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What makes manufacturing companies more desirous of recycling?

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Abstract

Purpose – The purpose of this paper is to specify the treatment options of manufacturing companies with the specific emphasis on recyclable wastes. The options are focused mainly on recycling instead of taking recycling issue as a sub-function of environmental policies or reverse logistics disposition strategies. This paper also aims to find out if there are some relationships between those options and some characteristics of manufacturing companies.

Design/methodology/approach – A survey methodology is structured in order to collect pure categorical data. Pearson chi-square and categorical regression analyses were carried out on a sample of 255 Turkish manufacturers mostly operating in the textile, furniture, automotive and machinery industries.

Findings – The results indicate that some characteristics that were expected to have relationships with the treatment options, are supported by the two analyses while others are not. For example, "employing at least an engineer" is in double-supported and "collaboration with other companies for returns" is in the non-supported characteristic.

Practical implications – The results can be used as a guideline for manufacturers when they try to find out what obstacles are making their companies less desirous of recycling. The companies will be able to eliminate those obstacles and gain some competitive advantages by recycling materials.

Originality/value – The approach to treatment options on recyclable wastes, from manufacturing companies' point of view, links together the behavioural issues and institutional levels of those companies. This study is unique not only in handling those issues in this perspective by intensely focusing on recycling, but also by being the first large sample survey of those issues in Turkey.

Keywords Waste management, Manufacturing industries, Recycling, Turkey, Reverse logistics, Solid wastes, Treatment options, Affecting characteristics

Paper type Research paper

Introduction

The materials containing glass, metal, paper, or plastic contributes heavily to the solid waste stream and are allegeable to recycling. These materials can be included in both packaging wastes (PWs) and none-packaging solid wastes (NPSWs). Recycling increases environmental performance of companies and is one of the most important ingredients for the structure of this performance. Environmental performances of companies are also positively related to their economic performances (Russo and Fouts, 1997). If PWs are not disposed and they are put into some recycling processes, it is possible to gain many benefits of an environmentally sound company (Dyllick 1989; Cairncross, 1992; Light, 2000). After some repair and maintenance activities, scrapped and wasted parts and components or some end-of-life products, other than packaging, are also become some recyclable materials. How those materials are to be treated is one of the major problems of companies. A number of studies show that recycling of those materials provides some benefits or advantages to manufacturing companies (Gallarotti, 1995; Ambec and Lanoie, 2008; Guide *et al.*, 2000; Orsato, 2006). In generally

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speaking, an environmentally sound company gains some increase in sales and market shares, cost reduction in material, energy and services, better distribution network, better corporate management, better risk management, and a green corporate image. A manufacturing company is free to do any kind of treatment to those recyclable materials unless it is mandated by some legislative regulations or suppressed by its competitors. It may put them in trash directly or recycle. Putting them in trash seems to be the least preferred one among other waste prevention options (Eurostat, 2009; Republic of Turkey Ministry of Environment and Forest General Directorate of Environmental Management, 2008).

No specific research could be found in the literature that focusses on recycling separately from the company's treatment options point of view. Therefore, the first research question investigated in this study is to specify institutional treatments of a company that can be managed on recyclable wastes. Based on different company characteristics, some categories of companies increase the tendency for some of those treatments while they decrease it for others. Then, the second question investigated is to find out relationship degrees between how manufacturing companies behave on recyclable wastes and the categories based on those company characteristics, in other words, to find out how big the treatments are affected from those different categories. In order to investigate the second question, analyses are based on survey data from 255 Turkish manufacturing companies in this study.

The paper is organized as follows: first, based on a literature review, treatment options of companies for PWs and NPSWs are specified; second, research hypotheses regarding some characteristics of manufacturing companies are proposed; third, a description of the methodology for the study and the results of analyses are presented. Finally, these results are discussed and some concluding remarks are given.

Company's treatment options for the wastes and recycling

From personal recycling behavior determinants point of view, Hornik and Cherian (1995) classified the strongest predictors of recycling into six categories: knowledge of recycling, perceived social influence, personal satisfaction derived from recycling, frequency of collection, proximity of containers, and distribution of materials for recyclables. In Aung and Arias (2006) study, social norms were the affecting factor of personal norms and both norms were the affecting factors of intentions to act. Some effects of those norms and intentions shape environmental behavior regarding waste management. Bezzina and Dimech (2011) incorporated elements of the theory of planned behavior (Ajzen, 1991), the model of altruistic behavior (Schwartz, 1977) as well as other additional variables of personal recycling behavior. After an exploratory factor analysis, they found nine determinants of recycling behavior in their survey study: "personal recycling attitudes, norms and skills," "scheme preference," "intentions to act," "inconveniences," "social recycling attitudes and norms," "satisfaction with service provided," "motivating factors," "awareness of the consequences," and "knowledge of issues."

From the behavior of a manufacturing company point of view, however, studies handled recycling issues only indirectly. The studies in literature generally include recycling in a company's environmental policies, disposition strategies, and reverse logistics activities. Orsato (2006) specified four generic competitive environmental strategies. Those strategies are eco-efficiency, beyond compliance leadership, environmental cost leadership, and eco-branding. A company may choose any appropriate one of these strategies in terms of competitive advantage and competitive

focus. In their survey study on process industry firms, French and LaForge (2006) found that the most frequently used option for internal and external returns was "dispose as waste or destroy." "Blend-off at some percentage into the same or similar product" was the second, and "repackage" was the third frequently used options. "Use scrap or trim pieces from one product to re-cut smaller products" was the least frequently used one among 11 options. Willems *et al.* (2006) developed a linear programming model for end-of-life scenario selection. This model minimizes the costs in reverse supply chain from take-back organization to end-of-life options. According to Thierry *et al.* (1995), five product recovery options are repair, refurbish, remanufacturing, cannibalization, and recycling. The options are listed in order of the required degree of disassembly (teardown).

From reverse logistics point of view, there are five disposition options about what manufacturing companies may do to returned products: destroying, recycling, refurbishing, remanufacturing, and repackaging (Skinner *et al.*, 2008; Rogers and Tibben-Lembke, 1998). Major types of reverse chain actors are traditional middlemen such as retailers collect and return items, secondary commodities' dealers, manufacturer-controlled recycling centers, and resource recovery centers that process unsorted municipal waste (Guiltinan and Nwokoye, 1975). Because the actors often differ in the forward and reverse supply-chain systems, reverse supply-chain system for recycled material is often designed after and separately from existing forward supply chain (Field and Sroufe, 2007). If a returned or scrapped product needs to end-of-life management and its refurbishment and remanufacturing are not possible, the most favorable option is to recycle with disassembly and/or without disassembly (Pagell *et al.*, 2007). The company may perform some activities related to recycling in house such as disassembly, separation, sorting, and cleaning but outsource all fabrication activities of recycling (Thierry *et al.*, 1995).

Another approach can be given from extended producer responsibility (EPR) point of view. When implementing EPR, mandated or voluntary product take-back are the two most important policy approaches in which recycling is affected. The government mandates that manufacturers take-back products in the mandated approach while the producers agree to organize a take-back system for their products and set recycling goals in the voluntary approach. Based on the product in question and throughout its life cycle, the types of EPR approach are categorized as liability, economic, physical, ownership, and informative (Nnorom and Osibanjo, 2008).

All of the studies mentioned above are focussed on recovery options and disposition strategies. In this study, however, the focus is heavily on recycling and how a manufacturing company may behave on wastes from the recycling point of view. In order to concentrate on this topic, the company's treatments for recyclable wastes are categorized into five options regardless of the producer's responsibility is mandated or voluntary:

(1) *To put PWs and NPSWs in trash*: wastes are put directly in trash by companies as soon as possible or within a very short time. A company experiences some problems in this option such as being at a distance from proper landfill areas, some difficulties in providing carriages or boxes, etc. A company that chooses this option cannot take any advantage of the benefits of recycling.

(2) *To stock PWs and NPSWs somewhere in the facility*: it is very important that those materials should not damage around while they are staying in the junkyards or other places. Those materials are retained in the company

because the company hopes that they will be reused or there is no place or method to dispose of. The most important inconvenience of this option is that it constricts the working area in a company. After a certain period, it is inescapable to those stocked wastes send in trash.

(3) *To give PWs and NPSWs another company without any purpose*: a company gives those materials to another company only to get rid of them easily and harmlessly regardless of expecting any benefit from them. It is possible to give them to other companies by expecting with or without any charge. The company does not concern about recycling or not recycling of them.

(4) *To recycle PWs and NPSWs in a facility of the company*: this option removes dependability to other companies in recycling efforts and many members of the supply chain can remain ignorant (Pagell *et al.*, 2007). The companies that do recycling processes internally have the opportunity of potential to establish new businesses. On the other hand, this option may require the company to invest more money in those facilities. A separate area should be allocated for those facilities (Rogers, 2009). Furthermore, recycling matters, always needs planning and taking care of as a secondary job, keep the company busy.

(5) *To give PWs and NPSWs to another company for recycling purposes*: the company does not need any planning and spend any effort on recycling continuously since this responsibility is given to another company. On the other hand, the company has to accept prices and offers coming from the recycling company. In the short term, to outsource recycling is a quick and relatively low cost solution but in the long-term implications, it increases the dependability of the focal firm to outside recycling companies and the risk of loosing intellectual property, data, materials, and modules (Pagell *et al.*, 2007).

Research hypotheses

Some characteristics of manufacturing companies and their environmental strategies may be taken a role to determine the treatment of those companies on recyclable wastes (Bowen *et al.*, 2001). Certain characteristics make those companies more desirous of some of these treatments while less desirous of some others. Six categorical characteristics take place in the following sub-headings and hypotheses of this study are proposed accordingly.

Quality certificate (QC) ownership

In a multinational survey, Rao (2002) found that 77 percent of the surveyed companies agreed or strongly agreed with the implementation of ISO 14001 system benefits recycling. Klassen (2000) found that investment in recycling is strongly associated with investment in quality-related organizational systems. According to Klassen, investment in recycling increase significantly as quality systems increased. Corbett and Cutler (2000) suggested that having a quality management system in place does facilitate the development of an environmental management system. Therefore, it can be said that the companies holding any QC are more likely to recycle PWs and NPSWs than the others are:

H1a. Treatment of a company on PWs (*H1b* … NPSWs) is related to whether or not the company has a QC.

Using a software package (SP) for returns

Daugherty *et al.* (2005) found that information technology capabilities have a direct impact on reverse logistics economic performance. Benefits of having an SP regarding returns are facilitating the smooth and efficient backflow of product from the customer-service desk all the way to the final disposition (Ferguson and Browne, 2001), distinguishing parts and operations that belong to manufacturing from remanufacturing (Dowlatshahi, 2005), easy exchange of information with reverse logistics partners (Kulp *et al.*, 2004), and easy integration with other information systems (Kim *et al.*, 2006). When an SP provides the disposition function, a decision is made about whether or not the product is to be recycled (Rogers, 2009). Therefore, it can be said that companies using an SP for returns are more likely and give much attention to recycle PWs and NPSWs:

H2a. Treatment of a company on PWs (*H2b* … NPSWs) is related to whether or not the company uses an SP for returns.

Engineer employment (EE)

Some courses and trainings about recycling, environment and sustainability concepts are given almost all of the branches in engineering education (Boyle, 2004). If an engineer is given a managerial position, his knowledge and skills will enhance the recycling effort in the organization's culture. Engineers are the persons who usually take the responsibility of environmental issues. In Johnson's (1998) study, for example, it is understood that much of the responsibility for ferrous scrap disposal are given to facility engineers. A working engineer in a company may convince managerial stuff to benefits and necessity of recycling. Therefore, if a manufacturing company employs at least an engineer, it is more likely to recycle PWs and NPSWs:

H3a. Treatment of a company on PWs (*H3b* … NPSWs) is related to whether or not the company employs any engineer.

Company size (CS)

In this study, size of companies are determined in terms of their number of employees and micro, small, medium and large companies are concerned with 0-9, 10-49, 50-249, and over 249 working employees, respectively. Many of the studies in literature have shown that when the size of companies are large, capabilities in sustainable production, environmental management, green supply-chain management, and as a result of these, in recycling practices are greater in those companies than their small counterparts (Min and Galle, 2001; Simpson, 2010; González *et al.*, 2008; Lee and Klassen, 2008; Ahmed *et al.*, 1998). Therefore, it is expected that medium- and large-sized companies are more likely to recycle than small- and micro-sized ones:

H4a. Treatment of a company on PWs (*H4b* … NPSWs) is related to its size based on number of employees.

Collaboration (CL) with other companies for returns

Vachon and Klassen (2006) conducted an empirical survey, which indicates that logistical and technological integration in a supply chain increase environmental collaboration. They found in another study that as environmental collaboration increases, a plant's environmental performance improves (Vachon and Klassen, 2008).

Vachon (2007) found that there is a significant positive correlation between environmental collaboration with suppliers and investment in environmental technologies. Therefore, it can be said that companies integrated in this kind of collaboration pay much attention to recycling of PWs and NPSWs.:

H5a. Treatment of a company on PWs (*H5b* … NPSWs) is related to whether or not the company collaborates with other companies for returns.

Industry (IN) in which the company operates

Zhu *et al.* (2008) compared four industries, namely power generating, chemical/petroleum, electrical/electronic, and automobile companies, in terms of their green supply-chain management (GSCM) practices. They found that GSCM, internal environmental management, and green purchasing practices are significantly different in those industries. Percentage of logistics social responsibility practices (purchasing, sustainable transportation, sustainable packaging, sustainable warehousing, reverse logistics) are significantly differentiated among eight industries in the study of Ciliberti *et al.* (2008). Therefore, it is expected that some treatment options on recyclable wastes are more preferential than the others are in some industries:

H6a. Treatment of a company on PWs (*H6b* … NPSWs) is related to the industry in which the company operates.

Methodology

The sample and questionnaire

Survey data were collected from manufacturing companies mostly operates in Marmara region in Turkey. Marmara region is on the northwest side of Turkey and it is the most industrialized region since many significant manufacturing cities such as İstanbul, Bursa, Sakarya, and Kocaeli are located on it. Under these cities' pressure, manufacturing abilities are increased in some other cities of this region such as Bilecik and Tekirdağ.

Several managers in three manufacturing companies have filled and criticized the questionnaire and several academicians gave some recommendations before the whole survey was begun. Since the questions were very simple, no significant change was made on the questionnaire. The respondents were asked about some demographics of their companies. After these demographics, two multiple-choice questions were asked about their company's treatment options for PWs and NPSWs as described in the first section. All the survey data were collected from March until September in 2008. During that time, students of Statistics II course in the Faculty of Economics and Administrative Sciences at Bilecik University have actively participated to collect the survey data. No specific company name was given to the students to collect the data. However, first they were requested to go to manufacturing companies in textile, furniture, machinery, and automotive industries. Second, they were requested to contact with persons who were in managerial positions of those companies in order to fill the questionnaire. A total of 529 students were free to go to any manufacturing company that satisfied these requests. As soon as a student submitted a single questionnaire, the respondent was called by phone and asked if his/her answers were real. These calls were done for every single questionnaire. A total of 255 usable questionnaires from different manufacturing companies were collected. Therefore, the response rate of the

questionnaire was about 48 percent. All of the respondents hold managerial qpositions (25.5 percent owners, 5.1 percent shareholders, 49 percent top managers, and 19.8 percent managers) in the companies. Detailed distribution of the sample is shown in Table I.

Analysis and results

First, the hypotheses were tested by using Pearson χ^2 analysis because all of the data were categorical. Table II shows the Pearson χ^2 values between affecting characteristics and companies' treatments on packaging wastes (TPWs). There is no relationship between SP and TPWs ($p > 0.05$), and CL and TPWs ($p > 0.05$). There are significant relationships between QC and TPWs ($p < 0.01$), EE and TPWs ($p < 0.01$), CS and TPWs ($p < 0.01$), and IN and TPWs ($p < 0.05$). Therefore, *H1a*, *H3a*, *H4a*, and *H6a* are supported but *H2a* and *H5a* are not.

Table III shows the Pearson χ^2 values between affecting characteristics and companies' treatments on none-packaging solid wastes (TNPSWs). There is no relationship between CL and TNPSWs ($p > 0.05$). There are significant relationships between QC and TNPSWs ($p < 0.01$), SP and TNPSWs ($p < 0.05$), EE and TNPSWs ($p < 0.01$), CS and TNPSWs ($p < 0.01$), and IN and TNPSWs ($p < 0.01$). Therefore, *H1b*, *H2b*, *H3b*, *H4b*, and *H6b* are all supported but *H5b* is not.

In Figures 1 and 2, frequency percentages for each category of PWs and NPSWs are presented, respectively, for each affecting characteristics. In Figure 1, option (c) has the lowest percentages in almost all affecting categories. Option (e) is the first choice for all categories. In some categories, option (e) passes even 50 percent.

City	*n*	%
İstanbul	106	41.6
Bursa	42	16.5
Kocaeli	18	7.1
Bilecik	13	5.1
Sakarya	9	3.5
Tekirdağ	4	1.6
Eskişehir	12	4.7
Ankara	7	2.7
Others	*44*	*17.2*
Total	255	100.0

Size	*n*	%
Micro	49	19.2
Small	115	45.1
Medium	56	22.0
Large	*35*	*13.7*
Total	255	100.0

Industry	*n*	%
Textile	83	32.5
Furniture	95	37.3
Automotive	15	5.9
Machinery	26	10.2
Others	*36*	*14.1*
Total	255	100.0

Percentage of returns for repair (within a year)	*n*	%
<1	55	21.6
Between 1 and 5	140	54.9
Between 6 and 10	33	12.9
>10	*18*	*7.1*
Total	246	96.5
Missing	*9*	*3.5*
Total	255	100.0

Company operates (year)	*n*	%
<0-3	43	16.9
Between 3 and 7	36	14.1
Between 8 and 15	71	27.8
Between 16 and 30	59	23.1
>30	*37*	*14.5*
Total	246	96.5
Missing	*9*	*3.5*
Total	255	100.0

Percentage of returns for renewal (within a year)	*n*	%
<1	109	42.7
Between 1 and 5	115	45.1
Between 6 and 10	16	6.3
>10	*5*	*2.0*
Total	245	96.1
Missing	*10*	*3.9*
Total	255	100.0

Table I. Distribution of the sample

Very similar results are true for the options of NPSWs and they presented in Figure 2. The most significant difference between the results of Figures 1 and 2 is focussed on option (a). This option is preferred as the first one for companies that have no QC, employ no engineer, are micro- and small-sized and operate in the furniture industry. Especially in the furniture industry, option (e) is reduced to third level.

In the second part of the analysis, the hypotheses were tested by using categorical regression. SPSS SP were utilized for this. Relationship between a response variable and a set of predictors can be described by categorical regression analysis (Meulman and Heiser, n.d.). It is very similar to multiple regression analysis in many aspects. Figure 3 shows the conceptual model for this analysis.

For initial specifications of the analysis, optimal scaling levels were chosen as "nominal" for each variable, initial configuration was chosen as "random," and no regularization method was used. Due to missing values, there were 229 usable questionnaires for this analysis. Correlations of original variables were the same for both PWs and NPSWs so that they presented in a single table, Table IV. For correlations of transformed variables, Table V shows the correlations of PWs, and Table VI shows the correlations of NPSWs separately.

Table VII shows the results of the hypotheses testing for PWs. If there is any large negative value of importance ("Imp" marked column in the Table) measure, it indicates multicollinearity. If there is any tolerance value near 1, it indicates no multicollinearity. On the other hand, very low tolerance values indicate multicollinearity (Meulman and Heiser, n.d.). When looking at these values in Table VII, the tolerance values indicate that multicollinearity should not be a matter of concern in the model. The regression results indicate TPWs is not affected by QC ($\beta = 0.023$; $p > 0.05$), SP ($\beta = 0.004$; $p > 0.05$), and CL ($\beta = 0.021$; $p > 0.05$) variables. However, it is affected by EE

Table II.
Pearson χ^2 values for PWs

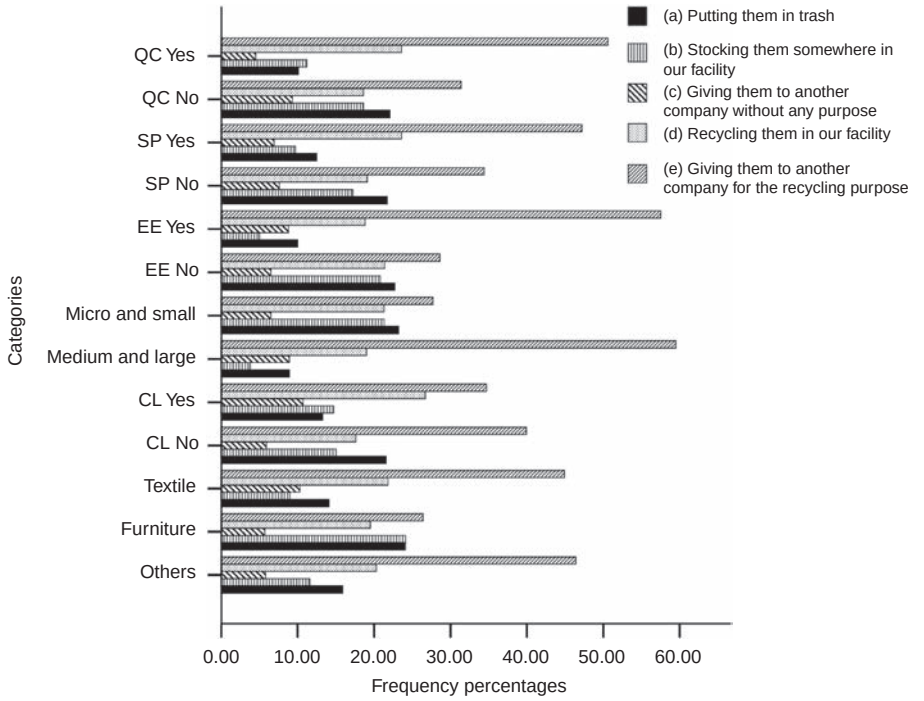
	n	Cramer's V	Contingency coefficient	df	χ^2	p
Quality certificate (QC)	229	0.246	0.239	4	13.848	0.008**
Software package (SP)	229	0.171	0.169	4	6.695	0.153
Engineer employment (EE)	234	0.328	0.312	4	25.171	0.000**
Company size (CS)	234	0.361	0.340	4	30.555	0.000**
Collaboration (CL)	228	0.158	0.156	4	5.703	0.222
Industry (IN)	234	0.187	0.256	8	16.404	0.037*

Notes: df, degrees of freedom. *$p < 0.05$; **$p < 0.01$

Table III.
Pearson χ^2 values for NPSWs

	n	Cramer's V	Contingency coefficient	df	χ^2	p
Quality certificate (QC)	237	0.274	0.264	4	17.784	0.001**
Software package (SP)	237	0.226	0.220	4	12.077	0.017*
Engineer employment (EE)	243	0.326	0.310	4	25.880	0.000**
Company size (CS)	243	0.360	0.339	4	31.546	0.000**
Collaboration (CL)	235	0.071	0.071	4	1.187	0.880
Industry (IN)	243	0.213	0.288	8	22.007	0.005**

Notes: df, degrees of freedom. *$p < 0.05$; **$p < 0.01$



Notes: QC, quality certificate; SP, software package; EE, engineer employment; CL, collaboration

Figure 1.
Frequency percentages of TPWs

($\beta = 0.246$; $p < 0.01$), CS ($\beta = 0.232$; $p < 0.05$), and IN ($\beta = 0.133$; $p < 0.05$) variables. Therefore, *H1a*, *H2a*, and *H5a* are not supported while *H3a*, *H4a*, and *H6a* are supported.

Table VIII shows the result of the hypotheses testing for NPSWs. According to importance and tolerance values in Table VIII, multicollinearity should not be a matter of concern in this model, either. The regression results indicate company treatment on waste and scrap is not affected by QC ($\beta = 0.062$; $p > 0.05$), SP ($\beta = 0.006$; $p > 0.05$), and CL ($\beta = 0.017$; $p > 0.05$) variables. However, it is affected by EE ($\beta = 0.188$; $p < 0.05$), CS ($\beta = 0.236$; $p < 0.01$), and IN ($\beta = 0.119$; $p < 0.1$) variables. Accordingly, *H1b*, *H2b*, and *H5b* are not supported while *H3b*, *H4b*, and *H6b* are supported.

Discussions

Hypotheses were tested by two different statistical analyses in this study, Pearson χ^2 and categorical regression. After gaining some insights from the results of Pearson χ^2 analysis, one can have some further understandings from the results of categorical regression. Double, single or no proofs can be achieved by applying this procedure.

According to the results of both analyses, no significant relationship exists between having an SP and the TPWs. It means that having or not having an SP for procedures of returned products do not affect the TPWs. According to Pearson χ^2 analysis,

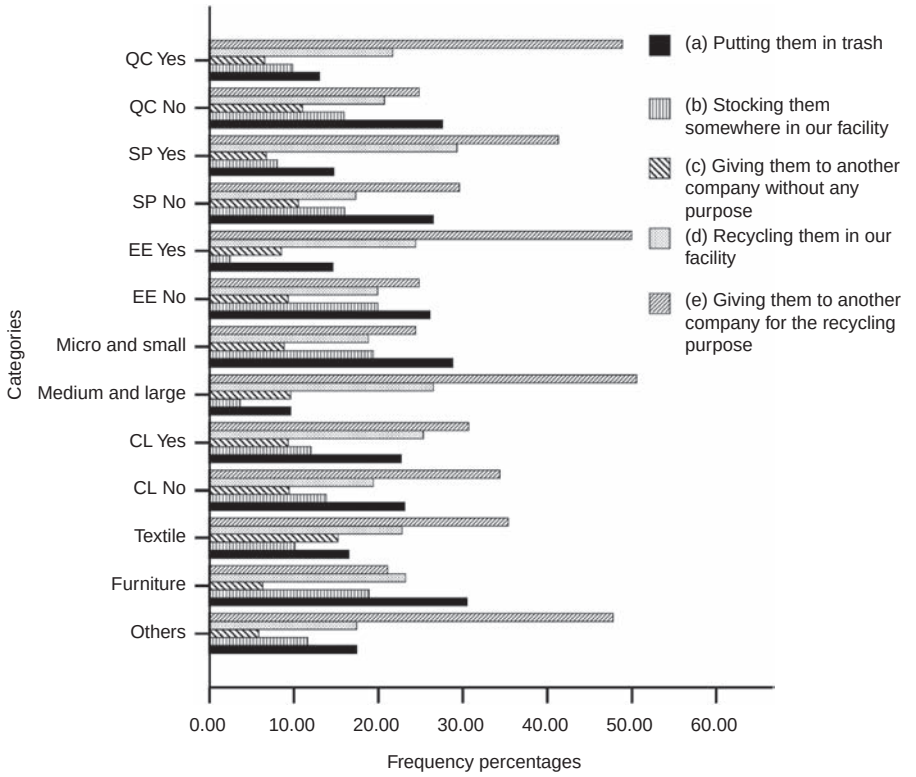


Figure 2.
Frequency percentages of TNPSWs

Notes: QC, quality certificate; SP, software package; EE, engineer employment; CL, collaboration

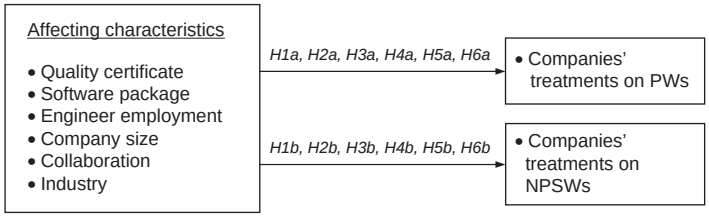


Figure 3.
Conceptual framework of categorical regression

n: 229	1	2	3	4	5	6
1. Quality certificate	1.000					
2. Software package	0.384	1.000				
3. Engineer employment	0.421	0.355	1.000			
4. Company size	−0.495	−0.390	−0.472	1.000		
5. Collaboration	−0.002	0.149	0.003	0.044	1.000	
6. Industry	−0.227	−0.145	−0.286	0.004	0.045	1.000
Eigenvalue	2.344	1.077	0.988	0.616	0.570	0.404

Table IV.
Correlations of original variables for PWs and NPSWs

however, we cannot say the same interpretation for TNPSWs and it has only a single analysis proof.

There are insignificant results according to both analyses in CL with another company for returned products. Therefore, this kind of CL does not affect a company's treatments on those materials directly. One possible reason can be given for this is that returned products are not scraped or wasted each time. They are renewed or given back to the customer most of the time with some little repair or modifications. It seems natural that CL with other companies for this kind of operations does not have a direct effect to determine recycling.

Relationships between QC and "TPWs and TNPSWs" have taken only Pearson χ^2 analysis proof. From Pearson χ^2 analysis point of view, our interpretations would be in the direction of most of the literature findings such as Rao (2002), Klassen (2000),

n: 229	1	2	3	4	5	6
1. Quality certificate	1.000					
2. Software package	−0.384	1.000				
3. Engineer employment	−0.421	0.355	1.000			
4. Company size	−0.495	0.390	0.472	1.000		
5. Collaboration	0.002	0.149	0.003	−0.044	1.000	
6. Industry	−0.004	0.013	−0.019	0.251	0.055	1.000
Eigenvalue	2.278	1.079	1.045	0.617	0.571	0.409

Table V. Correlations of transformed variables for PWs

n: 229	1	2	3	4	5	6
1. Quality certificate	1.000					
2. Software package	−0.384	1.000				
3. Engineer employment	0.421	−0.355	1.000			
4. Company size	0.495	−0.390	0.472	1.000		
5. Collaboration	−0.002	−0.149	0.003	−0.044	1.000	
6. Industry	0.108	−0.083	0.106	0.326	0.050	1.000
Eigenvalue	2.341	1.054	0.994	0.614	0.572	0.425

Table VI. Correlations of transformed variables for NPSWs

n: 229	Correlations Zero-order	Partial	Imp	Tolerance AT	BT	Standard β	*F*	*p*
Quality certificate	−0.197	0.021	−0.024	0.676	0.660	0.023	0.129	0.719
Software package	0.178	0.004	0.004	0.751	0.750	0.004	0.010	0.922
Engineer employment	0.345	0.223	0.440	0.701	0.662	0.246	9.262	0.003***
Company size	0.370	0.192	0.447	0.576	0.608	0.232	6.497	0.011**
Collaboration	0.019	0.023	0.002	0.958	0.960	0.021	0.151	0.698
Industry	0.188	0.138	0.130	0.894	0.854	0.133	4.613	0.011**
R^2: 0.192						Regression:	7.508	0.000***

Notes: Imp, importance; AT, after transformation; BT, before transformation. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Table VII. Categorical regression results of TPWs

Table VIII.
Categorical regression results of TNPSWs

n: 229	Correlations Zero-order	Partial	Imp	Tolerance AT	BT	Standard β	*F*	*p*
Quality certificate	0.268	0.057	0.085	0.681	0.660	0.062	0.760	0.384
Software package	−0.189	0.006	−0.006	0.752	0.750	0.006	0.019	0.891
Engineer employment	0.336	0.174	0.320	0.711	0.662	0.188	6.489	0.012**
Company size	0.391	0.196	0.467	0.577	0.608	0.236	7.144	0.008***
Collaboration	0.012	0.019	0.001	0.959	0.960	0.017	0.161	0.688
Industry	0.222	0.123	0.134	0.882	0.854	0.119	2.959	0.054*
R^2: 0.198						Regression:	7.772	0.000***

Notes: Imp, importance; AT, after transformation; BT, before transformation. *$p < 0.10$; **$p < 0.05$; ***$p < 0.01$

Corbett and Cutler (2000), and Skinner *et al.* (2008) although the samples of those studies are based on some different populations or case studies. Those literature findings were explained briefly in the research hypotheses section in this study.

EE, CS, and IN variables have taken double proof from both analyses. Employing engineers can increase productivity in manufacturing processes. Engineers can find out optimal solutions in many working areas. They positively influence recycling processes and convince management about materials recycling. For example, Aung and Arias (2006) found out that the workers learned about waste management from an engineer in a flower plantation. There are many similar literature findings for CS variable such as Min and Galle (2001), Simpson (2010), González *et al.* (2008), Lee and Klassen (2008), and IN variable such as Zhu *et al.* (2008) and Ciliberti *et al.* (2008). Those findings were also explained briefly in the research hypotheses section in this study. Although those studies in literature depend on some different populations, cases and analyses, we can needless to say that manufacturing companies tend to recycling and handle it professionally when they become larger. Some kind of industries such as textile, machinery, and automotive (as illustrated inside "others" category in Figures 1 and 2), and their characteristics may pressure belonging companies to recycling.

When looking at Figures 1 and 2, manufacturing companies do not want to give PWs and NPSWs to another company without any purpose in general. If they do not put them in trash, they may use them as is or through some recycling processes. In general, option (e) is in first or second order for respondent companies. This may indicate that recycling gains much attention in Turkey. On the other hand, option (a) has first or second order for companies that have no QC, employ no engineer, are micro- and small-sized and operates in furniture industry. This may indicate that there is no enough reason for those companies to feel themselves under the pressure of recycling or consciously enough about recycling.

Limitations and future research

All of the data come from Turkish manufacturing companies. These data considerations may cause some bias problems when interpreting the results from multinational point of view. In future studies, sample questions can be applied to different countries and larger samples can be collected. Because the students were free to go to any manufacturing company satisfying industry limitation, randomness

assumption is mainly provided. Therefore, the sampling procedure is not a pure convenience sampling and does not hold many disadvantages of it.

Conclusions

Recyclable materials can be treated and profited by companies in five different ways: putting them in trash, stocking them somewhere in the facility, giving them to another company without any purpose, recycling them in the company's own facility, and giving them to another company for recycling purposes. The first one is the worthless one for both a company and a society. The second and third one can serve recycling purposes only indirectly. The purpose is directly recycling in the fourth and fifth ones, however. These last two are also the most adaptable ones to sustainable production systems.

One of the significant findings of this study is that some affecting characteristics of manufacturing companies may cause some aforementioned treatment options of companies are more preferential than the others are. For both PWs and NPSWs, these characteristics are QC ownership, using a SP for returns, employing an engineer, being of a specific size, and operating in a certain industry. Another very interesting finding of this study is whether or not collaborating with other companies when dealing with those recyclable wastes is or is not related to a company's treatment options on them. Turkish companies usually give PWs and NPSWs to other companies for recycling purposes. On the other hand, although those recyclable wastes are given to another company for recycling purposes, they are mostly put in the trash by the companies that have no QC, do not employ any engineer, are micro- and small-sized, and operate in the furniture industry. Giving recyclable wastes to another company without any purpose is the least preferred option among companies because profitability from compensation for these wastes increasingly gains attentions among them.

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