Journal of Supply Chain Management Science

https://journals.open.tudelft.nl/jscms

http://dx.doi.org/10.18757/jscms.2022.6177

A systematic review of multi-objective optimization applications in reverse logistics

Alireza Arab [a1]

[a] *Faculty of Management, University of Tehran, Tehran, Iran*

Article history: received 05-12-2021, accepted 18-06-2022, published 30-06-2022

Abstract – Reverse logistics (RL) have received the attention of the practitioners and researchers of the fields of supply chain and logistics due to, inter alia, the increase in public awareness, boundless waste generation, and environmental issues. To formulate RL issues, multi-objective decision-making (MODM) techniques are of the most practical approaches. MODM methods refer to an optimization problem with multiple objectives that usually conflict with each other and must be satisfied simultaneously. However, no literature review had yet undertaken a comprehensive systematic review of the utilization of MODM methods in RL. Therefore, 205 relevant papers published in scientific journals are considered and investigated from descriptive and technical content dimensions in this paper. The results clearly illustrate the quantitative increase in the number of papers published in this field over the last 20 years. This increase depicts that the researchers' focus on this field has been increasing in the last decade. Content analysis on the main focus areas, case study sector, solution methodology, uncertainty modeling, period(s), product(s), and numerous objectives that these 205 papers considered in their study helped to visualize the current state of this field and reveal research gaps and introduce future directions. Finally, some potential topics are provided based on the results that cover all reverse logistics activities and also content analysis categories.

Keywords: Literature review; Multi-objective decision-making (MODM); Reverse logistics (RL); Optimization

1. Introduction

Based on Chopra et al. (2013), a traditional supply chain (forward flow: from supplier to customer) refers to a set of actors to satisfy a customer request. These actors include suppliers, manufacturers, transporters, warehouses, and retailers. Due to, inter alia, the increase in public awareness, corporate societal responsibility, boundless waste generation, environmental issues, legislative shifts towards the environment, and sustainable competitiveness, reverse logistics (RL) have received the attention of the practitioners and researchers of the supply chain field (Agrawal et al. 2015, Govindan et al. 2015, Prajapati et al. 2019). This form of logistics is the reverse of the traditional form of supply chain movement of goods from suppliers to customers. Thus, instead the goods are moving from the original consumer to the supplier. In a comprehensive and well-known definition, the American Executive Council of Reverse Logistics defines RL as “the process of planning, implementing, and controlling the efficient, cost-effective flow of raw materials, in-process inventory, finished goods, and related information from the point of consumption to the point of origin for the purpose of recapturing value or proper disposal” (Rogers and Tibben-Lembke 2001).

There is a difference between RL, waste management, and green logistics. Waste management aims to collect, and process waste that cannot utilized; however, when looking at RL we can turn this waste into new products, by utilizing several techniques, and create value in RL. Green logistics is concerned with environmental obstacles in

[1] Corresponding author. Email address: alireza.arab@ut.ac.ir

logistics, especially in the forward flow of supply chains such as international environmental standards, material, and energy usage (Farahani and Rezapour 2011).

A basic flow diagram of forward and reverse logistics activities is illustrated in Figure 1.

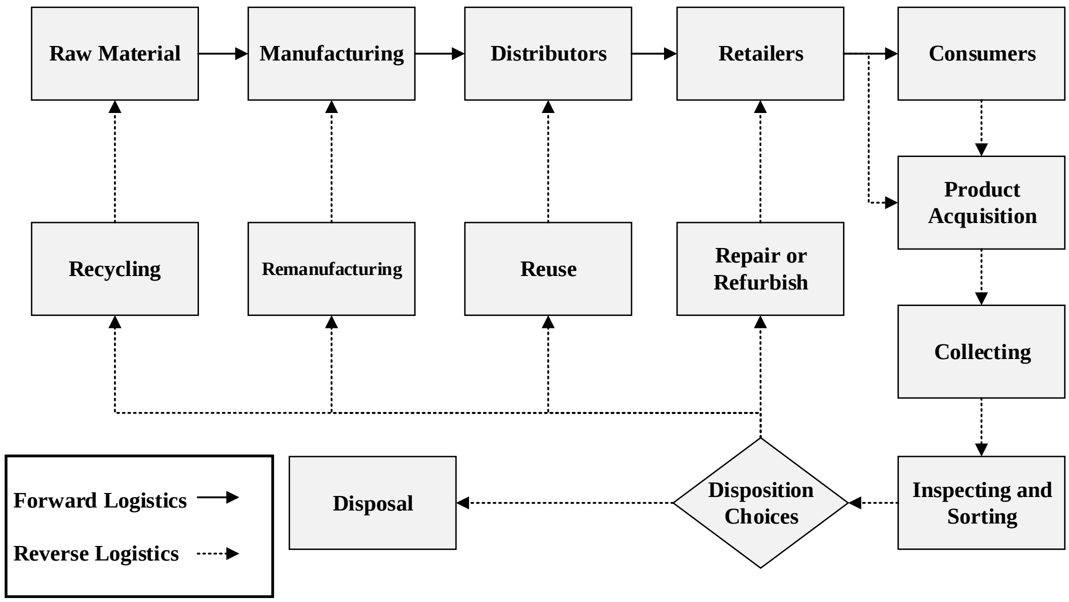

Figure 1. Basic flow diagram of forward and reverse logistics activities.

Figure 1 shows that RL has four main operations 'product acquisition', 'collecting', 'inspecting and sorting', and 'disposition choices.' In product acquisition, used products are taken from the consumers to be processed. In collecting, the firm obtains the products' possession for further processing. In inspecting and sorting, the general state of the collected products is evaluated prior to deciding on what further actions to take (Agrawal et al. 2015). After inspecting and sorting, the firm should make a disposition choice among six alternatives: repair (product recovery and correction of defects) or refurbish (fix any flaws the product has; rehabilitating it), reuse (selling a used product with a sufficient quality level), remanufacturing (disassemble, remanufacture, and reassemble the product to modify its quality or specifications), recycling (transform the product to the basic materials such as paper and metal to use with other processed materials forming the new products), and disposal (concluding none of the other processes would work (sufficiently) and thus deciding to part ways with the product) (Jayaraman 2006).

This supply chain brings about problems for firms, especially in the areas of design, planning, and control (Rachih et al. 2019). These problems have gotten many parties involved, such as suppliers, buyers, customers, and recycling specialists. These also have multiple objectives, decision variables, and constraints. One of the most practical approaches to formulating these complex problems is multi-objective decision-making (MODM). Multi-objective decision-making refers to an optimization problem with multiple objectives that usually conflict with each other and must be satisfied simultaneously. This model includes decision variables, objective functions, and constraints. Decision-makers aim to calculate optimal values of decision variables to maximize or minimize the objective functions (depending on the objectives type) under the constraints condition. Generally, MODM problems can be formulated as standard forms as follows:

$$Max\ f_m(x), \qquad m = 1, 2, 3, \dots, M,$$

$$\text{Subject to: } x \in X = \{x \in R^n | g(x) \leq b,\ x^L \leq x \leq x^U\}.$$

where $f_m(x)$ denotes M conflicting objective functions (it can be a maximization or minimization or a combination of them), $g(x) \leq b$ shows k constraints (it can be equality or non-equality constraints or both), and x is the n-vector of decision variables. x^L and x^U are lower and upper bounds of decision variable x and considering the type of mathematical problem, it can be categorized as an integer variable. Unlike single-objective optimization, this problem might not have a unique global optimal solution (because of the existence of conflicting objectives), and decision-makers must select a solution from the set of efficient solutions called Pareto optimal solutions. Pareto optimal solutions refer to a set of trade-offs between different non-dominated solutions of objectives and means that there is no other solution that would improve an objective without causing a worsening in another one (Deb 2001, Lu and Ruan 2007).

The methods for solving multi objective problems are MODM methods such as goal programming (Charnes and Cooper 1957), weighted sum (Zadeh 1963), ε-constraint (Haimes 1971), and Augmented ε-constraint (Mavrotas 2009). So, if a firm aims to make a decision about a reverse logistics problem characterized by multiple objectives, multiple variables, and multiple constraints, it should evaluate the objectives using a multi-objective decision-making method based on one or more decision-makers (experts) opinions to optimize the objectives of the supply chain.

Some researchers have conducted literature review (LR) in the RL field, such as Govindan et al. (2015), Kazemi et al. (2019), Prajapati et al. (2019), Agrawal et al. (2015), and Pokharel and Mutha (2009).

Besides, a literature review of multi-criteria decision-making (MCDM) applications in reverse logistics is conducted by Rezaei (2015) using multi-attribute decision-making (MADM) methods where a number of alternatives are evaluated with respect to a set of decision attributes to select the best alternative(s). Rachih et al. (2019) conducted a comprehensive literature review on applications of meta-heuristics methods for reverse logistics, and Abid et al. (2019) reviewed the related literature to simulation techniques applied in RL. However, no literature review has yet undertaken a comprehensive systematic review of the use of MODM methods in RL. The current paper aims to fill this critical gap and suggest future research directions for researchers. This contribution is made by addressing these main research questions:

RQ1. What are the main contents and areas of the published research on reverse logistics by using MODM methods, and how does MODM contribute to RL optimization?

RQ2. What are the opportunities for future research in this field?

The remainder of the paper is organized as follows. In section 2, the literature review methodology used in this paper is described, which is followed by a detailed analysis of the literature. Finally, the conclusion and future research suggestions are provided in Section 3.

2. Research methodology

In this study we use a systematic literature review approach based on Mayring (2010) to answer the main research questions and classify the body of the literature and analyze the literature in a structured way. This approach has been used by several literature review studies in the RL field (Kazemi et al. 2019, Rachih et al. 2019) and has four stages: material collection, descriptive analysis, content analysis, and material evaluation.

2.1 Material collection

This stage is about collecting papers related to the application of MODM methods in the RL field. For this procedure we utilize a review protocol to ensure the relevance of the papers discussed. In this protocol, we consider the pair combination of these keywords in the search in the Scopus electronic database. We include papers that contain at least one pair of these keywords in their title AND/OR abstract AND/OR keywords: (redistribute* OR refurbish* OR "end-of-life_product*" OR "product*_recovery" OR "product*_repair" OR "product*_reuse" OR "product*_returns" OR "reverse_logistics" OR "product*_recycling" OR remanufacture*) AND ("MODM" OR "multi*-objective_optimization*" OR "multi*-criteria_optimization*" OR "multi*-objective_decision-making" OR "multi*-objective" OR "bi*-objective").

The searches were conducted on 23 May 2021. Inclusion criteria consist of scientific journal research articles published in the English language between January 2001 and May 2021 that employed MODM in RL. We removed literature reviews and conference papers, thesis/dissertations, books, and book chapters from the list of reviewable articles.

Then the irrelevant papers were excluded by reading the abstract and skimming the paper to ensure the adaptation of an MODM method in the RL field is the situation and then exclude duplicated papers from the study. Finally, we focus on the remaining papers and investigate them to answer the main research questions. All the mentioned stages with the number of the included papers in each of them are illustrated in Figure 2.

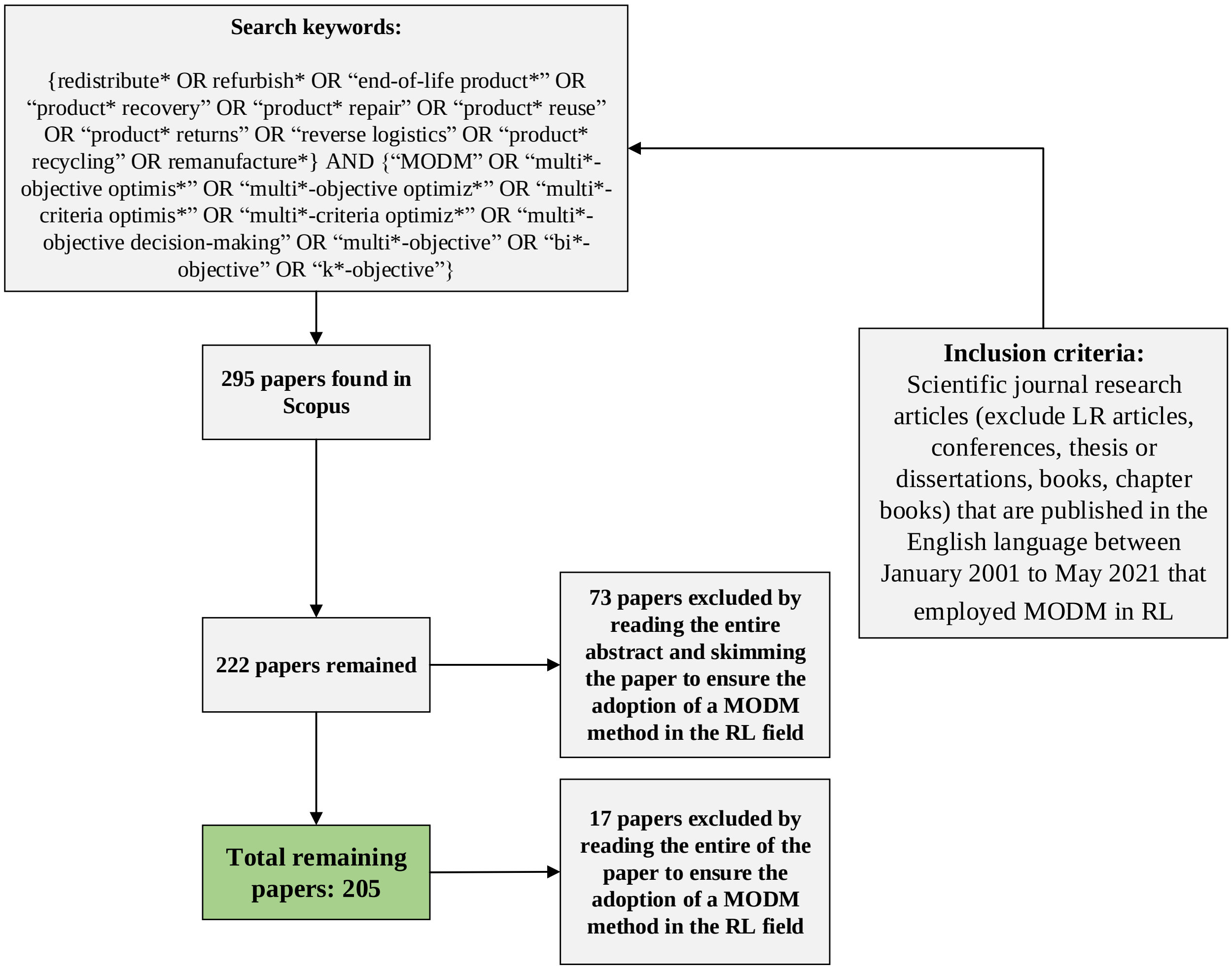

Figure 2. Stages of the material collection.

2.2 Descriptive analysis

In this step, 205 scientific papers were evaluated in detail by dimensions such as the total number of published papers per year and research fields of the journals, Figure 3 shows the distribution trend and increase in the number of papers published in this field over the last 20 years. This growth shows that the researchers' focus on this field has increased over the last few years due to some important issues such as public awareness, waste generation, and environmental issues.

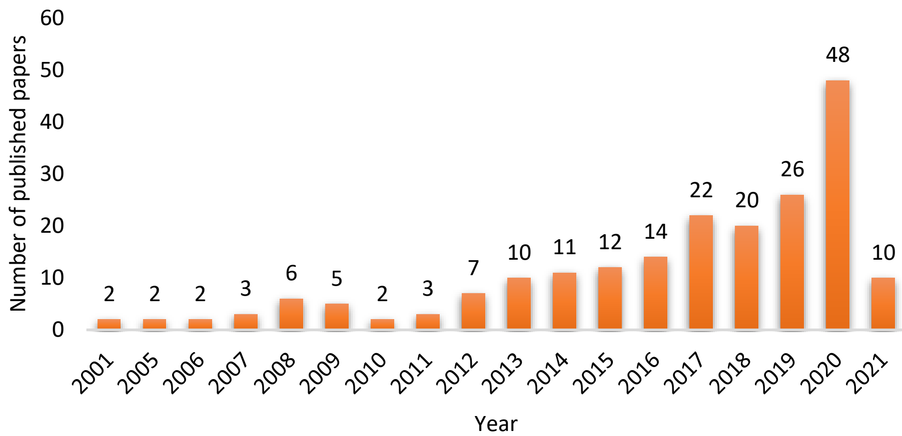

Figure 3. The number of published papers during the last 20 years.

Also, Figure 4 shows the distribution of publications based on different journals. As can be seen, the *Journal of Cleaner Production*, *International Journal of Production Research*, *International Journal of Advanced Manufacturing Technology*, *Annals of Operations Research*, *Applied Soft Computing Journal*, *International Journal of Production Economics*, and *Sustainability* are the top contributors in this field.

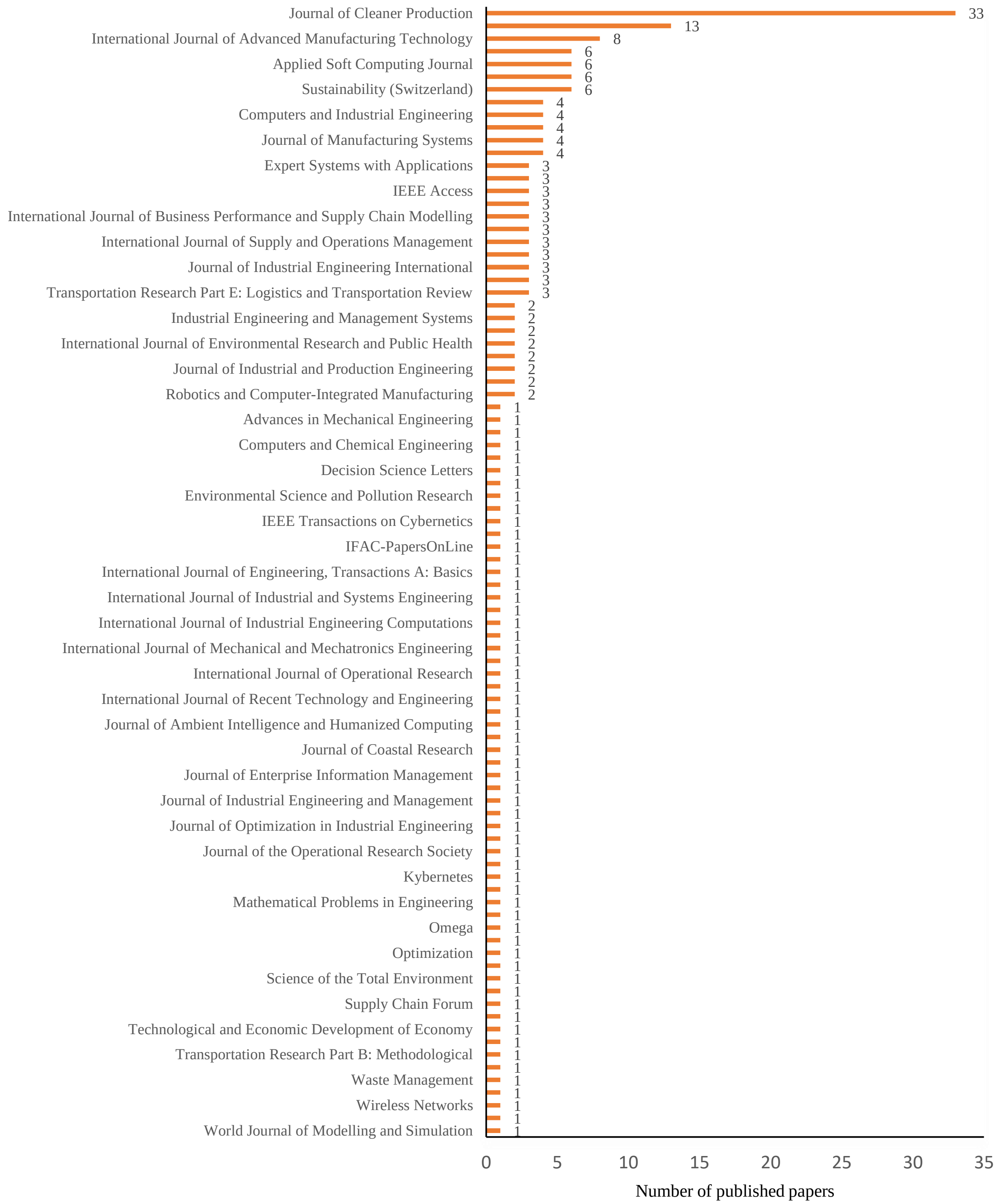

Figure 4. The publications per journal distribution.

Furthermore, in Figure 5, the keywords used in the considered papers and their co-occurrence (the frequency that a keyword appeared with other keywords) is illustrated by using VOSviewer. In this way, keywords cluster by investigating their co-occurrence by the full counting method and with the five minimum number of occurrences of a keyword condition. Consequently, 26 keywords satisfied this condition, a significant reduction from 593. This figure shows that "reverse logistic," "multi-objective optimization," "closed-loop supply chain," "sustainability," "remanufacturing," and "product recovery" were the most frequently used keywords by the authors. These keywords are clustered so that different clusters are illustrated with different colors. Multi-objective optimization (in a green color cluster) has been chiefly used with the keywords of genetic algorithm, remanufacturing, supply chain management, sustainable development, sustainable supply chain, NSGAII, and reverse logistics. In contrast, product recovery (in a blue cluster) has been chiefly used with the keywords of disassembly line balancing, disassembly, and metaheuristics.

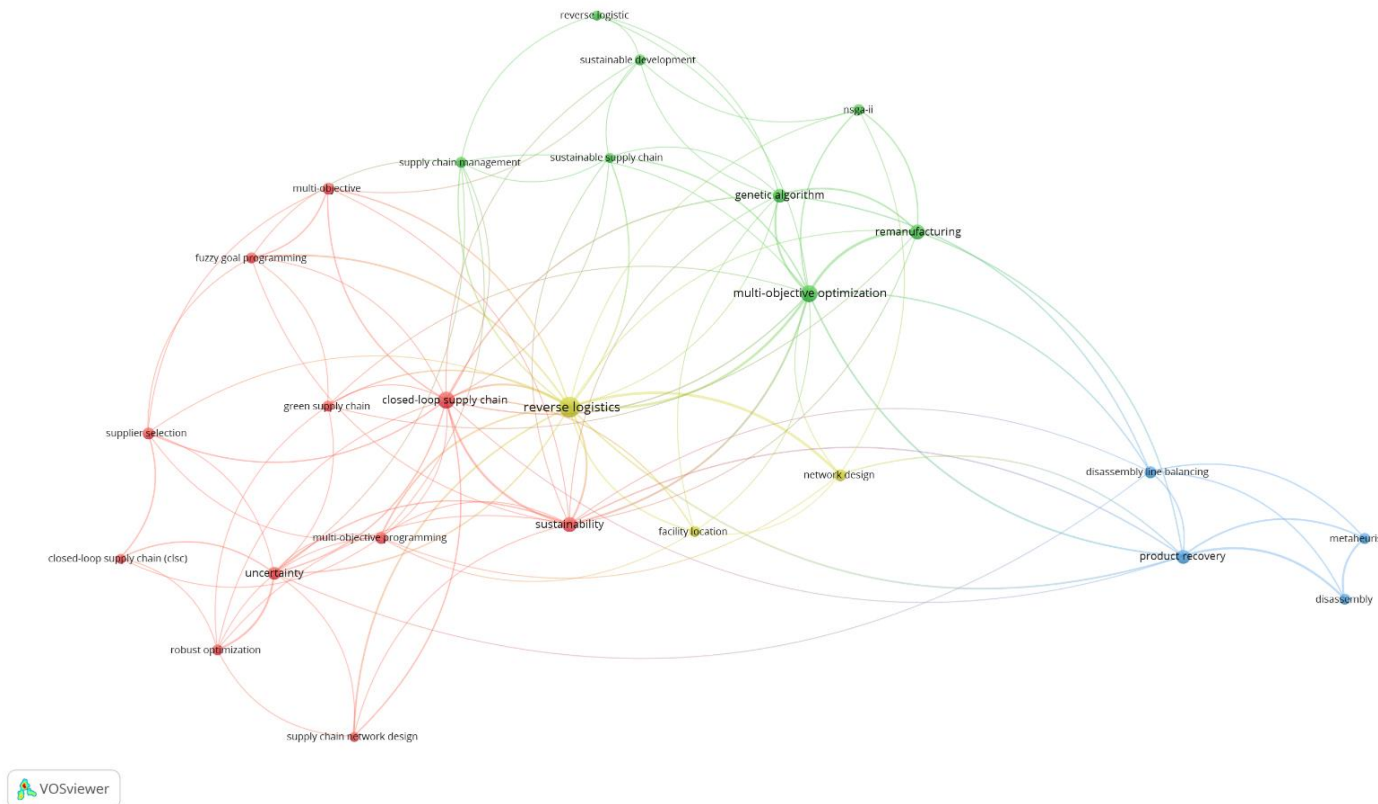

Figure 5. Co-occurrence of author-keywords used in the papers.

2.3 Content analysis

This section provides detailed information about the main focus area, case study sector, solution methodology, and method type, uncertainty modeling, number of the periods, products and objectives, and kind of objectives that these 205 papers have considered in their study to provide a clear current state of this field and introduce research gaps and future direction. Table 1 shows the extended details of these papers in each content analysis category.

Table 1. Reviewed studies.

Row	Author (year)	Coverage
1	X. Liu, Chu, Dolgui, Zheng, and Liu (2021)	(C-D,RG,E,ST,MPE,MPR,2,C&SAL)
2	L. Zhang, Zhao, Ke, Dong, and Zhong (2021)	(DLB,A,M,C,SPE,SPR,2,T&EI)
3	Fasihi, Tavakkoli-Moghaddam, Najafi, and Hajiaghaei-Keshteli (2021)	(ND,FI,E,C,SPE,SPR,2,C&D)
4	Laili, Li, Wang, Ren, and Wang (2021)	(DLB,R,M,C,SPE,MPR,2,T&FR)
5	Dalle Mura, Pistolesi, Dini, and Lazzerini (2021)	(DLB,E,M,C,SPE,SPR,4,P&LB&F&S)
6	Liang et al. (2021)	(DLB,RG,M,C,SPE,SPR,3,T&WS&EC)
7	Pant, Yadav, and Singh (2021)	(ND,P,E,C,MPE,SPR,2,P&UV)
8	Guo, Zhou, Liu, and Qi (2021)	(DLB,E,M,C,SPE,MPR,2,P&EC)
9	Ren et al. (2021)	(DLB,E,M,C,SPE,MPR,2,P&ES)
10	Sazvar, Zokaee, Tavakkoli-Moghaddam, Salari, and Nayeri (2021)	(ND,H,E&H,ST,MPE,MPR,3,P&EI&SI)
11	He, Chu, Zheng, Liu, and Chu (2020)	(DLB,RG,E,ST,SPE,SPR,2,C&T)
12	J.-L. Shi, Ma, Wang, and Qu (2020)	(EOLM,E,M,C,MPE,SPR,2,C&EC)
13	Meng, Cao, Peng, Prybutok, and Gupta (2020)	(PR,A,M,ST,SPE,SPR,3,P&SI&ES)
14	J. Shi, Chen, Zhou, and Zhang (2020)	(L,HO,M,C,MPE,SPR,3,C&W)
15	Beiki, Seyedhosseini, Ghezavati, and Seyedaliakbar (2020)	(VRP,EA,E&M,C,MPE,MPR,2,C&SAL)
16	Meng, Qian, Lou, and Zhang (2020)	(PR,A,M,C,SPE,MPR,2,C&EC&ES)
17	Djatna and Amien (2020)	(VRP,B,M,C,SPE,MPR,2,C&RLN)
18	Guo, Zhou, Liu, and Qi (2020)	(DLB,E,M,C,SPE,MPR,3,T&EC&REV)
19	Dutta, Mishra, Khandelwal, and Katthawala (2020)	(ND,CL,E,C,SPE,SPR,3,C&EI&SI)
20	Fang, Xu, Liu, and Pham (2020)	(DLB,R,M,C,MPE,MPR,2,C&NOR)
21	Tosarkani, Amin, and Zolfagharinia (2020)	(ND,R,E,R&F&SI,MPE,MPR,2,C&EI)
22	Zarbakhshnia, Kannan, Kiani Mavi, and Soleimani (2020)	(ND,RG,M,C,MPE,MPR,3,C&T&SI)
23	Sun and Su (2020)	(ND,RG,M,C,SPE,MPR,3,C&EI&REV)
24	Huang, Zhen, and Yin (2020)	(ND,P,E,C,SPE,SPR,3,C&EI&SI)
25	Rabbani, Amirhossein Sadati, and Farrokhi-Asl (2020)	(WM,A,E,C,SPE,MPR,2,C&R)
26	Porkar, Mahdavi, Maleki Vishkaei, and Hematian (2020)	(ND,RG,M,C,MPE,MPR,2,Q&P&EI)
27	Hao Yu and Solvang (2020)	(ND,RG,E,F-S,SPE,MPR,2,C&EI)
28	X. Gao and Cao (2020)	(ND,RG,E,C,SPE,SPR,3,P&EI&SI)
29	Park, Kim, Ko, and Song (2020)	(ND,B,E,C,SPE,SPR,2,C&NR)
30	Jabarzadeh, Reyhani Yamchi, Kumar, and Ghaffarinasab (2020)	(ND,FF,E,C,MPE,SPR,3,C&EI&D)
31	A. Liu, Zhang, Luo, and Miao (2020)	(ND,RG,E,C,MPE,SPR,3,EI&SI&NPV)
32	Moslehi, Sahebi, and Teymouri (2020)	(ND,E,E,ST,SPE,MPR,2,C&EI)
33	Q. Lu et al. (2020)	(DLB,E&BP,M,C,SPE,MPR,2,P&EC)
34	Goodarzian, Hosseini-Nasab, and Fakhrzad (2020)	(ND,RG,M,C,SPE,SPR,3,C&EI&SI)
35	Ghoushchi and Hushyar (2020)	(ND,E,E,C,MPE,MPR,3,Q&P&SW)
36	Ahlaqqach, Benhra, Mouatassim, and Lamrani (2020)	(ND&L,H,E,C,SPE,MPR,3,P&SI&R)
37	Budak (2020)	(ND&DLB,E,E,C,MPE,SPR,3,C&EI&SI)
38	Sajedi, Sarfaraz, Bamdad, and Khalili-Damghani (2020)	(ND,RG,M,F,MPE,MPR,3,C&EI&SI)
39	Fathollahi-Fard, Ahmadi, and Al (2020)	(ND&WM,EN,E,F,SPE,SPR,3,C&EI&SI)

Row	Author (year)	Coverage
40	C. Yang and Chen (2020)	(L,M,E,C,MPE,MPR,3,C&RLN&EI)
41	Ali, Paksoy, Torğul, and Kaur (2020)	(ND&PR,E,E,F,MPE,MPR,7,C&EI&REV)
42	Pourmehdi, Paydar, and Asadi-Gangraj (2020)	(ND,S,E,F-S,SPE,MPR,3,P&EI&SI&EC&MWD)
43	Antucheviciene, Jafarnejad, Amoozad Mahdiraji, Razavi Hajiagha, and Kargar (2020)	(ND,S,M,R,SPE,MPR,3,P&EI&SEL)
44	Kargar, Pourmehdi, and Paydar (2020)	(ND&WM,H,E,C,MPE,SPR,3,C&W&R)
45	Govindan, Mina, Esmaeili, and Gholami-Zanjani (2020)	(ND&SS&OA,A,E,F,SPE,MPR,2,C&SH)
46	Trochu, Chaabane, and Ouhimmou (2020)	(ND,WO,E,ST,MPE,MPR,2,P&LF)
47	Shahbazbegian, Hosseini-Motlagh, and Haeri (2020)	(ND,EN,E,FR,MPE,SPR,2,C&E)
48	X. Jiang, Li, Lu, and Tian (2020)	(ND,M,M,G,SPE,SPR,2,C&EI)
49	Zandkarimkhani, Nasiri, and Heydari (2020)	(ND&VRP&L,CH,E,F,MPE,MPR,2,C&VEPS)
50	Khalafi, Hafezalkotob, Mohammaditabar, and Sayadi (2020)	(RSC,F,E,F,MPE,MPR,2,P&SAL)
51	Khan et al. (2020)	(ND,A,E&M,C,SPE,SPR,3,C&T&EI)
52	S. Lu, Zhu, Wang, Xie, and Su (2020)	(ND,E,E,F,MPE,MPR,3,C)
53	Pan, Xie, and Feng (2020)	(ND&WM,C,E,C,MPE,SPR,3,C&P&RCP)
54	Rossit, Toutouh, and Nesmachnow (2020)	(L,C,E&H,C,SPE,SPR,3,C&DI&GF)
55	Kumar, Jain, and Sharma (2020)	(ND,A,E,F,SPE,MPR,4,P&CF&EI&RCP)
56	Mehrbakhsh and Ghezavati (2020)	(IM,RG,E&M,ME,MPE,MPR,2,C&EI)
57	Safdar, Khalid, Ahmed, and Imran (2020)	(ND&WM,E,E,N,SPE,MPR,3,P&EI&SI)
58	H. Yu, Sun, Solvang, and Zhao (2020)	(ND&WM,H,E,C,MPE,SPR,3,C&R)
59	Z. Wang, Huang, and He (2020)	(ND,H,E,G,MPE,MPR,2,C&EI)
60	Z. Jiang, Wang, Zhang, Mendis, and Sutherland (2020)	(PR,L,M,C,SPE,SPR,3,C&E&LSE)
61	Yuchi, Wang, Li, Yang, and Jiang (2019)	(ND,RG,M,G,MPE,SPR,2,C&EI)
62	Tao, Meng, Lou, Peng, and Qian (2019)	(DLB&VRP,E,M,C,SPE,MPR,2,P&ES)
63	S.-H. Tseng, Wee, Song, and Jeng (2019)	(ND,P,E,C,MPE,SPR,2,C&EI)
64	Ahlaqqach, Benhra, Mouatassim, and Lamrani (2019)	(VRP,H,M,C,SPE,SPR,2,C&R)
65	Khorshidian, Akbarpour Shirazi, and Fatemi Ghomi (2019)	(VRP,F,E,C,MPE,MPR,2,C&T)
66	Farrokhi-Asl, Makui, Ghousi, and Rabbani (2019)	(ND,RG,M,C,SPE,SPR,4,C&RLN&EI&SI)
67	Alkahtani and Ziout (2019)	(ND,E,E,C,SPE,SPR,3,C&EI&SI)
68	Roghanian and Cheraghalipour (2019)	(ND,AG,E&M,C,MPE,SPR,3,C&EI&D)
69	Yadong Wang and Shi (2019)	(ND,RG,H,C,MPE,SPR,2,T&FR)
70	Jin, Song, Yih, and Sutherland (2019)	(ND,A&E,E,C,MPE,MPR,2,P&EI)
71	Govindan, Agarwal, Darbari, and Jha (2019)	(SS,E,E,C,SPE,MPR,2,P&EI&SI)
72	Farahinejad and Gholamian (2019)	(IM,E,E,C,MPE,MPR,2,C&T)
73	Tseng, Wee, Reong, and Wu (2019)	(IM,M,E,C,MPE,MPR,2,C&EI)
74	Taleizadeh, Pourrezaie Khaligh, and Moon (2019)	(PS,RG,M,ST,SPE,SPR,2,P&SAL)
75	Zarbakhshnia, Soleimani, Goh, and Razavi (2019)	(ND,E,E,C,SPE,MPR,3,C&EI&NOR)
76	Avakh Darestani and Pourasadollah (2019)	(ND&P,RG,M,F,MPE,MPR,3,C&Q&LD)

Row	Author (year)	Coverage
77	Papen and Amin (2019)	(ND&SS,B,E,C,SPE,MPR,4,Q&P&EI&LD)
78	Darbari, Kannan, Agarwal, and Jha (2019)	(ND,E,E,F,SPE,MPR,3,P&EI&SI)
79	X. Gao (2019)	(ND,M,E,ST,SPE,SPR,2,P&EI)
80	Jalil, Hashmi, Asim, and Javaid (2019)	(ND,M,E,F,SPE,MPR,3,C&Q)
81	S. Lu, Xie, Zhu, and Su (2019)	(ND,E,E,C,MPE,MPR,2,C&EI)
82	Pouriani, Asadi-Gangraj, and Paydar (2019)	(WM,C&W,E,R,MPE,MPR,2,C)
83	Z. Li, Kucukkoc, and Zhang (2019)	(DLB,B,H,C,SPE,MPR,4,LB&WS&D&R)
84	Ahmadi and Amin (2019)	(ND&SS&OA,E,E,F-S,MPE,MPR,2,P&SW)
85	Cheraghalipour, Paydar, and Hajiaghaei-Keshteli (2018)	(ND,FF,M,C,SPE,SPR,2,C&D)
86	Y. Gao, Feng, Wang, Zheng, and Tan (2018)	(PR,A,M,TUM,SPE,MPR,2,P&F)
87	Ghassemi, Asl-Najafi, and Yaghoubi (2018)	(ND&SS,M,E,C,MPE,MPR,2,P&GW)
88	Bortolini, Galizia, Mora, Botti, and Rosano (2018)	(ND,FF,E,C,MPE,MPR,2,C&EI)
89	Badurdeen, Aydin, and Brown (2018)	(PR,E,M,C,MPE,MPR,3,C&EI&EC)
90	Yong Wang et al. (2018)	(VRP,M,H&M,C,MPE,SPR,2,C&UV)
91	Nobari and Kheirkhah (2018)	(ND&P,RG,M,C,MPE,MPR,3,P&EI&SI)
92	W. Yang, Xie, and Li (2019)	(IM,E,M,C,MPE,MPR,2,C&SEL)
93	Jiayi Liu et al. (2018)	(DLB,R,M,C,MPE,MPR,3,NW&T&WS)
94	Tosarkani and Amin (2018)	(ND&SS,E,E,C,MPE,MPR,4,Q&P&EI&LD)
95	Rasi (2018)	(ND,CH,M,F,MPE,SPR,2,C&LD)
96	Mohebalizadeh and Hafezalkotob (2018)	(ND,M,E,F,SPE,SPR,4,C&T&SI&EC)
97	Soleimani, Chaharlang, and Ghaderi (2018)	(VRP,RG,E,F,SPE,MPR,2,C&EI)
98	Mota, Gomes, Carvalho, and Barbosa-Povoa (2018)	(ND,E,E,ST,MPE,MPR,3,EI&SI&NPV)
99	Ren et al. (2018)	(DLB,RG,H,F,SPE,SPR,2,LB&WS)
100	Yadollahinia, Teimoury, and Paydar (2018)	(ND&CRM,A,E,R,MPE,MPR,3,C&DI&SAL)
101	Hao Yu and Solvang (2018)	(ND,RG,E,ST,SPE,MPR,2,P&EI)
102	Rabbani, Mokhtarzadeh, and Farrokhi-Asl (2018)	(VRP&WM&L,RG,M,C,SPE,SPR,2,C&EI)
103	Saxena, Jain, and Sharma (2018)	(ND,A,E,F,MPE,MPR,4,P&PV&EI&RCP)
104	Mohsen Rahimi and Ghezavati (2018)	(ND,RG,E,ST,MPE,SPR,3,P)
105	Maleki, Pasandideh, Niaki, and Cárdenas-Barrón (2017)	(P&CM&O,RG,M,C,SPE,MPR,2,P&NW)
106	Farrokhi-Asl, Tavakkoli-Moghaddam, Asgarian, and Sangari (2017)	(WM,RG,M,C,SPE,SPR,2,C&SI)
107	Meng, Lou, Peng, and Prybutok (2017)	(PR,A,M,C,SPE,SPR,3,C&Q&PR)
108	Wu, Kwong, Aydin, and Tang (2017)	(ND&PFD,RG,E,C,SPE,MPR,2,C&P)
109	Jindal and Sangwan (2017)	(ND,M,E,F,SPE,MPR,2,P&EI)
110	Dinler and Güngör (2017)	(WM,M,E,F,MPE,MPR,2,P&R)
111	Soleimani, Govindan, Saghafi, and Jafari (2017)	(ND,RG,M,F,MPE,MPR,3,P&D&MWD)
112	Paydar, Babaveisi, and Safaei (2017)	(ND,EN,E,R&C,MPE,MPR,2,P&R)
113	Keshavarz Ghorabaee, Amiri, Olfat, and Khatami Firouzabadi (2017)	(ND,E,E,F,MPE,MPR,2,C&EI)
114	Shakourloo (2017)	(PROCP,E,E,F-S,MPE,MPR,3,C&P&EI&EC)
115	Kadambala, Subramanian, Tiwari, Abdulrahman, and Liu (2017)	(ND,M,M,C,SPE,SPR,2,P&EC)
116	Chen, Wang, Wang, and Chen (2017)	(ND,EN,M,C,SPE,SPR,2,C&EI)
117	Fazli-Khalaf, Mirzazadeh, and Pishvaee (2017)	(ND,CH,E,F-S&R,SPE,SPR,2,C&EI)

Row	Author (year)	Coverage
118	Amir Mohammad, Gholian-Jouybari, Mohammad, and Mostafa (2017)	(ND&RM,RG,M,ST,SPE,SPR,2,C&R)
119	Amin and Baki (2017)	(L,C,E,F,MPE,MPR,2,P&LD)
120	Zhao and Ke (2017)	(VRP&RM&WM&L,C,E,C,SPE,SPR,2,C&R)
121	Ivanov, Pavlov, Pavlov, and Sokolov (2017)	(PR,M,E,C,MPE,MPR,4,C&TH&I&RP)
122	Govindan, Darbari, Agarwal, and Jha (2017)	(ND,E,E,F,MPE,SPR,3,C&EI&SW)
123	Shokouhyar and Aalirezaei (2017)	(L,E,M,C,SPE,SPR,3,P&EI&SI)
124	Jahangoshai Rezaee, Yousefi, and Hayati (2017)	(SS&OA,M,E,C,SPE,MPR,4,Q&P&E&LD)
125	Jia Liu and Wang (2017)	(DLB,E,M,C,SPE,MPR,4,T&WS&D&R)
126	Feitó-Cespón, Sarache, Piedra-Jimenez, and Cespón-Castro (2017)	(ND,CH,E,ST,SPE,MPR,3,C&EI&SI)
127	Dai (2016)	(ND,M,E,F,SPE,MPR,4,C&W&EI&R)
128	Ghezavati and Beigi (2016)	(VRP&L,RG,M,C,SPE,SPR,2,C&T)
129	Z. Jiang et al. (2016)	(PROCP,L,M,C,SPE,MPR,2,C&REL)
130	Govindan, Paam, and Abtahi (2016)	(ND,RG,E&M,F,MPE,MPR,3,C&EI&SI)
131	Afshari, Sharafi, ElMekkawy, and Peng (2016)	(L,A,M,ST,MPE,MPR,2,C&SAL)
132	Wu, Kwong, Lee, and Tang (2016)	(PFD,E,M,C,SPE,MPR,2,C&MS)
133	Zohal and Soleimani (2016)	(ND,G,M,C,SPE,SPR,3,C&EI&REV)
134	Mohammad Rahimi, Baboli, and Rekik (2016)	(IM,RG&F,E,F,MPE,MPR,2,P&SI)
135	Entezaminia, Heydari, and Rahmani (2016)	(PRODP,RG,E,C,MPE,MPR,2,C&EI)
136	Hao Yu and Solvang (2016)	(ND,M,E,C,SPE,SPR,2,C&EI)
137	Kalayci, Polat, and Gupta (2016)	(DLB,M,M,C,SPE,SPR,4,T&WS&D&R)
138	Govindan, Jha, and Garg (2016)	(ND&PR&L,E,E,C,MPE,MPR,3,P&EI&SI)
139	Shakourloo, Kazemi, and Javad (2016)	(SS&OA,WA,E,C,SPE,MPR,3,C&P&W)
140	Azadeh, Zarrin, and Salehi (2016)	(SS,M,E,C,MPE,SPR,2,Q&P)
141	Saffar, Shakouri G, and Razmi (2015)	(ND,RG,E&M,F,MPE,MPR,2,C&EI)
142	Moghaddam (2015b)	(SS&OA,M,E,F&C,SPE,MPR,4,P&LD&R)
143	Mehrbod, Xue, Miao, and Lin (2015)	(L,RG,M,C,MPE,MPR,3,C&T&LD)
144	Moghaddam (2015a)	(SS&OA,M,E,F,SPE,MPR,4,Q&P&EI&LD)
145	R. Zhang, Ong, and Nee (2015)	(LS&PRODP,RG,M,C,SPE,SPR,2,PE&M)
146	Ghayebloo, Tarokh, Venkatadri, and Diallo (2015)	(DLB&SS,RG,E,C,SPE,MPR,2,P&EI)
147	Kwak (2015)	(PFD,A,E,C,SPE,MPR,2,P&EI)
148	J.-E. Lee, Chung, Lee, and Gen (2015)	(ND,B,M,C,MPE,SPR,2,C&LD)
149	Xiaoyang Zhou (2015)	(ND,B,M,C,SPE,SPR,2,C&T)
150	Kwak and Kim (2015)	(PFD,E,E,C,MPE,SPR,2,P&EI)
151	Subulan, Taşan, and Baykasoğlu (2015)	(ND,CH,E,F,SPE,MPR,3,C&NR&PV)
152	Sathish and Jayaprakash (2015)	(EOLM,E,M,C,MPE,MPR,2,C)
153	Eskandarpour, Nikbakhsh, and Zegordi (2014)	(ND,RG,M,C,SPE,MPR,2,C&TTR)
154	Mirakhorli (2014)	(ND,F,M,F,SPE,SPR,2,D&RP)
155	Sadjadi, Soltani, and Eskandarpour (2014)	(ND&L,RG,H,F,SPE,MPR,2,C&D)
156	Amin and Zhang (2014)	(ND,E,E,C,SPE,MPR,3,C&Q&T)
157	Mehrbod, Tu, and Miao (2014)	(L,RG,E,R&F,MPE,MPR,2,C&T)
158	Ghorbani, Arabzad, and Tavakkoli-Moghaddam (2014)	(ND,RG,E,F,SPE,MPR,3,C&T&W)
159	Altmann and Bogaschewsky (2014)	(ND,M,E,R,MPE,SPR,2,C&EI)
160	Özceylan and Paksoy (2014)	(ND,RG,E,F,MPE,SPR,4,C)
161	Tari and Alumur (2014)	(L,E,E,C,MPE,MPR,3,C&EF&SF)
162	Ondemir and Gupta (2014)	(PR,E,E,C,SPE,MPR,4,C&Q&GW&REV)

Row	Author (year)	Coverage
163	Ramos, Gomes, and Barbosa-Póvoa (2014)	(VRP,C,E,C,MPE,MPR,3,DI&EI&SI)
164	Özkır and Başlıgil (2013)	(ND,RG,E,F,SPE,MPR,3,P&SAL)
165	Aydemir-Karadag and Turkbey (2013)	(DLB,RG,M,ST,SPE,SPR,2,C&LB)
166	H. Lee, Zhang, Boile, Theofanis, and Choo (2013)	(L,M,E,C,MPE,MPR,2,C&T)
167	Amin and Zhang (2013a)	(L,RG,E,ST,MPE,SPR,2,C&EI)
168	Ramezani et al. (2013)	(ND,RG,E,ST,MPE,SPR,3,Q&P&RLN)
169	Vahdani, Tavakkoli-Moghaddam, Jolai, and Baboli (2013)	(ND,S,E,R&F,SPE,MPR,2,C&REL)
170	Hu and Sheu (2013)	(PDM,C,E,C,MPE,SPR,3,C&PS&R)
171	Can B. Kalayci and Surendra M. Gupta (2013a)	(DLB,E,M,C,SPE,MPR,4,T&WS&D&R)
172	Amin and Zhang (2013b)	(ND&SS&OA,E,E,F,SPE,MPR,4,C&Q&LD&SW)
173	Can B Kalayci and Surendra M Gupta (2013)	(DLB,E,M,C,SPE,MPR,3,E&S&REV)
174	Vahdani, Tavakkoli-Moghaddam, Modarres, and Baboli (2012)	(ND,RG,E,R&F,MPE,SPR,2,C)
175	Paksoy, Pehlivan, and Özceylan (2012)	(ND,RG,E,F,SPE,MPR,4,C&EI&ECR)
176	Achillas et al. (2012)	(WM,W,E,C,SPE,SPR,3,C&EI&EC)
177	Xiao, Cai, and Zhang (2012)	(RM,E,M,F,SPE,SPR,3,C&P&R)
178	Amin and Zhang (2012)	(ND&SS,E,E,C,SPE,MPR,3,Q&P&SW)
179	Yacan Wang, Lu, and Zhang (2012)	(L,E,E,C,SPE,MPR,3,C&W&EC)
180	S. Li, Wang, He, Che, and Ma (2012)	(ND,E,M,C,SPE,SPR,3,C&T&SEL)
181	X. Wang, Zhang, and Yang (2011)	(WM&L,C,E,C,SPE,MPR,2,C&DI)
182	Ashayeri and Tuzkaya (2011)	(ND,E,E,F,SPE,SPR,4,C&PV&CU&SEL)
183	Tuzkaya, Gülsün, and Önsel (2011)	(ND,E,M,C,SPE,SPR,2,C&PV)
184	Pishvaee et al. (2010)	(ND,RG,M,C,SPE,SPR,2,C&RLN)
185	Fonseca, García-Sánchez, Ortega-Mier, and Saldanha-da-Gama (2010)	(L,W,E,ST,SPE,MPR,3,NPV&D&R)
186	R. D. Kusumastuti, R. Piplani, and G. H. Lim (2009)	(ND&PR,E,M,SI,MPE,MPR,2,EI&EC&REV)
187	Quariguasi Frota Neto, Walther, Bloemhof, van Nunen, and Spengler (2009)	(EE,E,E,C,SPE,MPR,3,W&D&REV)
188	Wongthatsanekorn (2009)	(WM,CH,E,C,MPE,MPR,3,C&I&RCP)
189	Dehghanian and Mansour (2009)	(ND,C,M,C,SPE,SPR,3,P&EI&SI)
190	Xiaoyang Zhou and Xu (2009)	(ND,B,M,F,SPE,SPR,2,C&T)
191	Du and Evans (2008)	(ND,RG,E&M,C,SPE,SPR,2,C&TTC)
192	Sheu (2008)	(ND,EN,E,C,MPE,SPR,2,P&R)
193	Shimizu and Yamada (2008)	(DLB,E,M,C,SPE,MPR,2,C&T)
194	Luminita Duta, Filip, and Popescu (2008)	(DLB,E,M,C,SPE,MPR,2,P&LB)
195	Luminata Duta, Filip, Henrioud, and Popescu (2008)	(DLB,E,M,C,SPE,MPR,2,C&LB)
196	R. Pati, P. Vrat, and P. Kumar (2008)	(ND&WM,P,E,C,SPE,MPR,3,C&Q&EI)
197	Jun, Cusin, Kiritsis, and Xirouchakis (2007)	(PR,RG,M,C,SPE,MPR,2,C&Q)
198	Sheu (2007)	(WM,W,E,C,MPE,MPR,2,C&R)
199	S. M. McGovern and Gupta (2007)	(DLB,RG,H&M,C,SPE,MPR,2,T&WS)
200	Ahluwalia and Nema (2006)	(WM,E,E,C,SPE,MPR,2,C&EI)
201	Seamus M. McGovern and Gupta (2006)	(DLB,E,M,C,SPE,MPR,5,LB&T&WS&DC&D&R)
202	Sheu et al. (2005)	(ND,E,E,C,MPE,SPR,2,P)
203	Gerner, Kobeissi, David, Binder, and Descotes-Genon (2005)	(DLB,S,E,C,SPE,MPR,2,P&EI)
204	S. Lee, Lye, and Khoo (2001)	(EOLM,E,H,C,SPE,MPR,2,C&EI)
205	Luo, Zhou, and Caudill (2001)	(ND,E,E,F,SPE,SPR,4,C&T&EI&EC)

Coverage: (Main focus area, Case study sector, Solution methodology, Uncertainty modeling, Period, Product, Number of objectives, Objectives)

Main focus area= {Network design: ND, Disassembly line balancing/ sequencing: DLB, Location: L, Waste management: WM, Supplier selection: SS, Product recovery: PR, Vehicle routing problem: VRP, Order allocation: OA, Inventory management: IM, Product family design: PFD, Pricing: P, End of life management: EOLM, Risk management: RM, Process planning: PROCP, Production planning: PRODP, Capacity management: CM, Revenue sharing contract: RSC, Outsourcing the products: O, Eco-efficiency: EE, Post-disaster management: PDM, Customer relationship management: CRM, Production system: PS, Collection- disassembly: C-D, Lot scheduling: LS}

Case study sector= {Electronic: E, Random generated: RG, Manufacturing: M, Auto: A, City/ country: C, beverages: B, Chemical: CH, healthcare: H, Energy: EN, steel: S, Robotic: R, Waste treating: W, paper: P, fresh fruits: FF, food: F, lathe: L, Gold: G, Earthquake: EA, ballpoint pen: PP, Household: HO, Wood: WO, Agriculture: AG, Cloth: CL, Fish: FI, Watch: WA}

Solution methodology= {Exact: E, Heuristics: H, Metaheuristics: M}

Uncertainty modeling= {Crisp: C, Fuzzy: F, Stochastic: ST, Robust: R, Fuzzy-Stochastic: F-S, Grey: G, Simulation: SI, Fuzzy-Robust: FR, Neutrosophic: N, Maximum Entropy: ME, Taxonomy of uncertainty metrics: TUM}

Period= {Single: SPE, Multiple: MPE}

Product= {Single: SPR, Multiple: MPR}

Number of objectives= {2, 3, 4, 5, 7}

Objectives= {Cost: C, Environmental impact: EI, Profit: P, Social impact: SI, Time: T, Risk: R, Quality: Q, Energy consumption: EC, Demand: D, late delivery: LD, Work station: WS, Revenue: RE, line balance: LB, Waste: W, Satisfaction level: SAL, Responsiveness of a logistics network: RLN, Suppliers weight: SW, Efficiency: E, Distance: DI, Product volume: PV, Energy saving: ES, Recovered/ recycled product coverage: RPC, service level: SEL, Net present value: NPV, Inventory: I, Feasibility: F, Number of remanufacturing end of-use products: NR, Number of waiting products in remanufacturing workstation queues: NW, Safety: S, Return product: RP, Satisfy the price expectations of customers: SPEC, Global weight: GW, Fill rate: FR, Reliability: RE, Number of occupied robot/ machine: NCR, Missed working days: MWD, Performance: PE, Makespan: M, Landfilling flows: LF, Throughput: TH, Shortage: SH, Value of establishing potential sites: VEPS, Life span equilibrium: LSE, price: PR, equity among different firms: EF, Steady flow of products to each firm: SF, Total tardiness of cycle time: TTC, Capacity flexibility: CF, Capacity utilization: CU, Direction changes: DC, Used vehicles: UV, Total tardiness of returning repaired products: TTR, Encourage customers to use recycle products: EC, psychological: PS, Garbage accumulation points frequency: GF, Market share: MS}

2.3.1 Main focus areas

In this section the classification of papers regarding their main focus is provided. The results show that network design is the most focused area in the literature of this field with 43.8 percent. RL network design is the process of modeling a supply chain to improve the determination of the best location and optimal size of the facilities to be included in the network and aims to find an optimal chain that collects used, refurbished, or defective products from the market and processes their recovery activities efficiently (Rezaei 2015). Disassembly line balancing/ sequencing is in second place with 10.8 percent. This category refers to the process of determining the number of workstations and the sequence of tasks that must be performed in each station to have an efficient line. The next frequent one is the location problem with 8.4 percent. This problem determines which facilities are to be selected and where to locate new facilities to minimize the total distances or costs or to optimize other objectives to satisfy the RL supply chain aims. Waste management is the next one with 6.8 percent. It refers to all the activities including finding the best waste management strategy and the optimal level of tactical activities such as collection, transportation, and waste disposal and treatment. Supplier selection is in the next place with 5.6 percent. A reverse logistic supplier selection evaluates suppliers according to the defined attributes to select the best ones. The next one is product recovery and also VRP with 4.8 percent. The first one aims to select the best end-of-life options (such as disassembling, remanufacturing, and recycling) of components to maximize the recovery value, reduce costs, and increase sustainability. The last one refers to finding optimal routes for the considered objectives (such as costs, customer demands or satisfaction level, and environmental goals). The next one is order allocation with 2.8 percent. Order allocation aims to find an optimal amount of order of materials/goods to different suppliers for considered objectives such as cost, the environment, social, resiliency, and sustainability. The other categories are inventory management (2 percent), product family design (1.6 percent), pricing (1.2 percent), EOL management (1.2 percent), risk management (1.2 percent), process planning (0.8 percent), production planning (0.8 percent), capacity management (0.4 percent), revenue sharing contract (0.4 percent), outsourcing the products (0.4 percent), eco-efficiency (0.4 percent), post-disaster management (0.4 percent), CRM (0.4 percent), production system (0.4 percent), collection- disassembly (0.4 percent), lot scheduling (0.4 percent), respectively. Figure 6 shows the distribution of the classification of papers regarding their main focus.

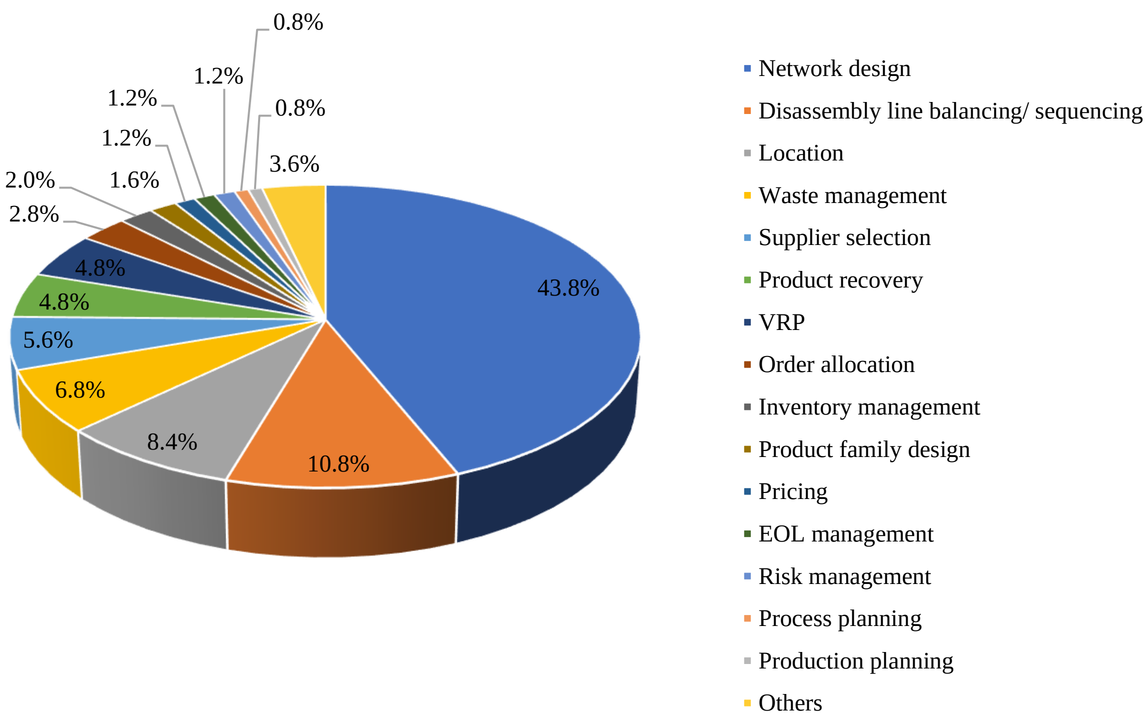

Figure 6. Distribution of the classification of papers regarding their main focus.

2.3.2 Case study sector

In this section we investigated the sectors considered in the papers. Our analysis reveals that out of all 205 papers, 24.4 percent used randomly generated examples to validate their optimization model. However, others used real examples from various sectors. Among them, electronics, with 26.8 percent, is the most considered sector. Because the electronic products have rapid growth and existing models reach their end of life sooner and reverse logistics helps reduce costs and environmental disadvantages, and corporates can then incorporate them into new products' manufacturing to reduce waste and their effects on society and lower production expenses. After that, manufacturing (generic manufacturing without saying the name of products) with 10 percent, auto with 6.7 percent, city/country with 4.3 percent, beverages, chemical and healthcare with 2.9 percent, energy, steel, robotic, waste treating, paper, and food with about 2 percent, fresh fruits with about 1 percent and other sectors such as lathe, gold, earthquake, and agriculture with an overall 5.3 percent considered, respectively. Figure 7 shows this distribution in detail.

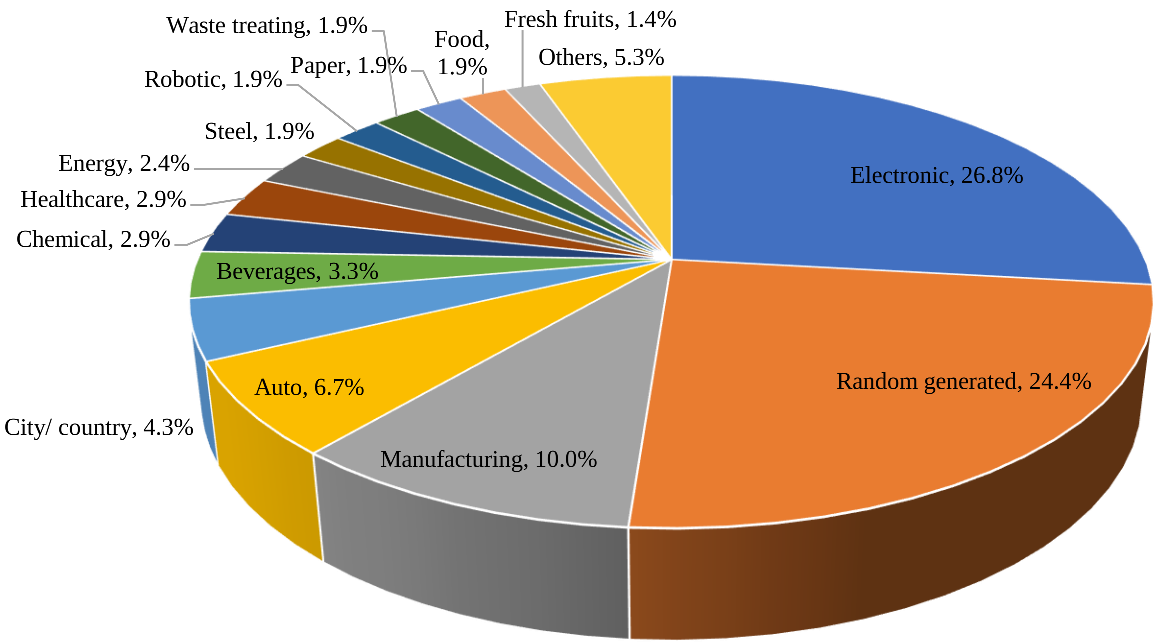

Figure 7. Distribution of case study sectors.

2.3.3 Solution methodology and method type

There are different methodologies in the literature of the MODM application to the RL field to solve the multi-objective optimization model. We investigated the solution methodology and method type of all 205 papers. Our analysis shows that the solution methodologies can be categorized into three categories 'exact', 'heuristics' and 'metaheuristics.' Exact algorithms are appropriate for small and finite-size optimization problems in bounded time. However, for the NP-Hard problems, this category is not suitable for finding an optimal solution. The most common and popular exact methods are branch and bound, linear programming, dynamic programming, mixed integer programming, and decomposition methods. Heuristics appeared to overcome exact algorithms' shortcomings. In this kind of algorithms, we have near-optimal solutions instead of optimal ones leading to computational efficiency. These algorithms are similar to an approximate for a problem to get a good guess of the solution, and these ones are problem dependent. It means that for any special problem, you should design a unique heuristic algorithm. Meta-heuristic algorithms appeared to overcome the heuristics shortcomings about problem dependency and to trap in a local optimum solution and failure in reaching the near-global optimum solution. These kind of algorithms' efficiency and effectiveness is more than heuristics; they can be applied to a broad range of problems (problem-independent), and also their mechanism can help them to escape from trapping in the local optimum solutions. The results show that exact, heuristics, and metaheuristic algorithms were considered in 205 papers with the share of 57.87%, 4.2%, and 37.93%, respectively. It is noted that the most frequently applied exact methods in this field are 'epsilon-constraint', 'weighted sum,' 'LP-metric,' and 'augmented epsilon-constraint,' respectively. Also, methods based on 'augmented epsilon-constraint 2', 'PageRank', '2-Opt exchange', and 'multiple service action' are the most frequent heuristic ones, and 'NSGA II,' 'GA,' 'MOPSO,' 'ABC,' 'VNS,' and 'ant colony' are the most metaheuristics ones, respectively.

2.3.4 Uncertainty modeling

In this section, we investigated the uncertainty modeling of the problem's parameters considered in the papers. The parameters deem to be deterministic or uncertain. Deterministic parameters are the ones whose values are known, and precise, and uncertain parameters are the ones whose values are not known and precise due to some uncertainties in real situations of markets. For more information about uncertainties in supply chain management, one can see Peidro et al. (2009), Simangunsong et al. (2012), and Flynn et al. (2016). Our analysis reveals that 59.6 percent of the papers consider crisp or deterministic parameters in their model, while 40.4 percent consider uncertainty in their modeling. Among the uncertainty approaches that these studies utilized, fuzzy (20.7 percent), stochastic (8.5 percent), robust (4.7 percent), fuzzy-stochastic (2.3 percent), grey (1.4 percent), simulation (0.9 percent), fuzzy-robust (0.5 percent), neutrosophic (0.5 percent), maximum entropy (0.5 percent) and taxonomy of uncertainty metrics (0.5 percent) were the most frequent ones, respectively. Figure 8 shows the distribution of the uncertainty modeling approaches. The most frequent parameters that considered uncertain in the RL optimization field are demands and return amounts, environmental issues, delivery time, lead-time, transportation time, and risk factors.

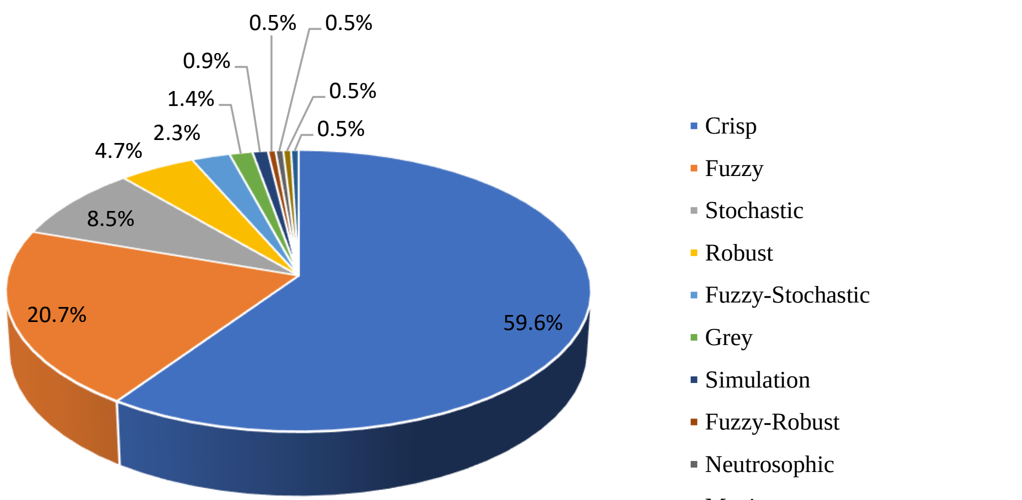

Figure 8. Distribution of the uncertainty modeling approaches.

2.3.5 Number of the period(s), product(s), and objectives

This part considers the number of the period(s), product(s), and objectives in the 205 target papers' multi-objective optimization model. In this field, the models can be single or multiple in terms of the period (multiple period model cover time horizon decision about problem but single period support one static point of time horizon), product (multiple product models cover more than one kind of products but the single product only support one special product in decisions), and also can have two or more than two objective functions. Our analysis shows that out of all 205 papers, about 58 percent considered single-period and 42 percent considered multiple periods. Also, 61 percent have multiple products in their model, while 39 percent considered only one product. Besides, about 54 percent considered only two objective functions, about 35 percent considered three objectives, about 11 percent considered four objectives, and the remaining papers, that are only 1 percent considered more than 4 objectives. Figure shows this distribution in detail.

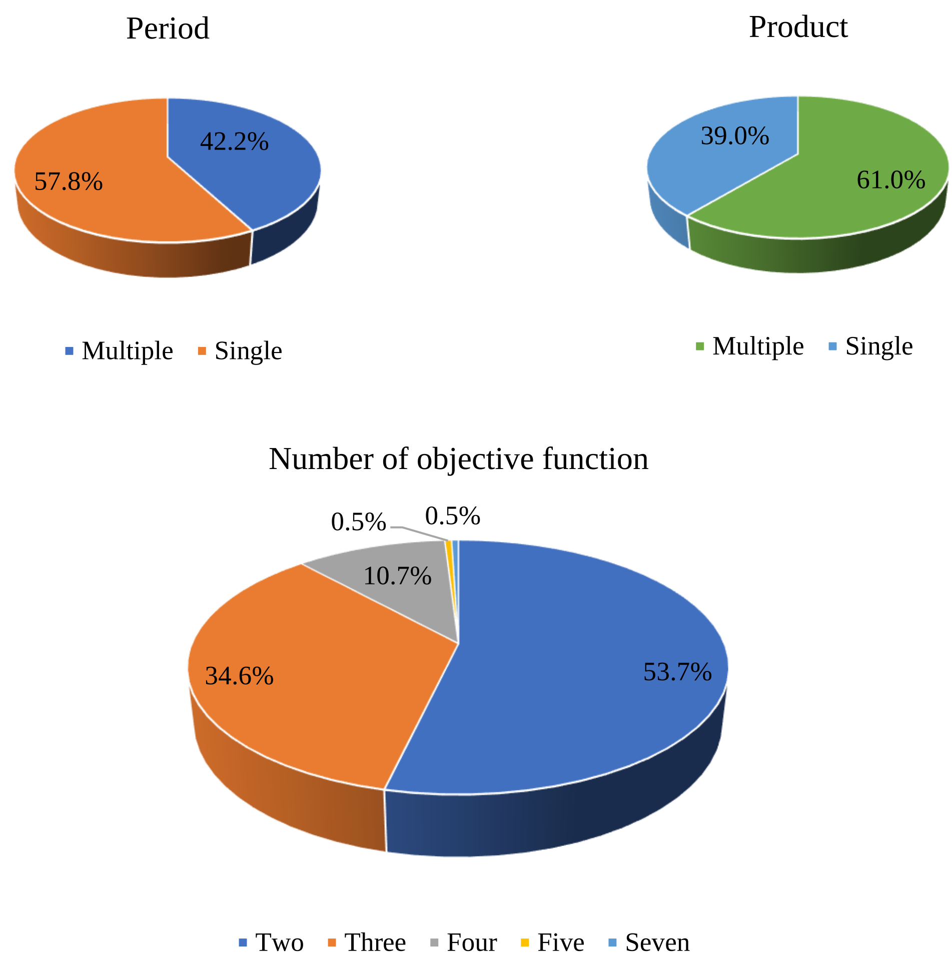

Figure 9. Distribution of the number of the period(s), product(s), and objectives.

2.3.6 Type of objectives

In this section, we investigated the objective functions considered in the papers to be optimized. Our analysis reveals that cost reduction is considered the most frequent objective with 24.2 percent Total cost consists of RL activities such as opening and design costs, transportation costs, holding costs, production costs, processing and re-processing costs, CO_2 emission costs, and the costs savings associated with combining distribution, collection/ inspection, combining recycling, and disposal centers. After that, environmental impact with 15.2 percent includes in their models. This objective highlights the severity of pollution, CO_2 emissions and waste. The next frequent is profit with 11.9 percent. Profit is defined by the total profit obtained by subtracting the total cost from the total revenue. After that social impact was considered with 5.6 percent. Social impact is, in this case, defined by social unsettlement surrounding the construction of disposal facilities, the number of jobs created by supply chains. Time with 5.4 percent is the next frequent objective. Time might refer to total operation time, the cycle time of the assembly and disassembly line, total transportation and delivery time, collection time, and lost production time. Risk is the last to be elaborated on with 4 percent. It refers to all strategic and operational points in the RL network at which unexpected consequences can occur that negatively affect the process. such consequences can for example occur during purchasing, transportation, storage, (re)processing, disposing. These can occur in several scopes such as the environment, society and HSE. Also, quality (3.3 percent), energy consumption (2.9 percent), demand (2.7 percent), late delivery (2.1 percent), work station (1.7 percent), revenue (1.5 percent), line balance (1.3 percent), waste (1.3 percent), satisfaction level (1.3 percent), the responsiveness of a logistics network (1 percent), suppliers weight (1 percent) and other objectives (13.7 percent) that each (40 objectives) have below 1 percent are the other objectives considered in the papers. Figure 10 shows this distribution in detail.

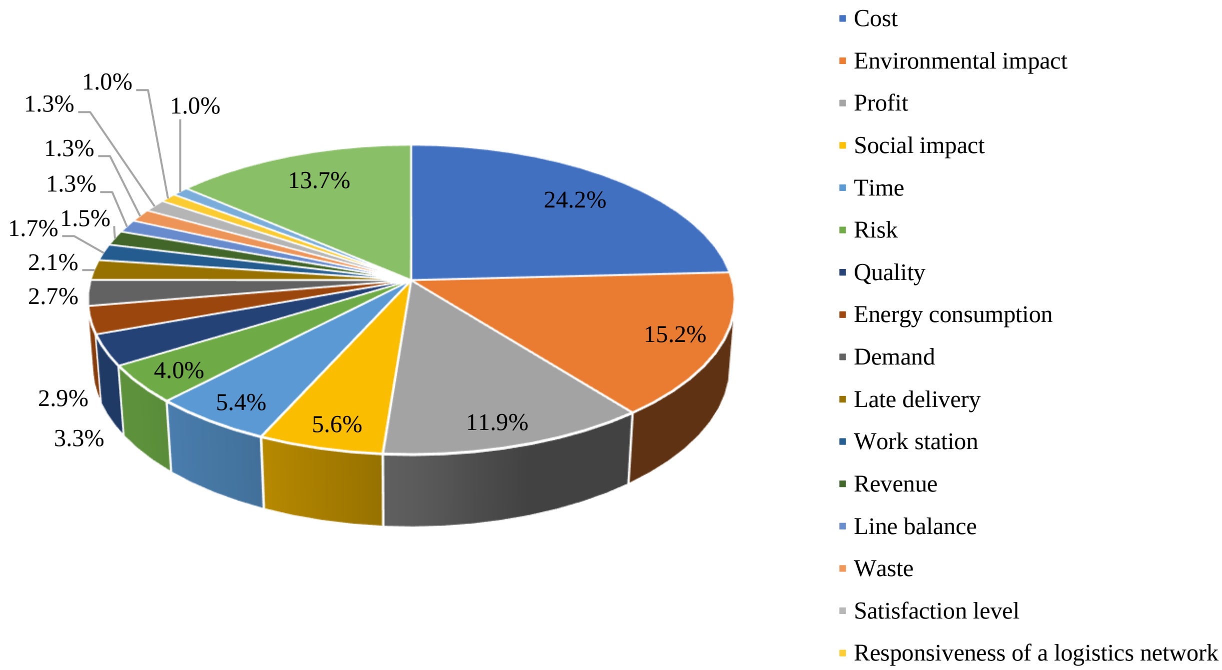

Figure 10. Distribution of kind of objectives.

3. Conclusion and future directions

Nowadays reverse logistics is one of the most exciting and highlighted topics researched in the fields of supply chain management and logistics. This is, inter alia, because of increased public awareness about environmental and societal issues, boundless waste generation, governmental and environmental legislation, and sustainable competitiveness. But firms struggle with this supply chain, which has many parties with different objectives involved, and are faced with significant problems and challenges in the design, planning, and control departments. Multi-objective decision-making (MODM) is one of the most worthwhile approaches to handle these complex problems. Despite the importance and applicability of multi-objective decision-making in reverse logistics (RL), there is not a literature review done on this topic. This paper aims to fill this critical gap and clarify the state of this field, reveal research gaps, and introduce future directions by showing the main contents and areas of the published research on reverse logistics by using multi-objective decision-making methods, and by illustrating how and with what significance multi-objective decision-making contributes to reverse logistics optimization. This allows practitioners to have a comprehensive view on the issue and to take advantage of it accordingly. In addition, it prevents researchers from devoting time to duplicate research.

For that reason, it is that after conducting the literature review stages, 205 relevant papers published in scientific journals were left and investigated. The results clearly illustrate the quantitative increase in the number of papers published in this field over the last 20 years, in which top journals and published papers in the field of reverse logistics were introduced. Besides, content analysis on the main focus area, case study sector, solution methodology, uncertainty modeling, period(s), and product(s) were purported. These results have significant implications for both academics and practitioners that work in this field. We propose some of the most important implications of the literature review results as follows:

- Some areas of research in this field have not received much attention, including the role of the industrial revolution in the form of industry 4.0 and new technologies in the RL activities such as IoT or blockchains. Also, researchers have not paid attention to some other areas such as human factors, ethical complications, cognitive biases, and other multidisciplinary areas. Whilst these play a significant role in the current business environment. So, future research should cover them.

- The case study sectors' investigation showed that 24.4 percent of the papers were conducted based on randomly generated data. This has some major complications when adapted to the real world. The main problem is the validity of these papers' models, and the lack there of. In fact, since real word problems often consist of complex and unique situations that sometimes behave different from what research expects them to, we cannot expect solutions based on generated date to be plausible and efficient. Therefore, it is recommended to conduct research by utilizing case studies. Besides, some sectors such as the electronics and car manufacturing industries have received significantly more attention than other sectors while paying attention to other fields such as the pharmaceutical, food and agricultural, and steel industries in which reverse logistics are very meaningful potentially can turn out crucial in improving effectiveness and efficiency in these sectors.
- About the uncertainty modeling, the results showed that about 60 percent of studies see the parameters of the problem in a deterministic state. However, we know that in real-world situations, there is a high level of uncertainty. Hence, considering uncertainty can only seem logical. Also, some novel uncertainty modeling approaches such as chaos theory, neutrosophic numbers, rough set theory, and robust optimization have received less attention than other popular and classical methods, while these can be considered as potential topics for future works.
- Another issue is about using solution methodology. Most of the studies have not considered the complexity of the problem and selected the methodology and method based on the name of the algorithm used in recent years while in real-world problems, it depends on the problem's size and complexity.

Similar to all studies, this research has limitations. We investigated scientific journal papers that were published in English between January 2001 and May 2021. Thus, other scientific articles, such as conference papers, theses, dissertations, books, and book chapters were excluded. Besides, the increasing trend of publishing in this field causes many articles that have been published towards the end of the study period to be ignored. In addition, because of limitations due to the length of the paper, we eschew the discussion about each element of content analysis categories and discussed the most important and frequent studies.

References

Abid, S., Radji, S., and Mhada, F. Z. (2019) 'Simulation techniques applied in reverse logistic: a review', *The 2019 International Colloquium on Logistics and Supply Chain Management (LOGISTIQUA)*.

Achillas, C., Aidonis, D., Vlachokostas, C., Moussiopoulos, N., Banias, G., and Triantafillou, D. (2012) 'A multi-objective decision-making model to select waste electrical and electronic equipment transportation media', *Resources, Conservation and Recycling*, 66, 76-84.

Afshari, H., Sharafi, M., ElMekkawy, T. Y., and Peng, Q. (2016) 'Multi-objective optimisation of facility location decisions within integrated forward/reverse logistics under uncertainty', *International Journal of Business Performance and Supply Chain Modelling*, 8, 250-276.

Agrawal, S., Singh, R. K., and Murtaza, Q. (2015) 'A literature review and perspectives in reverse logistics', *Resources, Conservation and Recycling*, 97, 76-92.

Ahlaqqach, M., Benhra, J., Mouatassim, S., and Lamrani, S. (2019) 'Modeling and optimization of a multi-objective ridesharing problem in the case of medical waste', *International. Journal of Recent Technology Engineering,* 8, 1911-1918.

Ahlaqqach, M., Benhra, J., Mouatassim, S., and Lamrani, S. (2020) 'Closed loop location routing supply chain network design in the end of life pharmaceutical products', *Supply Chain Forum: An International Journal,* 21, 79-92.

Ahluwalia, P. K., and Nema, A. K. (2006) 'Multi-objective reverse logistics model for integrated computer waste management', *Waste Management Research*, 24, 514-527.

Ahmadi, S., and Amin, S. H. (2019) 'An integrated chance-constrained stochastic model for a mobile phone closed-loop supply chain network with supplier selection', *Journal of Cleaner Production*, 226, 988-1003.

Ali, S. S., Paksoy, T., Torğul, B., and Kaur, R. (2020) 'Reverse logistics optimization of an industrial air conditioner manufacturing company for designing sustainable supply chain: a fuzzy hybrid multi-criteria decision-making approach', *Wireless Networks*, 26, 5759-5782.

Alkahtani, M., and Ziout, A. (2019) 'Design of a sustainable reverse supply chain in a remanufacturing environment: A case study of proton-exchange membrane fuel cell battery in Riyadh', *Advances in Mechanical Engineering*, 11(4), 1-14.

Altmann, M., and Bogaschewsky, R. (2014) 'An environmentally conscious robust closed-loop supply chain design', *Journal of Business Economics*, 84, 613-637.

Amin, S. H., and Baki, F. (2017) 'A facility location model for global closed-loop supply chain network design', *Applied Mathematical Modelling*, 41, 316-330.

Amin, S. H., and Zhang, G. (2012) 'An integrated model for closed-loop supply chain configuration and supplier selection: Multi-objective approach', *Expert Systems with Applications*, 39, 6782-6791.

Amin, S. H., and Zhang, G. (2013a) 'A multi-objective facility location model for closed-loop supply chain network under uncertain demand and return', *Applied Mathematical Modelling*, 37, 4165-4176.

Amin, S. H., and Zhang, G. (2013b) 'A three-stage model for closed-loop supply chain configuration under uncertainty', *International Journal of Production Research*, 51, 1405-1425.

Amin, S. H., and Zhang, G. (2014) 'Closed-loop supply chain network configuration by a multi-objective mathematical model', *International Journal of Business Performance and Supply Chain Modelling*, 6, 1-15.

Amir Mohammad, F. F., Gholian-Jouybari, F., Mohammad, M. P., and Mostafa, H.-K. (2017) 'A Bi-Objective Stochastic Closed-loop Supply Chain Network Design Problem Considering Downside Risk', *Industrial Engineering & Management Systems*, 16, 342-362.

Antucheviciene, J., Jafarnejad, A., Amoozad Mahdiraji, H., Razavi Hajiagha, S. H., and Kargar, A. (2020) 'Robust Multi-Objective Sustainable Reverse Supply Chain Planning: An Application in the Steel Industry', *Symmetry*, 12, 594.

Ashayeri, J., and Tuzkaya, G. (2011) 'Design of demand driven return supply chain for high-tech products', *Journal of Industrial Engineering and Management*, 4(3), 481-503.

Avakh Darestani, S., and Pourasadollah, F. (2019) 'A multi-objective fuzzy approach to closed-loop supply chain network design with regard to dynamic pricing', *Journal of Optimization in Industrial Engineering*, 12, 173-194.

Aydemir-Karadag, A., and Turkbey, O. (2013) 'Multi-objective optimization of stochastic disassembly line balancing with station paralleling', *Computers & Industrial Engineering*, 65, 413-425.

Azadeh, A., Zarrin, M., and Salehi, N. (2016) 'Supplier selection in closed loop supply chain by an integrated simulation-Taguchi-DEA approach', *Journal of Enterprise Information Management*, 29, 302-326.

Badurdeen, F., Aydin, R., and Brown, A. (2018) 'A multiple lifecycle-based approach to sustainable product configuration design', *Journal of Cleaner Production*, 200, 756-769.

Beiki, H., Seyedhosseini, S., Ghezavati, V., and Seyedaliakbar, S. (2020) 'Multi-objective optimization of multi-vehicle relief logistics considering satisfaction levels under uncertainty', *International Journal of Engineering*, 33, 814-824.

Bortolini, M., Galizia, F. G., Mora, C., Botti, L., and Rosano, M. (2018) 'Bi-objective design of fresh food supply chain networks with reusable and disposable packaging containers', *Journal of Cleaner Production*, 184, 375-388.

Budak, A. (2020) 'Sustainable reverse logistics optimization with triple bottom line approach: An integration of disassembly line balancing', *Journal of Cleaner Production*, 270, 122475.

Charnes, A., and Cooper, W. W. (1957) 'Management models and industrial applications of linear programming', *Management Science*, 4, 38-91.

Chen, Y.-W., Wang, L.-C., Wang, A., and Chen, T.-L. (2017) 'A particle swarm approach for optimizing a multi-stage closed loop supply chain for the solar cell industry', *Robotics and Computer-Integrated Manufacturing*, 43, 111-123.

Cheraghalipour, A., Paydar, M. M., and Hajiaghaei-Keshteli, M. (2018) 'A bi-objective optimization for citrus closed-loop supply chain using Pareto-based algorithms', *Applied Soft Computing*, 69, 33-59.

Chopra, S., Meindl, P., and Kalra, D. V. (2013) '*Supply chain management: strategy, planning, and operation*', Vol. 232, Pearson Boston, MA.

Dai, Z. (2016) 'Multi-objective fuzzy design of closed-loop supply chain network considering risks and environmental impact', *Human and Ecological Risk Assessment: An International Journal*, 22, 845-873.

Dalle Mura, M., Pistolesi, F., Dini, G., and Lazzerini, B. (2021) 'End-of-life product disassembly with priority-based extraction of dangerous parts', *Journal of Intelligent Manufacturing*, 32, 837-854.

Darbari, J. D., Kannan, D., Agarwal, V., and Jha, P. C. (2019) 'Fuzzy criteria programming approach for optimising the TBL performance of closed loop supply chain network design problem', *Annals of Operations Research*, 273, 693-738.

Deb, K. (2001) *Multiobjective Optimization Using Evolutionary Algorithms*. Wiley, New York: Springer.

Dehghanian, F., and Mansour, S. (2009) 'Designing sustainable recovery network of end-of-life products using genetic algorithm', *Resources, Conservation and Recycling*, 53, 559-570.

Dinler, E., and Güngör, Z. (2017) 'Planning decisions for recycling products containing hazardous and explosive substances: A fuzzy multi-objective model', *Resources, Conservation and Recycling*, 117, 93-101.

Djatna, T., and Amien, G. A. M. (2020) 'Bi-objective freight scheduling optimization in an integrated forward/reverse logistic network using non-dominated sorting genetic algorithm-II', *Decision Science Letters*, 9, 91-106.

Du, F., and Evans, G. W. (2008) 'A bi-objective reverse logistics network analysis for post-sale service', *Computers & Operations Research*, 35, 2617-2634.

Duta, L., Filip, F. G., Henrioud, J.-M., and Popescu, C. (2008) 'Disassembly line scheduling with genetic algorithms', *International Journal of Computers, Communications and Control*, 3, 230-240.

Duta, L., Filip, F. G., and Popescu, C. (2008) 'Evolutionary programming in disassembly decision making', *International Journal of Computers, Communications and Control*, 3, 282-286.

Dutta, P., Mishra, A., Khandelwal, S., and Katthawala, I. (2020) 'A multiobjective optimization model for sustainable reverse logistics in Indian E-commerce market', *Journal of Cleaner Production*, 249, 119348.

Entezaminia, A., Heydari, M., and Rahmani, D. (2016) 'A multi-objective model for multi-product multi-site aggregate production planning in a green supply chain: Considering collection and recycling centers', *Journal of Manufacturing Systems*, 40, 63-75.

Eskandarpour, M., Nikbakhsh, E., and Zegordi, S. H. (2014) 'Variable neighborhood search for the bi-objective post-sales network design problem: A fitness landscape analysis approach', *Computers & Operations Research*, 52, 300-314.

Fang, Y., Xu, H., Liu, Q., and Pham, D. T. (2020) 'Evolutionary optimization using epsilon method for resource-constrained multi-robotic disassembly line balancing', *Journal of Manufacturing Systems*, 56, 392-413.

Farahani, R., and Rezapour, S. (2011) '*Logistics operations and management: concepts and models*'. London, UK: Elsevier.

Farahinejad, K., and Gholamian, M. R. (2019) 'Optimizing the Safety Stock with Guaranteed Service Model in Reverse Logistics Considering Internal and External Returns', *International Journal of Supply and Operations Management*, 6, 188-199.

Farrokhi-Asl, H., Makui, A., Ghousi, R., and Rabbani, M. (2019) 'Designing a sustainable integrated forward/reverse logistics network', *Journal of Modelling in Management*, 14, 896-921.

Farrokhi-Asl, H., Tavakkoli-Moghaddam, R., Asgarian, B., and Sangari, E. (2017) 'Metaheuristics for a bi-objective location-routing-problem in waste collection management', *Journal of Industrial and Production Engineering*, 34, 239-252.

Fasihi, M., Tavakkoli-Moghaddam, R., Najafi, S. E., and Hajiaghaei-Keshteli, M. (2021) 'Developing a Bi-objective Mathematical Model to Design the Fish Closed-loop Supply Chain', *International Journal of Engineering*, 34, 1257-1268.

Fathollahi-Fard, A. M., Ahmadi, A., and Al, E. H. S. (2020) 'Sustainable closed-loop supply chain network for an integrated water supply and wastewater collection system under uncertainty', *Journal of Environmental Management*, 275, 111277.

Fazli-Khalaf, M., Mirzazadeh, A., and Pishvaee, M. S. (2017) 'A robust fuzzy stochastic programming model for the design of a reliable green closed-loop supply chain network', *Human and Ecological Risk Assessment: An International Journal*, 23, 2119-2149.

Feitó-Cespón, M., Sarache, W., Piedra-Jimenez, F., and Cespón-Castro, R. (2017) 'Redesign of a sustainable reverse supply chain under uncertainty: A case study', *Journal of Cleaner Production*, 151, 206-217.

Flynn, B. B., Koufteros, X., and Lu, G. (2016) 'On theory in supply chain uncertainty and its implications for supply chain integration', *Journal of Supply Chain Management*, 52, 3-27.

Fonseca, M. C., García-Sánchez, Á., Ortega-Mier, M., and Saldanha-da-Gama, F. (2010) 'A stochastic bi-objective location model for strategic reverse logistics', *Top*, 18, 158-184.

Gao, X. (2019) 'A novel reverse logistics network design considering multi-level investments for facility reconstruction with environmental considerations', *Sustainability*, 11, 2710.

Gao, X., and Cao, C. (2020) 'A novel multi-objective scenario-based optimization model for sustainable reverse logistics supply chain network redesign considering facility reconstruction', *Journal of Cleaner Production*, 270, 122405.

Gao, Y., Feng, Y., Wang, Q., Zheng, H., and Tan, J. (2018) 'A multi-objective decision making approach for dealing with uncertainty in EOL product recovery', *Journal of Cleaner Production*, 204, 712-725.

Gerner, S., Kobeissi, A., David, B., Binder, Z., and Descotes-Genon, B. (2005) 'Integrated approach for disassembly processes generation and recycling evaluation of an end-of-life product', *International Journal of Production Research*, 43, 195222.

Ghassemi, A., Asl-Najafi, J., and Yaghoubi, S. (2018) 'A dynamic bi-objective closed-loop supply chain network design considering supplier selection and remanufacturer subcontractors', *Uncertain Supply Chain Management*, 6, 117-134.

Ghayebloo, S., Tarokh, M. J., Venkatadri, U., and Diallo, C. (2015) 'Developing a bi-objective model of the closed-loop supply chain network with green supplier selection and disassembly of products: The impact of parts reliability and product greenness on the recovery network', *Journal of Manufacturing Systems*, 36, 76-86.

Ghezavati, V. R., and Beigi, M. (2016) 'Solving a bi-objective mathematical model for location-routing problem with time windows in multi-echelon reverse logistics using metaheuristic procedure', *Journal of Industrial Engineering International*, 12, 469-483.

Ghorbani, M., Arabzad, S. M., and Tavakkoli-Moghaddam, R. (2014) 'A multi-objective fuzzy goal programming model for reverse supply chain design', *International Journal of Operational Research*, 19, 141-153.

Ghoushchi, S. J., and Hushyar, I. (2020) 'Designing a closed-loop supply chain network and providing a multi-objective mathematical model to select a third-party logistics company and supplier simultaneously', *International Journal of Industrial Engineering*, 27, 245-275.

Goodarzian, F., Hosseini-Nasab, H., and Fakhrzad, M. (2020) 'A multi-objective sustainable medicine supply chain network design using a novel hybrid multi-objective metaheuristic algorithm', *International Journal of Engineering*, 33, 1986-1995.

Govindan, K., Agarwal, V., Darbari, J. D., and Jha, P. C. (2019) 'An integrated decision making model for the selection of sustainable forward and reverse logistic providers', *Annals of Operations Research*, 273, 607-650.

Govindan, K., Darbari, J. D., Agarwal, V., and Jha, P. C. (2017) 'Fuzzy multi-objective approach for optimal selection of suppliers and transportation decisions in an eco-efficient closed loop supply chain network', *Journal of Cleaner Production*, 165, 1598-1619.

Govindan, K., Jha, P. C., and Garg, K. (2016) 'Product recovery optimization in closed-loop supply chain to improve sustainability in manufacturing', *International Journal of Production Research*, 54, 1463-1486.

Govindan, K., Mina, H., Esmaeili, A., and Gholami-Zanjani, S. M. (2020) 'An Integrated Hybrid Approach for Circular supplier selection and Closed loop Supply Chain Network Design under Uncertainty', *Journal of Cleaner Production*, 242, 118317.

Govindan, K., Paam, P., and Abtahi, A.-R. (2016) 'A fuzzy multi-objective optimization model for sustainable reverse logistics network design', *Ecological Indicators*, 67, 753-768.

Govindan, K., Soleimani, H., and Kannan, D. (2015) 'Reverse logistics and closed-loop supply chain: A comprehensive review to explore the future', *European Journal of Operational Research*, 240, 603-626.

Guo, X., Zhou, M., Liu, S., and Qi, L. (2020) 'Lexicographic multiobjective scatter search for the optimization of sequence-dependent selective disassembly subject to multiresource constraints', *IEEE Transactions on Cybernetics*, 50, 3307-3317.

Guo, X., Zhou, M., Liu, S., and Qi, L. (2021) 'Multiresource-Constrained Selective Disassembly With Maximal Profit and Minimal Energy Consumption', *IEEE Transactions on Automation Science and Engineering*, 18, 804-816.

Haimes, Y. (1971) 'On a bicriterion formulation of the problems of integrated system identification and system optimization', *IEEE Transactions on Systems, Man, and Cybernetics*, 1, 296-297.

He, J., Chu, F., Zheng, F., Liu, M., and Chu, C. (2020) 'A multi-objective distribution-free model and method for stochastic disassembly line balancing problem', *International Journal of Production Research*, 58, 5721-5737.

Hu, Z.-H., and Sheu, J.-B. (2013) 'Post-disaster debris reverse logistics management under psychological cost minimization', *Transportation Research Part B: Methodological*, 55, 118-141.

Huang, L., Zhen, L., and Yin, L. (2020) 'Waste material recycling and exchanging decisions for industrial symbiosis network optimization', *Journal of Cleaner Production*, 276, 124073.

Ivanov, D., Pavlov, A., Pavlov, D., and Sokolov, B. (2017) 'Minimization of disruption-related return flows in the supply chain', *International Journal of Production Economics*, 183, 503-513.

Jabarzadeh, Y., Reyhani Yamchi, H., Kumar, V., and Ghaffarinasab, N. (2020) 'A multi-objective mixed-integer linear model for sustainable fruit closed-loop supply chain network', *Management of Environmental Quality: An International Journal*, 31, 1351-1373.

Jahangoshai Rezaee, M., Yousefi, S., and Hayati, J. (2017) 'A multi-objective model for closed-loop supply chain optimization and efficient supplier selection in a competitive environment considering quantity discount policy', *Journal of Industrial Engineering International*, 13, 199-213.

Jalil, S. A., Hashmi, N., Asim, Z., and Javaid, S. (2019) 'A de-centralized bi-level multi-objective model for integrated production and transportation problems in closed-loop supply chain networks', *International Journal of Management Science and Engineering Management*, 14, 206-217.

Jayaraman, V. (2006) 'Production planning for closed-loop supply chains with product recovery and reuse: an analytical approach', *International Journal of Production Research*, 44, 981-998.

Jiang, X., Li, J., Lu, Y., and Tian, G. (2020) 'Design of reverse logistics network for remanufacturing waste machine tools based on multi-objective gray wolf optimization algorithm', *IEEE Access*, 8, 141046-141056.

Jiang, Z., Wang, H., Zhang, H., Mendis, G., and Sutherland, J. W. (2020) 'Value recovery options portfolio optimization for remanufacturing end of life product', *Journal of Cleaner Production*, 210, 419-431.

Jiang, Z., Zhou, T., Zhang, H., Wang, Y., Cao, H., and Tian, G. (2016) 'Reliability and cost optimization for remanufacturing process planning', *Journal of Cleaner Production*, 135, 1602-1610.

Jin, H., Song, B. D., Yih, Y., and Sutherland, J. W. (2019) 'A bi-objective network design for value recovery of neodymium iron-boron magnets: A case study of the United States', *Journal of Cleaner Production*, 211, 257-269.

Jindal, A., and Sangwan, K. S. (2017) 'Multi-objective fuzzy mathematical modelling of closed-loop supply chain considering economical and environmental factors', *Annals of Operations Research*, 257, 95-120.

Jun, H. B., Cusin, M., Kiritsis, D., and Xirouchakis, P. (2007) 'A multi-objective evolutionary algorithm for EOL product recovery optimization: turbocharger case study', *International Journal of Production Research*, 45, 4573-4594.

Kadambala, D. K., Subramanian, N., Tiwari, M. K., Abdulrahman, M., and Liu, C. (2017) 'Closed loop supply chain networks: Designs for energy and time value efficiency', *International Journal of Production Economics*, 183, 382-393.

Kalayci, C. B., and Gupta, S. M. (2013a) 'Artificial bee colony algorithm for solving sequence-dependent disassembly line balancing problem', *Expert Systems with Applications*, 40, 7231-7241.

Kalayci, C. B., and Gupta, S. M. (2013b) 'A particle swarm optimization algorithm with neighborhood-based mutation for sequence-dependent disassembly line balancing problem', *The International Journal of Advanced Manufacturing Technology*, 69, 197-209.

Kalayci, C. B., Polat, O., and Gupta, S. M. (2016) 'A hybrid genetic algorithm for sequence-dependent disassembly line balancing problem', *Annals of Operations Research*, 242, 321-354.

Kargar, S., Pourmehdi, M., and Paydar, M. M. (2020) 'Reverse logistics network design for medical waste management in the epidemic outbreak of the novel coronavirus (COVID-19) ', *Science of The Total Environment*, 746, 141183.

Kazemi, N., Modak, N. M., and Govindan, K. (2019) 'A review of reverse logistics and closed loop supply chain management studies published in IJPR: a bibliometric and content analysis', *International Journal of Production Research*, 57, 4937-4960.

Keshavarz Ghorabaee, M., Amiri, M., Olfat, L., and Khatami Firouzabadi, S. M. A. (2017) 'Designing a multi-product multi-period supply chain network with reverse logistics and multiple objectives under uncertainty', *Technological and Economic Development of Economy*, 23, 520-548.

Khalafi, S., Hafezalkotob, A., Mohammaditabar, D., and Sayadi, M. K. (2020) 'Multi objective fuzzy programming of remanufactured green perishable products using supply contracts', *International Journal of Management Science and Engineering Management*, 15, 274-287.

Khan, A. S., Pruncu, C. I., Khan, R., Naeem, K., Ghaffar, A., Ashraf, P., and Room, S. (2020) 'A trade-off analysis of economic and environmental aspects of a disruption based closed-loop supply chain network', *Sustainability*, 12, 7056.

Khorshidian, H., Akbarpour Shirazi, M., and Fatemi Ghomi, S. M. T. (2019) 'An intelligent truck scheduling and transportation planning optimization model for product portfolio in a cross-dock', *Journal of Intelligent Manufacturing*, 30, 163-184.

Kumar, L., Jain, P. K., and Sharma, A. K. (2020) 'A fuzzy goal programme–based sustainable greenfield supply network design for tyre retreading industry', *The International Journal of Advanced Manufacturing Technology*, 108, 2855-2880.

Kusumastuti, R. D., Piplani, R., and Lim, G. (2009) 'Designing reverse logistics network for product recovery', *International Journal of Business Performance and Supply Chain Modelling*, 1, 257-289.

Kwak, M. (2015) 'Planning demand- and legislation-driven remanufacturing for a product family: A model for maximizing economic and environmental potential', *Industrial Engineering and Management Systems*, 14, 159-174.

Kwak, M., and Kim, H. (2015) 'Design for life-cycle profit with simultaneous consideration of initial manufacturing and end-of-life remanufacturing', *Engineering Optimization*, 47, 18-35.

Laili, Y., Li, X., Wang, Y., Ren, L., and Wang, X. (2021) 'Robotic disassembly sequence planning with backup actions', *IEEE Transactions on Automation Science and Engineering*, 19(3), 2095 - 2107.

Lee, H., Zhang, T., Boile, M., Theofanis, S., and Choo, S. (2013) 'Designing an integrated logistics network in a supply chain system', *KSCE Journal of Civil Engineering*, 17, 806-814.

Lee, J.-E., Chung, K.-Y., Lee, K.-D., and Gen, M. (2015) 'A multi-objective hybrid genetic algorithm to minimize the total cost and delivery tardiness in a reverse logistics', *Multimedia Tools and Applications*, 74, 9067-9085.

Lee, S., Lye, S., and Khoo, M. (2001) 'A multi-objective methodology for evaluating product end-of-life options and disassembly', *The International Journal of Advanced Manufacturing Technology*, 18, 148-156.

Li, S., Wang, N., He, Z., Che, A., and Ma, Y. (2012) 'Design of a multiobjective reverse logistics network considering the cost and service level', *Mathematical Problems in Engineering*, 2012, 928620.

Li, Z., Kucukkoc, I., and Zhang, Z. (2019) 'Iterated local search method and mathematical model for sequence-dependent U-shaped disassembly line balancing problem', *Computers & Industrial Engineering*, 137, 106056.

Liang, J., Guo, S., Du, B., Li, Y., Guo, J., Yang, Z., and Pang, S. (2021) 'Minimizing energy consumption in multi-objective two-sided disassembly line balancing problem with complex execution constraints using dual-individual simulated annealing algorithm', *Journal of Cleaner Production*, 284, 125418.

Liu, A., Zhang, Y., Luo, S., and Miao, J. (2020) 'Dual-channel global closed-loop supply chain network optimization based on random demand and recovery rate', *International Journal of Environmental Research and Public Health*, 17(23), 8768.

Liu, J., and Wang, S. (2017) 'Balancing disassembly line in product recovery to promote the coordinated development of economy and environment', *Sustainability*, 9, 309.

Liu, J., Zhou, Z., Pham, D. T., Xu, W., Yan, J., Liu, A., Ji, C., and Liu, Q. (2018) 'An improved multi-objective discrete bees algorithm for robotic disassembly line balancing problem in remanufacturing', *The International Journal of Advanced Manufacturing Technology*, 97, 3937-3962.

Liu, X., Chu, F., Dolgui, A., Zheng, F., and Liu, M. (2021) 'Service-oriented bi-objective robust collection-disassembly problem with equipment selection', *International Journal of Production Research*, 59, 1676-1690.

Lu, J., and Ruan, D. (2007) '*Multi-objective group decision making: methods, software and applications with fuzzy set techniques*', (Vol. 6). London, UK: Imperial College Press.

Lu, Q., Ren, Y., Jin, H., Meng, L., Li, L., Zhang, C., and Sutherland, J. W. (2020) 'A hybrid metaheuristic algorithm for a profit-oriented and energy-efficient disassembly sequencing problem', *Robotics and Computer-Integrated Manufacturing*, 61, 101828.

Lu, S., Xie, L., Zhu, L., and Su, H. (2019) 'Integrated scheduling of a hybrid manufacturing and recovering system in a multi-product multi-stage environment with carbon emission', *Journal of Cleaner Production*, 222, 695-709.

Lu, S., Zhu, L., Wang, Y., Xie, L., and Su, H. (2020) 'Integrated forward and reverse logistics network design for a hybrid assembly-recycling system under uncertain return and waste flows: A fuzzy multi-objective programming', *Journal of Cleaner Production*, 243, 118591.

Luo, Y., Zhou, M., and Caudill, R. J. (2001) 'An integrated e-supply chain model for agile and environmentally conscious manufacturing', *IEEE/ASME Transactions on Mechatronics*, 6, 377-386.

Maleki, L., Pasandideh, S. H. R., Niaki, S. T. A., and Cárdenas-Barrón, L. E. (2017) 'Determining the prices of remanufactured products, capacity of internal workstations and the contracting strategy within queuing framework', *Applied Soft Computing*, 54, 313-321.

Mavrotas, G. (2009) 'Effective implementation of the ε-constraint method in multi-objective mathematical programming problems', *Applied Mathematics and Computation*, 213, 455-465.

McGovern, S. M., and Gupta, S. M. (2006) 'Ant colony optimization for disassembly sequencing with multiple objectives', *The International Journal of Advanced Manufacturing Technology*, 30, 481-496.

McGovern, S. M., and Gupta, S. M. (2007) 'Combinatorial optimization analysis of the unary NP-complete disassembly line balancing problem', *International Journal of Production Research*, 45, 4485-4511.

Mehrbakhsh, S., and Ghezavati, V. (2020) 'Mathematical modeling for green supply chain considering product recovery capacity and uncertainty for demand', *Environmental Science and Pollution Research*, 27, 44378-44395.

Mehrbod, M., Tu, N., and Miao, L. (2014) 'A hybrid solution approach for a multi-objective closed-loop logistics network under uncertainty', *Journal of Industrial Engineering International*, 11, 237-252.

Mehrbod, M., Xue, Z., Miao, L., and Lin, W.-H. (2015) 'A straight priority-based genetic algorithm for a logistics network', *RAIRO-Operations Research*, 49, 243-264.

Meng, K., Cao, Y., Peng, X., Prybutok, V., and Gupta, V. (2020) 'Demand-dependent recovery decision-making of a batch of products for sustainability', *International Journal of Production Economics*, 224, 107552.

Meng, K., Lou, P., Peng, X., and Prybutok, V. (2017) 'Multi-objective optimization decision-making of quality dependent product recovery for sustainability', *International Journal of Production Economics*, 188, 72-85.

Meng, K., Qian, X., Lou, P., and Zhang, J. (2020) 'Smart recovery decision-making of used industrial equipment for sustainable manufacturing: belt lifter case study', *Journal of Intelligent Manufacturing*, 31, 183-197.

Mirakhorli, A. (2014) 'Fuzzy multi-objective optimization for closed loop logistics network design in bread-producing industries', *The International Journal of Advanced Manufacturing Technology*, 70, 349-362.

Moghaddam, K. S. (2015a) 'Fuzzy multi-objective model for supplier selection and order allocation in reverse logistics systems under supply and demand uncertainty', *Expert Systems with Applications*, 42, 6237-6254.

Moghaddam, K. S. (2015b) 'Supplier selection and order allocation in closed-loop supply chain systems using hybrid Monte Carlo simulation and goal programming', *International Journal of Production Research*, 53, 6320-6338.

Mohebalizadeh, M., and Hafezalkotob, A. (2018) 'Modelling sustainable supply chain management problem with fuzzy demand based on multi-criteria decision making methods', *International Journal of Industrial and Systems Engineering*, 30, 267-297.

Moslehi, M. S., Sahebi, H., and Teymouri, A. (2020) 'A multi-objective stochastic model for a reverse logistics supply chain design with environmental considerations', *Journal of Ambient Intelligence and Humanized Computing*, 12, 8017-8040.

Mota, B., Gomes, M. I., Carvalho, A., and Barbosa-Povoa, A. P. (2018) 'Sustainable supply chains: An integrated modeling approach under uncertainty', *Omega*, 77, 32-57.

Nobari, A., and Kheirkhah, A. (2018) 'Integrated and dynamic design of sustainable closed-loop supply chain network considering pricing', *Scientia Iranica*, 25, 410-430.

Ondemir, O., and Gupta, S. M. (2014) 'Quality management in product recovery using the Internet of Things: An optimization approach', *Computers in Industry*, 65, 491-504.

Özceylan, E., and Paksoy, T. (2014) 'Interactive fuzzy programming approaches to the strategic and tactical planning of a closed-loop supply chain under uncertainty', *International Journal of Production Research*, 52, 2363-2387.

Özkır, V., and Başlıgil, H. (2013) 'Multi-objective optimization of closed-loop supply chains in uncertain environment', *Journal of Cleaner Production*, 41, 114-125.

Paksoy, T., Pehlivan, N. Y., and Özceylan, E. (2012) 'Fuzzy multi-objective optimization of a green supply chain network with risk management that includes environmental hazards', *Human and Ecological Risk Assessment: An International Journal*, 18, 1120-1151.

Pan, X., Xie, Q., and Feng, Y. (2020) 'Designing recycling networks for construction and demolition waste based on reserve logistics research field', *Journal of Cleaner Production*, 260, 120841.

Pant, K., Yadav, V. S., and Singh, A. R. (2021) 'Design of multi-tier multi-time horizon closed-loop supply chain network with sustainability under uncertain environment for Indian paper industry', *International Journal of Sustainable Engineering*, 14, 107-122.

Papen, P., and Amin, S. H. (2019) 'Network configuration of a bottled water closed-loop supply chain with green supplier selection', *Journal of Remanufacturing*, 9, 109-127.

Park, K., Kim, J., Ko, Y. D., and Song, B. D. (2020) 'Redesign of reverse logistics network with managerial decisions on the minimum quality level and remanufacturing policy', *Journal of the Operational Research Society*, 72, 1564-1577.

Pati, R. K., Vrat, P., and Kumar, P. (2008) 'A goal programming model for paper recycling system', Omega, 36, 405-417.

Paydar, M. M., Babaveisi, V., and Safaei, A. S. (2017) 'An engine oil closed-loop supply chain design considering collection risk', *Computers & Chemical Engineering*, 104, 38-55.

Peidro, D., Mula, J., Poler, R., and Lario, F.-C. (2009) 'Quantitative models for supply chain planning under uncertainty: a review', *The International Journal of Advanced Manufacturing Technology*, 43, 400-420.

Pishvaee, M. S., Farahani, R. Z., and Dullaert, W. (2010) 'A memetic algorithm for bi-objective integrated forward/reverse logistics network design', *Computers & Operations Research*, 37, 1100-1112.

Pokharel, S., and Mutha, A. (2009) 'Perspectives in reverse logistics: a review', *Resources, Conservation and Recycling*, 53, 175-182.

Porkar, S., Mahdavi, I., Maleki Vishkaei, B., and Hematian, M. (2020) 'Green supply chain flow analysis with multi-attribute demand in a multi-period product development environment', *Operational Research*, 20, 1405-1435.

Pouriani, S., Asadi-Gangraj, E., and Paydar, M. M. (2019) 'A robust bi-level optimization modelling approach for municipal solid waste management; a real case study of Iran', *Journal of Cleaner Production*, 240, 118125.

Pourmehdi, M., Paydar, M. M., and Asadi-Gangraj, E. (2020) 'Scenario-based design of a steel sustainable closed-loop supply chain network considering production technology', *Journal of Cleaner Production*, 277, 123298.

Prajapati, H., Kant, R., and Shankar, R. (2019) 'Bequeath life to death: State-of-art review on reverse logistics', *Journal of Cleaner Production*, 211, 503-520.

Quariguasi Frota Neto, J., Walther, G., Bloemhof, J., van Nunen, J. A. E. E., and Spengler, T. (2009) 'A methodology for assessing eco-efficiency in logistics networks', *European Journal of Operational Research*, 193, 670-682.

Rabbani, M., Amirhossein Sadati, S., and Farrokhi-Asl, H. (2020) 'Incorporating location routing model and decision making techniques in industrial waste management: Application in the automotive industry', *Computers & Industrial Engineering*, 148, 106692.

Rabbani, M., Mokhtarzadeh, M., and Farrokhi-Asl, H. (2018) 'A new mathematical model for designing a municipal solid waste system considering environmentally issues', *International Journal of Supply and Operations Management*, 5, 234-255.

Rachih, H., Mhada, F. Z., and Chiheb, R. (2019) 'Meta-heuristics for reverse logistics: A literature review and perspectives', *Computers & Industrial Engineering*, 127, 45-62.

Rahimi, M., Baboli, A., and Rekik, Y. (2016) 'Sustainable inventory routing problem for perishable products by considering reverse logistic', *Ifac-Papersonline*, 49, 949-954.

Rahimi, M., and Ghezavati, V. (2018) 'Sustainable multi-period reverse logistics network design and planning under uncertainty utilizing conditional value at risk (CVaR) for recycling construction and demolition waste', *Journal of Cleaner Production*, 172, 1567-1581.

Ramezani, M., Bashiri, M., and Tavakkoli-Moghaddam, R. (2013) 'A new multi-objective stochastic model for a forward/reverse logistic network design with responsiveness and quality level', *Applied Mathematical Modelling*, 37, 328-344.

Ramos, T. R. P., Gomes, M. I., and Barbosa-Póvoa, A. P. (2014) 'Planning a sustainable reverse logistics system: Balancing costs with environmental and social concerns', *Omega*, 48, 60-74.

Rasi, R. E. (2018) 'A cuckoo search algorithm approach for multi-objective optimization in reverse logistics network under uncertainty condition', *International Journal of Supply and Operations Management*, 5, 66-80.

Ren, Y., Jin, H., Zhao, F., Qu, T., Meng, L., Zhang, C., Wang, G., and Sutherland, J. W. (2021) 'A Multiobjective disassembly planning for value recovery and energy conservation from end-of-life products', *IEEE Transactions on Automation Science and Engineering*, 18, 791-803.

Ren, Y., Zhang, C., Zhao, F., Tian, G., Lin, W., Meng, L., and Li, H. (2018) 'Disassembly line balancing problem using interdependent weights-based multi-criteria decision making and 2-Optimal algorithm', *Journal of Cleaner Production*, 174, 1475-1486.

Rezaei, J. (2015) 'A systematic review of multi-criteria decision-making applications in reverse logistics', *Transportation Research Procedia*, 10, 766-776.

Rogers, D. S., and Tibben-Lembke, R. (2001) 'An examination of reverse logistics practices', *Journal of Business Logistics*, 22, 129-148.

Roghanian, E., and Cheraghalipour, A. (2019) 'Addressing a set of meta-heuristics to solve a multi-objective model for closed-loop citrus supply chain considering CO2 emissions', *Journal of Cleaner Production*, 239, 118081.

Rossit, D. G., Toutouh, J., and Nesmachnow, S. (2020) 'Exact and heuristic approaches for multi-objective garbage accumulation points location in real scenarios', *Waste Managment*, 105, 467-481.

Sadjadi, S. J., Soltani, R., and Eskandarpour, A. (2014) 'Location based treatment activities for end of life products network design under uncertainty by a robust multi-objective memetic-based heuristic approach', *Applied Soft Computing*, 23, 215-226.

Safdar, N., Khalid, R., Ahmed, W., and Imran, M. (2020) 'Reverse logistics network design of e-waste management under the triple bottom line approach', *Journal of Cleaner Production*, 272, 122662.

Saffar, M. M., Shakouri G, H., and Razmi, J. (2015) 'A new multi objective optimization model for designing a green supply chain network under uncertainty', *International Journal of Industrial Engineering Computations*, 6, 15-32.

Sajedi, S., Sarfaraz, A., Bamdad, S., and Khalili-Damghani, K. (2020) 'Designing a sustainable reverse logistics network considering the conditional value at risk and uncertainty of demand under different quality and market scenarios', *International Journal of Engineering*, 33, 2252-2271.

Sathish, T., and Jayaprakash, J. (2015) 'Meta-heuristic approach to solve multi period disassembly-to-order problem of end-of life products using adaptive genetic algorithm', *International Journal of Mechanical & Mechatronics Engineering*, 15, 59-67.

Saxena, L. K., Jain, P. K., and Sharma, A. K. (2018) 'A fuzzy goal programme with carbon tax policy for Brownfield Tyre remanufacturing strategic supply chain planning', *Journal of Cleaner Production*, 198, 737-753.

Sazvar, Z., Zokaee, M., Tavakkoli-Moghaddam, R., Salari, S. A., and Nayeri, S. (2021) 'Designing a sustainable closed-loop pharmaceutical supply chain in a competitive market considering demand uncertainty, manufacturer's brand and waste management', *Annals of Operations Research*, 1-32.

Shahbazbegian, V., Hosseini-Motlagh, S.-M., and Haeri, A. (2020) 'Integrated forward/reverse logistics thin-film photovoltaic power plant supply chain network design with uncertain data', *Applied Energy*, 277, 115538.

Shakourloo, A. (2017) 'A multi-objective stochastic goal programming model for more efficient remanufacturing process', *The International Journal of Advanced Manufacturing Technology*, 91, 1007-1021.

Shakourloo, A., Kazemi, A., and Javad, M. O. M. (2016) 'A new model for more effective supplier selection and remanufacturing process in a closed-loop supply chain', *Applied Mathematical Modelling*, 40, 9914-9931.

Sheu, J.-B. (2007) 'A coordinated reverse logistics system for regional management of multi-source hazardous wastes', *Computers & Operations Research*, 34, 1442-1462.

Sheu, J.-B. (2008) 'Green supply chain management, reverse logistics and nuclear power generation', *Transportation Research Part E: Logistics and Transportation Review*, 44, 19-46.

Sheu, J.-B., Chou, Y.-H., and Hu, C.-C. (2005) 'An integrated logistics operational model for green-supply chain management', *Transportation Research Part E: Logistics and Transportation Review*, 41, 287-313.

Shi, J.-L., Ma, M.-Y., Wang, H.-Z., and Qu, H.-W. (2020) 'An optimal EoL time point prediction method for mechanical product remanufacturing based on LCA and LCC', *Journal of Industrial and Production Engineering*, 37, 165-174.

Shi, J., Chen, W., Zhou, Z., and Zhang, G. (2020) 'A bi-objective multi-period facility location problem for household e-waste collection', *International Journal of Production Research*, 58, 526-545.

Shimizu, Y., and Yamada, Y. (2008) 'A meta-heuristic approach for supporting adaptive disassembly sequencing using a multi-objective concept', *International Journal of Sustainable Engineering*, 1, 202-213.

Shokouhyar, S., and Aalirezaei, A. (2017) 'Designing a sustainable recovery network for waste from electrical and electronic equipment using a genetic algorithm', *International Journal of Environment and Sustainable Development*, 16, 60-79.

Simangunsong, E., Hendry, L. C., and Stevenson, M. (2012) 'Supply-chain uncertainty: a review and theoretical foundation for future research', *International Journal of Production Research*, 50, 4493-4523.

Soleimani, H., Chaharlang, Y., and Ghaderi, H. (2018) 'Collection and distribution of returned-remanufactured products in a vehicle routing problem with pickup and delivery considering sustainable and green criteria', *Journal of Cleaner Production*, 172, 960-970.

Soleimani, H., Govindan, K., Saghafi, H., and Jafari, H. (2017) 'Fuzzy multi-objective sustainable and green closed-loop supply chain network design', *Computers & Industrial Engineering*, 109, 191-203.

Subulan, K., Taşan, A. S., and Baykasoğlu, A. (2015) 'A fuzzy goal programming model to strategic planning problem of a lead/acid battery closed-loop supply chain', *Journal of Manufacturing Systems*, 37, 243-264.

Sun, W., and Su, Y. (2020) 'Analysing Green Forward–Reverse Logistics with NSGA-II', *Sustainability*, 12, 6082.

Taleizadeh, A. A., Pourrezaie Khaligh, P., and Moon, I. (2019) 'Hybrid NSGA-II for an imperfect production system considering product quality and returns under two warranty policies', *Applied Soft Computing*, 75, 333-348.

Tao, Y., Meng, K., Lou, P., Peng, X., and Qian, X. (2019) 'Joint decision-making on automated disassembly system scheme selection and recovery route assignment using multi-objective meta-heuristic algorithm', *International Journal of Production Research*, 57, 124-142.

Tari, I., and Alumur, S. A. (2014) 'Collection center location with equity considerations in reverse logistics networks', *INFOR: Information Systems and Operational Research*, 52, 157-173.

Tosarkani, B. M., and Amin, S. H. (2018) 'A multi-objective model to configure an electronic reverse logistics network and third party selection', *Journal of Cleaner Production*, 198, 662-682.

Tosarkani, B. M., Amin, S. H., and Zolfagharinia, H. (2020) 'A scenario-based robust possibilistic model for a multi-objective electronic reverse logistics network', *International Journal of Production Economics*, 224, 107557.

Trochu, J., Chaabane, A., and Ouhimmou, M. (2020) 'A carbon-constrained stochastic model for eco-efficient reverse logistics network design under environmental regulations in the CRD industry', *Journal of Cleaner Production*, 245, 118818.

Tseng, Wee, Reong, and Wu. (2019) 'Considering JIT in assigning task for return vehicle in green supply chain', *Sustainability*, 11, 6464.

Tseng, S.-H., Wee, H. M., Song, P. S., and Jeng, S. (2019) 'Optimal green supply-chain model design considering full truckload', *Kybernetes*, 48, 2150-2174.

Tuzkaya, G., Gülsün, B., and Önsel, Ş. (2011) 'A methodology for the strategic design of reverse logistics networks and its application in the Turkish white goods industry', *International Journal of Production Research*, 49, 4543-4571.

Vahdani, B., Tavakkoli-Moghaddam, R., Jolai, F., and Baboli, A. (2013) 'Reliable design of a closed loop supply chain network under uncertainty: An interval fuzzy possibilistic chance-constrained model', *Engineering Optimization*, 45, 745-765.

Vahdani, B., Tavakkoli-Moghaddam, R., Modarres, M., and Baboli, A. (2012) 'Reliable design of a forward/reverse logistics network under uncertainty: A robust-M/M/c queuing model', *Transportation Research Part E: Logistics and Transportation Review*, 48, 1152-1168.

Wang, X., Zhang, K., and Yang, B. a. (2011) 'Optimal design of reverse logistics network on e-waste in Shanghai. *International Journal of Networking and Virtual Organisations*, 8, 209-223.

Wang, Y., Lu, T., and Zhang, C. (2012) 'Integrated logistics network design in hybrid manufacturing/remanufacturing system under low-carbon restriction', in *LISS 2012*. Berlin, Heidelberg: Springer.

Wang, Y., Peng, S., Assogba, K., Liu, Y., Wang, H., Xu, M., and Wang, Y. (2018) 'Implementation of cooperation for recycling vehicle routing optimization in two-echelon reverse logistics networks', *Sustainability*, 10, 1358.

Wang, Y., and Shi, Q. (2019) 'Spare parts closed-loop logistics network optimization problems: Model formulation and meta-heuristics solution', *IEEE Access*, 7, 45048-45060.

Wang, Z., Huang, L., and He, C. X. (2020) 'A multi-objective and multi-period optimization model for urban healthcare waste's reverse logistics network design', *Journal of Combinatorial Optimization*, 42, 785-812.

Wongthatsanekorn, W. (2009) 'A goal programming approach for plastic recycling system in Thailand', *Proceedings of World Academy of Science, Engineering and Technology*.

Wu, Z., Kwong, C. K., Aydin, R., and Tang, J. (2017) 'A cooperative negotiation embedded NSGA-II for solving an integrated product family and supply chain design problem with remanufacturing consideration', *Applied Soft Computing*, 57, 19-34.

Wu, Z., Kwong, C. K., Lee, C. K. M., and Tang, J. (2016) 'Joint decision of product configuration and remanufacturing for product family design', *International Journal of Production Research*, 54, 4689-4702.

Xiao, R., Cai, Z., and Zhang, X. (2012) 'An optimization approach to risk decision-making of closed-loop logistics based on SCOR model', *Optimization*, 61, 1221-1251.

Yadollahinia, M., Teimoury, E., and Paydar, M. M. (2018) 'Tire forward and reverse supply chain design considering customer relationship management', *Resources, Conservation and Recycling*, 138, 215-228.

Yang, C., and Chen, X. (2020) 'A novel approach integrating FANP and MOMILP for the collection centre location problem in closed-loop supply chain', *International Journal of Sustainable Engineering*, 13, 171-183.

Yang, W., Xie, Q., and Li, M. (2019) 'Inventory control method of reverse logistics for shipping electronic commerce based on improved multi-objective particle swarm optimization algorithm', *Journal of Coastal Research*, 83, 786.

Yu, H., and Solvang, W. D. (2016) 'A general reverse logistics network design model for product reuse and recycling with environmental considerations', *The International Journal of Advanced Manufacturing Technology*, 87, 2693-2711.

Yu, H., and Solvang, W. D. (2018) 'Incorporating flexible capacity in the planning of a multi-product multi-echelon sustainable reverse logistics network under uncertainty', *Journal of Cleaner Production*, 198, 285-303.

Yu, H., and Solvang, W. D. (2020) 'A fuzzy-stochastic multi-objective model for sustainable planning of a closed-loop supply chain considering mixed uncertainty and network flexibility', *Journal of Cleaner Production*, 266, 121702.

Yu, H., Sun, X., Solvang, W. D., and Zhao, X. (2020) 'Reverse logistics network design for effective management of medical waste in epidemic outbreaks: Insights from the coronavirus disease 2019 (COVID-19) outbreak in Wuhan (China)', *International Journal of Environmental Research and Public Health*, 17(5), 1770.

Yuchi, Q., Wang, N., Li, S., Yang, Z., and Jiang, B. (2019) 'A bi-objective reverse logistics network design under the emission trading scheme', *IEEE Access*, 7, 105072-105085.

Zadeh, L. (1963) 'Optimality and non-scalar-valued performance criteria', *IEEE Transactions on Automatic Control*, 8, 59-60.

Zandkarimkhani, S., Nasiri, M. M., and Heydari, J. (2020) 'Sustainable open-loop supply chain network design considering location routing problem: a hybrid approach based on FAHP, FTOPSIS, and mathematical programming', *International Journal of Logistics Systems and Management*, 36, 92-123.

Zarbakhshnia, N., Kannan, D., Kiani Mavi, R., and Soleimani, H. (2020) 'A novel sustainable multi-objective optimization model for forward and reverse logistics system under demand uncertainty', *Annals of Operations Research*, 295, 843-880.

Zarbakhshnia, N., Soleimani, H., Goh, M., and Razavi, S. S. (2019) 'A novel multi-objective model for green forward and reverse logistics network design', *Journal of Cleaner Production*, 208, 1304-1316.

Zhang, L., Zhao, X., Ke, Q., Dong, W., and Zhong, Y. (2021) 'Disassembly line balancing optimization method for high efficiency and low carbon emission', *International Journal of Precision Engineering and Manufacturing-Green Technology*, 8, 233-247.

Zhang, R., Ong, S. K., and Nee, A. Y. C. (2015) 'A simulation-based genetic algorithm approach for remanufacturing process planning and scheduling', *Applied Soft Computing*, 37, 521-532.

Zhao, J., and Ke, G. Y. (2017) 'Incorporating inventory risks in location-routing models for explosive waste management', *International Journal of Production Economics*, 193, 123-136.

Zhou, X. (2015) 'A random multi-objective model on integrated logistics', *World Journal of Modelling and Simulation*, 11, 243-255.

Zhou, X., and Xu, J. (2009) 'A class of integrated logistics network model under random fuzzy environment and its application to Chinese beer company', *International Journal of Uncertainty, Fuzziness and Knowledge-Based Systems*, 17, 807-831.

Zohal, M., and Soleimani, H. (2016) 'Developing an ant colony approach for green closed-loop supply chain network design: a case study in gold industry', *Journal of Cleaner Production*, 133, 314-337.