of Minerals and more than 57 billion tons of potential reserves that worth $770 billion in 2014. The most important mines in Iran include coal, metallic minerals, sand and gravel, chemical minerals and salt.

Iran is among the five top producers of decorative stones. One of the benefits of Iran Stone Industry is the diversity of its mines. While in other producing countries such as Brazil and India there is Granite quarry and in Italy there are marble quarry, in Iran there are rich reserves of various Mining of decorative stones such as granite, Mrmyt, porcelain and crystal and travertine marble, with high color variation. Mozaffari (2013) collected mine managers’ point of view about current mine waste management in Iran and found that legislations and policies about good practice minerals have priority in managing mining waste. It is declared by Blight (2011) that the damaging effect of mining to the environment is partly because of tailings generated in mines, which could be toxic. Although, as some mining residues left in stone mines are dry, usually create less pollution. The waste remaining from stone mining also includes some considerable percent of mineral extracted.

Table 1
Pressures for the adoption of GSCM from literature

Sl. no.	Pressures	Sources
Government Policies and Regulations (GPR)		
1	Central governmental environmental regulations (GPR1)	Zhu and Sarkis (2006), Wu et al. (2012)
2	Regional environmental regulations (GPR2)	Wu et al. (2012), Darnall et al. (2008), Zhu and Sarkis (2006), Zutshi and Sohal (2004), Zhu et al. (2008), Al Khidir and Zailani (2009), Huang et al. (2012)
3	Emission standards, regulations for waste of Electronic equipment and restriction of hazardous substances (GPR3)	Sundarakani et al. (2010), Ninlawan et al. (2010); diabat et al. (2014), Boni et al.,(2015)
4	Environmental regulations for export countries (GPR4)	Jia et al. (2014)
5	High penalty for environmental pollution (GPR5)	Abdallah et al. (2013)
6	Establishing environmental standards and regulations for green purchasing items and materials (Machinery and equipment through the procurement process.) (GPR6)	Lamming and Hampson (1996), Lippmann (1999), US-AEP (1999), Evans and Johnson (2005); Hsu and Hu (2008); Pishdar et al.(2014)
Global Competitiveness (GC)		
7	Competitors' green environmental protection strategy (GC1)	Wu et al. (2012)
8	WTO entry (GC2)	Wu et al. (2012), Kumar et al. (2012)
9	Fierce industrial competitiveness (GC3)	Van Hemel and Cramer (2002), Wu et al. (2012), Darnall et al. (2008), Zhu and Sarkis (2006), Zutshi and Sohal (2004)
10	New market opportunities (GC4)	Van Hemel and Cramer (2002)
11	Competitive advantage on adoption of green strategies(GC5)	Zutshi and Sohal (2004); Orougi, S. (2015)
External Factors (EF)		
12	Foreign direct investment (FDI) interest in green products (EF1)	Jia et al. (2014); Zhu and Sarkis (2006), Zhu and Geng (2001), Huang et al. (2012)
13	Customers' demand (EF2)	Mudgal et al. (2010), Al Khidir and Zailani (2009), Wu et al. (2012); Huang et al. (2012)
14	Establishing the company's green image (EF3)	Zhu et al. (2007); Hsu and Hu (2008);Luthra et al. (2015)
15	Pressure from Non-governmental organizations (NGOs) for environmentally friendly products (EF4)	Jia et al. (2014); Narulaa and Groverc (2015)
16	Negative media attention by environmental action groups (EF5)	Van Hemel and Cramer (2002); Huang et al., 2015
17	Social responsibility (Community pressure) (EF6)	Al Khidir and Zailani (2009), Lee and Kim (2009)
18	Globalization and international sourcing pressure (EF7)	Zhu, Sarkis, and Lai (2008)
19	Organisational resources and cultural factors (EF8)	Banerjee et al. (2003)
20	Environmental audits (EF9)	Zhu and Sarkis (2006); Lamming and Hampson (1996), Hu and Hsu (2010)
Financial Factors (FF)		
21	Increasing scarcity of resources (FF1)	Mudgal et al. (2010); Luthra et al., 2011; Mathiyazhagan et al. (2014)
22	Special tax exemption for ISO 14001 certified firms (FF2)	Elefsiniotis and Wareham (2005); Mathiyazhagan et al. (2013)
23	Cost for disposal of hazardous materials (FF3)	Zhu and Sarkis (2006); Shahrouzifard and Faraji (2016)
24	Carbon tax forcing fuel cost reduction (FF4)	Govindan et al. (2014)
25	Increasing expected business benefits (FF5)	Al Khidir and Zailani (2009)
26	Long-term profits associated with the adoption of 'green' strategies (FF6)	Green et al. (1998)
27	Pressure from new economic, energy saving (FF7)	Al Khidir and Zailani (2009)
Production and Operational Factors (POF)		
28	Focus on source reduction to reduce waste (POF1)	Kumar et al. (2012)
29	Integration with green product suppliers (POF2)	Vachon and Klassen (2006)
30	organizational knowledge on waste reduction and recycling and backfilling processes (knowledge pressure) (POF3)	Banerjee (2002); Mozaffari (2013),
Internal Factors (Internal sourcing pressure) (IF)		
31	Employee pressures (IF1)	Al Khidir and Zailani (2009)
32	Top management and senior managers pressures (IF2)	Luthra et al., 2015; Green et al. (1998); Lippmann (1999); Zargar, (2016)
33	E-logistics and green-procurement (IF3)	Sarkis (2003); Kahanaali et al. (2015)
34	Company's environmental mission (IF4)	Lee (2008)
35	Stakeholder pressures (IF5)	Banerjee et al. (2003); Hashemi Petrudi et al. (2014)

Table 1 summarizes the 35 pressures for GSCM adoption, extracted from the literature review and practitioners' opinion from the mining and mineral industry and is an extension for the work of

Mathiyazhagan et al. (2015) which had studied 15 pressures under five categories. Around 40 items were extracted from wide literature reviews and discussing with mining experts, but at last by help of mining experts and academics, these pressures were shortlisted to 35 items under six categories: Government Policies and Regulations, Global Competitiveness, External Factors, Financial Factors, production and operational factors and at last Internal Factors (Internal sourcing pressure). One new category named Internal factors and 20 pressures are added in this study.

4. Solution methodology

Grey system theory for the first time was introduced by Deng in 1982 and then it was extended by other researchers (Liu et al., 2004). According to Deng, this multidisciplinary and generic theory deals with systems characterized by vague information or lack of certainty (Deng, 1988). It is said that black expresses complete unknown information and white expresses the quite clear one, so the gray can describe something go between, thus, the system which include gray information is called gray system (Kamfiroozi & Naeini, 2012). The advantage of grey numbers over fuzzy numbers is stated its flexibility in terms of the condition of fuzziness (Deng, 1989).

Deng (1988) developed a "grey ordering model" and used some mathematical characteristics for making "grey hierarchical decisions" and by using grey pairwise comparison matrix. Chen (2000) developed the grey AHP based on some arithmetic discussions of the preference intervals. Preferences stated as intervals can be called grey judgments by adopting the definition of grey numbers (Deng, 1989). Lee (2002) developed the extended AHP with grey judgments, referred to as the "grey AHP" and concluded that grey AHP is more simply for implementation and more effective in resolving problems with vagueness and is superior to other AHP extensions.

According to Liu et al. (2004), the exact value of grey number is unknown but its range within which the value lies is known. The three types of grey number according to (Rahimnia et al., 2011) are as follows:

(1) Grey numbers with only lower limits but not upper limits:

$$\otimes G \in \left[\underline{a}, \infty\right) \rightarrow \otimes G(\underline{a}), \tag{1}$$

where, $\underline{a}$ as a fixed real value, is the lower limit of the grey number $\otimes G$.

(2) Grey numbers with only upper limits but not lower limits:

$$\otimes G \in \left[-\infty, \overline{a}\right) \rightarrow \otimes G(\overline{a}), \tag{2}$$

where $\overline{a}$, as a fixed real value, is the upper limit of the grey number $\otimes G$. One example of the grey number with upper limit is the maximum amount of the annual budget for a company.

(3) Interval grey numbers:

$$\otimes G \in \left[\underline{a}, \overline{a}\right], \tag{3}$$

where $\underline{a}$ and $\overline{a}$ represent the lower and upper limits of the interval grey number, respectively. Suppose that X is a reference set, then grey set of G, would be defined as below :

$$\overline{\mu}_G(x) : x \rightarrow [0,1], \ \underline{\mu}_G(x) : x \rightarrow [0,1] \tag{4}$$

It should be noted that $\overline{\mu}_G(x) \geq \underline{\mu}_G(x)$ and in the case of equality, grey set of G would become fuzzy set which indicate coverage of grey theory of fuzzy status and its flexibility in facing with fuzzy problems. The main operations of interval grey numbers are defined as follows: (Lin and Liu, 2007)

If $\otimes G_1 \in [a,b]$, a<b and $\otimes G_2 \in [c,d]$, c<d, then the sum of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 + \otimes G_2 \in [a+c, b+d]. \tag{5}$$

If $\otimes G_1 \in [a,b]$, a<b and $\otimes G_2 \in [c,d]$, c<d, then the difference of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 - \otimes G_2 \in [a-d, b-c]. \tag{6}$$

If $\otimes G_1 \in [a,b]$, a<b and $\otimes G_2 \in [c,d]$, c<d, then the product of $\otimes G_1$ and $\otimes G_2$ is defined as:

$$\otimes G_1 . \otimes G_2 \in [\min\{ac, ad, bc, bd\}, \max\{ac, ad, bc, bd\}]. \tag{7}$$

If $\otimes G_1 \in [a,b]$, a< b and $\otimes G_2 \in [c,d]$, c<d, then the quotient of $\otimes G_1$ divided by $\otimes G_2$ is defined as:

$$\frac{\otimes G_1}{\otimes G_2} \in \left[\min\left\{ \frac{a}{c}, \frac{a}{d}, \frac{b}{c}, \frac{b}{d} \right\} \right], \max\left\{ \frac{a}{c}, \frac{a}{d}, \frac{b}{c}, \frac{b}{d} \right\} \tag{8}$$

or

$$\otimes G_1 \div \otimes G_2 \in [a,b] \times \left[\frac{1}{c}, \frac{1}{d} \right] \tag{9}$$

If k is a positive real number, then the scalar multiplication of k and $\otimes G$ is defined as:

$$k . \otimes G \in [ka, kb] \tag{10}$$

The applied grey method finding weights of pressures from the opinion of mining experts is based on a grey possibility degree which is adopted from Li et al. (2007) for supplier selection problem. As it was stated by Li et al. (2007), this method is suitable for solving the group decision-making problem in an uncertain situation and environment. In this case, $P = \{P_1, P_2, ..., P_n\}$ is a set of 35 pressures for implementing GSCM and $\otimes w = \{\otimes w_1, \otimes w_2, ..., \otimes w_n\}$ is the vector of pressures weights. The pressures weights are considered as linguistic variables which are expressed in grey numbers by the 1-7 scale (Table 2).

Table 2
The scale of pressure weights $\otimes w$

Scale	$\otimes w_j$
Very low (VL)	(0.0,0.1)
Low (L)	(0.1,0.3)
Medium low (ML)	(0.3,0.4)
Medium (M)	(0.4,0.5)
Medium high (MH)	(0.5,0.6)
High (H)	(0.6,0.9)
Very high (VH)	(0.9,1.0)

For the next step, it was asked from the Mining Experts (ME), to identify the pressures weights of GSCM. IF there were k experts, then weight of pressure P_1 can be calculated as:

$$\otimes w_j = \frac{1}{k}\left\{\otimes w_j^1 + \otimes w_j^2 + \ldots + \otimes w_j^k\right\} \tag{11}$$

where $\otimes w_j^k\,(j=1,2,\ldots,n)$, is the pressure weight of *k*th experts and can be described by grey number $\otimes w_j^k\left[a_j^k, b_j^k\right]$. The weighted value of a grey number can be obtained generally through approaches as arithmetic, geometric and harmonic averaging procedures; these averaging approaches are shown as below:

$$\frac{Lij+Uij}{2};arithmetic \qquad \sqrt{Lij\times Uij};geometric \qquad \frac{2LijUij}{Lij+Uij};harmonic \tag{12}$$

According to the latest statistics published from the Ministry of Industries and Mines, there are 1265 decorative stones quarry in Iran, 926 numbers of them are active and 275 numbers of them are inactive and the rest are preparing equipment and the existed statistics of Iranian Mining Engineering Organization (IMEO) shows that there are 598 different mines (active, inactive, under preparing equipment and some of them are closed temporarily) in Fars Province of Iran. (the details are shown in table 3). According to the reports taken from IMEO website, there are 154 mines for Decorative stone which only 116 of them are active.

Clear questionnaires were mailed to 40 active decorative mines of Fars province by available sampling. The respondents were asked to mention an important degree of pressure for the GSCM implementation in their mines by using 1-7 scale linguistic variables (Table 2), 30 mines showed their interest to respond our mail, but at last and after some phone following, 24 valid responses were received, so 24 of 116, shows valid response rate of 20.68%. According to Malhotra and Grover (1998) and also as it was used by Mathiyazhagan et al (2014), a response rate of 20% was good for a positive appraisal of the survey.

Table 3
Statistics extracted from Iranian Mining Engineering Organization (IMEO) about Decorative stone mines

row	Type of mine	Numbers	percentage
1	fireclay	18	3%
2	iron ore	12	2%
3	Lime stone and marl	35	6%
4	sand	65	11%
5	carcass stone	118	20%
6	Industrial soil	9	2%
7	Marble	98	16%
8	Quartz	11	2%
9	gypsum	50	8%
10	Clay	21	4%
11	Others (salt, Chromite, Manganese, …)	161	27%
12	Total	598	100%

5. Application of proposed model

After the initial survey, 40 pressures were identified, where 5 of them in the first steps of research and discuss with Iranian mining practitioners, were rejected or included in other pressures and some of the pressures although could include under other items, but due to the important degree from Academic experts, researchers and practitioners, they were considered as a separate pressures. Finally 35 pressures under 5 categories were shortlisted and then the pressures weights and rank of each of them was calculated based on linguistic data, grey numbers, the verbal statements (linguistic values) of Mining Experts were quantified by using Table 2.

Table 4
Pressures categories weight and rank

Pressure category	$\otimes w_j$	w_j	Rank
GPR	(0.56, 0.72)	0.638	2
GC	(0.53, 0.70)	0.619	3
EF	(0.57, 0.75)	0.659	1
FF	(0.40, 0.58)	0.494	6
POF	(0.47, 0.64)	0.556	5
IF	(0.49, 0.65)	0.576	4

The relevant interval weights by grey numbers and ranks for pressures and their categories are shown in Table 4 and Table 5, by using Eq. (11) and arithmetic averaging of Eq. (12). In Table 5, the global weight of each specific pressure is gained by multiplying the relative weight of the pressure category values with related weights of each specific pressure.

6. Result and discussions

Based on results in Table 4, External Factor (EF) obtained the 1st position of the other five categories. In previous papers, External source pressure category also received high rank. Government Policies and Regulations (GPR) obtained the second position, Global Competitiveness (GC) gained third position, and then Internal Factors (IF) have fourth rank, Production and Operational Factors (POF) & Financial Factors (FF) gained the next & last position among other six categories. In Mathiyazhagan et al (2015) also Financial factor (F) was rated as a less important category among other pressures.

Based on global weight and rank depicted in Table 5 following results could be found. Of the six pressures in Government Policies and Regulations category; central government environmental regulations (GPR1) pressure, obtained the 2nd rank of the thirty five pressures and first position under its category. This pressure gained 8th rank of the fifteen pressures in Mathiyazhagan et al (2015). It can be resulted that central government by its environmental regulations and following their implementation as well, can play a very important role in motivation to adopt GSCM practices in mining industry. As stated by Mathiyazhagan et al (2015), the pressures listed in this category are essential to be responded in order to avoid penalties from norms, regulations and standards.

Marketing and global competitiveness is declared as a good pressure for improving environmental practices (Van Hemel and Cramer 2002; Darnall, Jolley, and Handfield 2008; Wu, Ding, and Chen 2012; Mathiyazhagan et al., 2014). Global Competitiveness category hasn't been considered in Mathiyazhagan et al., (2015) mining study. Competitors' green environmental protection strategy (GC1) and WTO entry (GC2), both obtained equal weights (0.439) and placed in 7th and 8th ranks of thirty five pressures. This equality can be explained due to the huge amount of exports of Iranian mining stones. Natural stones of Iran are recognized worldwide because of best in their quality, variety and color especially in decorative stones as Marble, Travertine which don't find in other regions of the world. It is said that Iran's quarry has the best production capacity in the world. Due to these facts there aren't any preferences in local markets compared to WTO and therefore both of GC1 and GC2 obtained the same weight which is point of accuracy in filling the questionnaires.

Table 5
Weight and rank of different factors

Pj	$\otimes w_j$	w_j	Global w_j	rank
GPR1	(0.75,0.9)	0.825	0.527	2
GPR2	(0.55,0.75)	0.65	0.415	11
GPR3	(0.34,0.48)	0.41	0.262	29
GPR4	(0.58,0.73)	0.655	0.418	10
GPR5	(0.66,0.85)	0.755	0.482	6
GPR6	(0.46,0.61)	0.535	0.342	20
GC1	(0.62,0.8)	0.71	0.439	7
GC2	(0.61,0.81)	0.71	0.439	8
GC3	(0.41,0.58)	0.495	0.306	25
GC4	(0.54,0.7)	0.62	0.384	15
GC5	(0.49,0.63)	0.56	0.347	19
EF1	(0.69,0.89)	0.79	0.521	3
EF2	(0.43,0.63)	0.53	0.350	18
EF3	(0.57,0.76)	0.665	0.439	9
EF4	(0.71,0.86)	0.785	0.518	5
EF5	(0.69,0.89)	0.79	0.521	4
EF6	(0.69,0.91)	0.8	0.528	1
EF7	(0.46,0.66)	0.56	0.369	17
EF8	(0.34,0.46)	0.4	0.264	28
EF9	(0.53,0.7)	0.615	0.406	13
FF1	(0.37,0.58)	0.475	0.235	30
FF2	(0.38,0.56)	0.47	0.232	31
FF3	(0.38,0.53)	0.455	0.225	32
FF4	(0.36,0.54)	0.45	0.222	33
FF5	(0.54,0.7)	0.62	0.306	24
FF6	(0.28,0.42)	0.35	0.173	35
FF7	(0.55,0.73)	0.64	0.316	23
POF1	(0.31,0.45)	0.38	0.212	34
POF2	(0.48,0.69)	0.585	0.326	21
POF3	(0.63,0.78)	0.705	0.392	14
IF1	(0.4,0.57)	0.485	0.279	26
IF2	(0.58,0.74)	0.66	0.380	16
IF3	(0.61,0.8)	0.705	0.406	12
IF4	(0.47,0.64)	0.555	0.320	22
IF5	(0.41,0.54)	0.475	0.274	27

In the External factors, Social responsibility (Community pressure) (EF6) is an essential factor to provide maximum pressure to adopt GSCM in Iranian mining industry. It obtained the first rank with the weight of (0.528). The first rank in Indian context was gained for Non-governmental organizations (NGOs) for environmentally friendly products. When discussing about the pressure obtained the first rank of thirty five other pressures with mining experts, they all implied to the effects that mines have had on the native people's life, because most of the mines of our sample which had responded to the questionnaires are near the towns and cities which are residential and these mines had a huge impact on the lives of people in these areas from different aspects like: economic, employment, pollution, …. Over the years, the people of these regions have shown that they have great power to deal with destructive and anti-environmental activities of mines, in some cases people persistence have led to the closure of mines for a long time. So it is clear that community pressure gained the first rank, if the local people near the mines became well aware of environmental activities and receive a good knowledge in this regards, they can have a maximum pressure for adopting GSCM practices from miners and mining owners. Mines cannot continue to their activities without satisfying these native people. There are seven pressures listed in financial factors which show lowest importance among other pressures and it seems that mines do not care to financial factors in GSCM adopting. Organizational knowledge on waste reduction and recycling and backfilling processes (knowledge pressure) (POF3) is ranked 14th pressure among listed pressures in this category.

Internal Factors is a new category which is added in this study and includes new pressures and reflect the pressures which can arise within organizations or can be related to some inner rules and regulation of each industry. E-logistics and green-procurement (IF3) comes in at 12th place. These new concepts consist of: Green procurement, green purchasing, green logistics and green supplier are gaining more and more attention in different industries. And as is studied by Kahanaali et al. (2015), these concepts can have a good pressure for adopting GSCM. Top management and senior managers pressures (IF2) also received a good degree of importance with rank of 16 among thirty five pressures. Other weights and ranks of pressures can be seen in Table 5.

7. Conclusions

GSCM should be considered in whole chain and green concept should be visible in all of practices in supply chain including: green purchasing, green supplying, green manufacturing, green distribution, and reverse logistics. In this paper, first the pressures for GSCM adoption were identified and categorized under specific category based on literature review and opinions from different mining experts in decorative stone mines. Then data was collected through carefully designed questionnaires and pressures ranked based on these data. The contribution of this paper is adding new category and new pressures under existed categories and studying GSCM pressures in an Iranian context in mining industry. The grey methodology was used for ranking and evaluating the pressures as this method converts the uncertain judgments of mining experts (decision makers) into quantitative expressions which could not be achievable through conventional MADM methods.

As responding to all the pressures simultaneously is not possible, so ranking the most effective pressures is very helpful for managers. This study extended the work of Mathiyazhagan et al. (2015) which had studied only fifteen pressures in Indian context. According to the results, the first rank obtained for Social responsibility (Community pressure). This shows that mining industry in Iran, feel and gets more pressure from side of society than other sides (as financial side or governmental sides) for adopting and implementing GSCM, because they are seen more pollution than other industries. (Muduli et al.,2013b; Mathiyazhagan et al., 2015), and the higher rank for this pressure in comparison with previous study can be described by this reason that in Iran and in the target population of this study, most of mines are very close to the cities and towns, it is the main reason that society can have a huge amount of pressure for dealing with the pollution of these mines. After Community pressure, the next important pressures are gained as: government regulations, foreign direct investment interest in green products and pressures from media. In the other hand; financial pressures, obtained lowest degree among other pressures. This study was accomplished in decorative stone mines and can be extended to other kind of mines in Iran in future like coal, metallic minerals, sand and gravel, chemical minerals and salt in order to find the differences between perceived pressures. Also new pressures can be added to this work, using new approaches for ranking and evaluating can be another suggestion for future studies.

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