**Recycling Stock Market using Information & Communication Technologies: An innovative service to create a micro-trend for the environment**

Evangelos Ergen[1], Panayiotis Ketikidis[1,2]
[1]*CITY College/International Faculty of the University of Sheffield, Thessaloniki, Greece*
[2]*South-East European Research Centre, Thessaloniki, Greece*
ergen@ergen.gr
pketikidis@city.academic.gr

**Abstract:** European Commission in recent research findings regarding waste management introduced the relation between wealth and waste. As European society has grown wealthier, it has created more waste. Each year in the European Union, 1.3 billion tons of waste is thrown away. According to European Environment Agency statistics, this amounts to about 3.5 tons of solid waste for every man, woman and child *(European Commission)*. A review made by the Organization for Economic Cooperation and Development found that between 1990 and 1995, the amount of waste generated in Europe had increased by 10%. The same organization estimated that by 2020, Europe could generate 45% more waste than it did in 1995 *(OECD, 2006)*.

This paper proposes a service on recycling by bringing together technology, economy and environment. The main idea is to establish a service which is expected to increase the recycling rates and create added value in a region through a micro-trend. The purpose is to create a micro-trend among inhabitants trying to change the attitude over recycling and attract them to involve in the protection of valuable resources. This research paper investigates the acceptability and value of the proposed service among consumers as well as the potential obstacles that might be raised on its implementation. A theoretical framework was adopted on three complementary perspectives by integrating *technology* (ICT theories and practices), *economy* (finance and stock markets) and *environment* (waste management & prevention). A cross-sectional web survey design was employed in a global diversified sample of 100 participants (consumers, researchers, industry experts and members of non-governmental institutes). The survey has been carried out in two phases: pilot phase and the survey. Three types of analysis were conducted: descriptive data analysis, bivariate correlation and group comparison. The global issue of environment's sustainability combined to low recycling rates in the region of European Union was strong motives for this study. The framework introduced has proven to be useful in improving the recycling percentages in the region. Consumers are willing to participate in the new service. On the contrary, recycling industry and local authorities might raise obstacles for the implementation, since its introduction request changes to be made. The specific paper contributes to the recycling industry sector as well as to other professional sectors that are involved in the recycling business.

**Keywords:** Recycling, innovation, information and communication technologies, regional development, environment, technology

## 1. Introduction

Recent studies have shown that, individuals follow a recycling behavior that is irrelevant or even hostile to environment's sustainability. Such behavior is multidimensional and is affected by different socio-demographic and psychographic factors. Different roles with different causal characteristics influence people, regarding their attitudes towards the environment *(Meneses and Palacio, 2005; Vicente et.al, 2008)*. In order to affect peoples' attitudes, there could be given a strong motive. Such motive could be originated from *the sense of reward*. This is related to the meaning of adding value to a practice, and remunerating an achievement.

According to European Union and the Sixth Environment Action Programme *(European Commission) recycling* and *reuse* consist one of the three principles in the EU's approach to the waste management policies. The Committee of the Regions - part of the European Commission responsible for the regional policies within European Union countries - has organized a series of events where a number of significant surveys were presented, regarding the effort of finding a way of cultivating sustainable policies for the protection both of the environment and human health. These policies examine also the increase in the quality of life in regional level and the creation of wealth and prosperity *(European Commision, Inforegio)*.

As waste could be administered, it would be a challenge to recover as many of the materials as possible through recycling. Since the reserves of raw materials are decreasing, there is a way nothing goes wasted *(Blumberg, 2005)*. A vast number of used products and materials have value that could be recovered through repair, disposition and recycling. There is "the rule of 1%" *(Charles, 2006)* which

is an emerging rule of thumb and suggests that if you get a group of 100 people online then one will create content, 10 will "interact" with it (commenting or offering improvements) and the other 89 will just view it. Micro-trends *(Penn and Zalesne, 2009)* are the small forces behind tomorrow's big changes. They are based on the idea that the most powerful forces in our society are the emerging, counterintuitive trends that are shaping tomorrow right before us.

This poses challenges and the proposed framework attempts to cultivate a scheme that could make recycling process more attractive, trying to add value in a simple daily task, enforcing a different attitude and turning negative impacts into positive values.

## 2. Technology, Economy and Environment

### *2.1 Technology*

Current business trends are defined by wireless technologies, mobility trends and proximity. This framework includes people interaction and communication as well as services that could be developed for any use. Technology adoption, incremental changes, imitation and combination of knowledge are some alternate ways of innovating.

Recent developments in information and communication technologies (ICT), have cultivated an innovation friendly environment *(AT&T, Westech,2005)*. European Commission in a recent technical report *(EU Joint Research Center)* regarding the mapping of European wireless' trends and drivers concluded that new technologies affect people and resources through their direct pervasion in a catalytic way. New trends in business telecommunications have caused the appreciation of their business value and have defined a new digital business environment *(Innovison Research Institute, part I-III, 2007).* The catalytic discovery was the introduction of mobility, which is applied through the wireless communication and the mobile computing. AT&T and Orange, have already announced new services offered to their customers relating to digital payments through their phones, replacement of credit cards, tickets, even e-commerce solutions *(Morris, 2007; AT&T Brief Report, 2007)*. Such key events create market trends and define future opportunities *(Source Media, 2008)*.

European Union focuses in the application of a cohesion policy *(Commission of the European Communities, 2008)*. It highlights that current era of financial crisis could be a suitable period for investing in energy efficiency, clean technologies and environmental services. Such crises are opportunities for behavioral changes since large group of people are involved and affected; therefore it is easier to penetrate in their mentalities and create micro-trends.

### *2.2 Economy*

The financial sector followed technology progress and fostered entrepreneurial initiatives. The jointure of technology and finance gave birth to new economies. Technology helped finance to reach the other side of Atlantic implying clearly those new economies emerged due to technological advancements *(Krugman, 2000)*. Globalization and technology have facilitated their invasion to daily economic life and a set of financial tools have been developed to increase money generation. This move affected people's psychological biases, shaped specific types of behaviors and have directed investors in the effects of overconfidence, socialization and familiarity*(Tourani and Kirkby, 2005)*.

The new era has been characterized by the mobility of capitals through stock markets and "carry trade". Globalization has created the suitable environment for the cultivation of stock market mentality among individuals *(Lerzan et al., 2008)*. Learning to invest is a life-long course which may support local communities to overcome difficult situations, especially when changes are mandated either in economic or social level *(Nofsinger, 2005)*. Investing leads people to start thinking by developing mental accounting, mental budgeting and by matching costs to benefits. In such a way, they learn to develop risk perception in the real world; they build behavioral portfolios, increase social interaction and develop a social dynamic. Such techniques primarily improve the economic behavior of individuals and in an extent, drain their characteristics in other sectors of life.

A local survey made in USA about recycling behavior, found that, economical benefits may be a significant factor that affects the recycling behavior *(Morgan and Hughes, 2006)*. In another study about recycling and international trade theory *(Kazunori, 2007)* it was identified that subsidies in the recycling sector are a strategy that is followed so far, and it aims to strengthen local economies and change the direction to a higher recycling ratio. The waste costs are strictly related to the optimal welfare rates because, through time, such costs aggravate the available resources of the community.

### *2.3 Environment*

European Union supports the aid for environmental protection *(Commision of the European Communities, 2009)* starting from waste management and going further to activities such as re-utilization, recycling and recovery. According to "The Sixth Environment Protection Programme" waste

prevention and management is one of the four top priorities for the Community *(Commision of the European Communities, 2009)*. Both European Union and United States *(US Protection Agency)* have set the waste reduction and recycling as crucial parts of a bigger environmental plan for the years to come. Mass production and use of raw materials is not an endless channel *(Aaron, 2008)*. Soon, companies will be obliged, by the circumstances, to use only recyclable raw materials.

Innovation and innovative approaches may be the answer to the environmental protection. Reverse logistics, modern procurement techniques, supply chain management and current recycling processes can transform a useless product to a valuable piece *(Blumberg, 2005)*.

A wide research made from the Organization for Economic Cooperation and Development in 2006 *(OECD, 2006)* presented that recycling markets face weaknesses and discrepancies considering their primary mission. A possible re-design though could help them to overpass failures and barriers and increase their effectiveness in terms of contribution. Alternatively traditional recycling policies and operations could be enriched with more effective tools that take advantage of information and communication technologies. Issues such as: (a) search and transaction costs, (b) quality of recycled goods and (c) penetration of recycled materials in the markets, could be easily coordinated by simply bringing together the involved parts through a communication tool. The Organization concluded that this is a desired outcome which does not exist but is expected to be found. Furthermore, there is a value-action gap in waste recycling which could be filled gradually by developing awareness among targeted groups, such as young people *(Chung et. al., 2007)*.

## 3. Study propositions and hypotheses

This study investigates a model that involves people in the learning process of building an investing behavior and contributes in recycling and waste prevention. Moreover, the development of other skills such as self-control, self-obedience and effective decision making, establishes a healthy framework within the region that could change its progress. The intention is to ensure sustainability and provide real tangible results in a wide supply chain by placing the end-consumer in the first link of a reverse green network.

The initial idea and proposition is to establish a company which will administer recyclable products (aluminum, glass, paper and plastic) by incorporating the philosophy of auctioning and using the know-how of stock markets and investing. For the effective operation of this effort, it would be considered necessary to depend on information and communication technologies. Participants could be: people as end-consumers; the company which will administer the service; the companies as traders and sellers since they sell the products; the recycling industry; the environmentalists; the governments;

Consumers will recycle their products; companies make offers to consumers in return of their increasing recycling participation; recyclables are sent back for reuse; recyclables are placed in an on-line auction system and the interesting parts give their offers to receive the material; consumers get back electronic shares analogous to their participation; the shares can be exchanged with products in the network of participating companies; It is hypothesized that a region-based prototype cell is created which will be supported by the regional authorities, professional associations, participating companies and the consumers. Since the concept incorporates the philosophy of auctioning, the service was assigned the name: ***"****Recycling Stock Market with the use of Information and Communication Technologies (ICT)****"*** or simpler Recycling Stock Market (RSM).

## 4. Methodology

### *4.1 Method and sample selection*

A cross sectional web-based survey was carried out among variety of entities, aiming to make survey's characteristics stronger and the results wider. In addition, another characteristic was the diversity of the sample. A personal email was sent to the respondents inviting them to visit the web site and participate in the survey. There were 100 participants originated from the following groups: (1) Researchers, who have a relation with the studied fields, (2) Consumers, (3) Professionals, in terms of technology and economy; industry experts, (4) Non-governmental institutes, in related areas such as environmental associations. The questionnaire was designed depending on a three-pronged strategy: (a) get feedback on a primary evaluation of the service, (b) get information on the potential value of the idea, and (c) get information on potential obstacles.

A 37-item structured electronic questionnaire was developed. The questionnaire was available to all respondents in order to achieve accessibility and time efficiency. Moreover, there was an on-line full presentation of the study *(http://www.ergen.gr/Recycling_Stock_Market.html).*

*4.2 Data Collection*

Data collection developed in two phases. In the first phase, the pilot, the questionnaire was distributed in 20 participants in order to get feedback about its characteristics. The feedback was positive and the questions considered simple and understandable, short and clear in their meanings. The questionnaire was available, either in electronic form or in hard copy accompanied by explanatory leaflet. The duration of this phase was one week. No serious changes in the original questionnaire have been done, except some re-phrasing in a number of questions.

In the second phase, the final version of questionnaire was available only through the web site's electronic version (*http://www.ergen.gr/web_survey/questionnaire.html*). The duration was three (3) weeks. An electronic invitation was sent to more than 300 potential participants in either their personal or professional emails. The number of respondents in this phase was 80 (response rate = 26.7%).

## 5. Results – Findings of the study *(Descriptive Statistics)*

There were 20 participants in the pilot phase. The results were adapted in the research questions: I(*a) Get feedback on how this service is evaluated (Primary Evaluation); (b)Get information on the potential value of this idea (Value and Sustainability); (c) Get information on potential obstacles (Barriers, Obstacles and Threats) (Appendix A, Recycling Stock Market - Technical Report, 2010)*,

In the survey a number of 80 questionnaires/respondents congregated from different areas of expertise and different places of the world.

*5.1 Frequencies (percentages)*

Questions (Q1-Q7) of the questionnaire capture the profile of each respondent *(see Appendix B in Recycling Stock Market – Technical Report, 2010).* The vast majority of participants were employed (over 80%), and not living alone (approx. 70%). A 52% of them are married and a 90% are at least University graduates. A 65% come from the age range of 30-49. The gender was almost balanced, 48% females - 52 males, while a 70% of the respondents declared consumers. The rest 30% were industry experts, researchers and environmentalists. The typical profile of the respondent is the following: *male/female consumer, aged 30-49, employed and married, with high educational background, living with others in the same household.*

Questions 8 to 21 are depended to the evaluation of the service. More than 80%, of the participants, found the idea of the new service as interesting and very interesting. Regarding the issue of potential participation in the service, 55% claimed that would definitely participate, 25% declared that would just participate, while a 20% were negative in the idea of participation. In both cases the positive percentages were over 90%. Also, it may work as an initiative for people to recycle more but it is not so sure that would change people's attitude. There is a 30% who believes that people will not be affected to change their routines. The same occurs with the case of living standards. There is a 44% who believes that living standards will not be affected. Obviously, this service may benefit the region/s where it will be applied and there is a strong sense among participants about that (over 70% positive). Finally, respondents declared that RSM is a smart way to recycle (over a 92%). It is a kind of service where people have some kind of direct tangible benefits (over a 92%), *(Appendix C, Recycling Stock Market-Technical Report, 2010)*.

Questions 22 to 29 are depended to the sustainability of the idea. A 43% of the respondents were not sure that the service could create growth in the region/s that will be applied although in the previous section a 70% were positive that could benefit the region/s. Participants do not see the service as an economic tool but mostly as a social initiative. Moreover, they are not so sure that this could bring income to them, only a 43% were positive about that. The penetration of the service in households seems to be an issue. An approximate of 37% declared that there would be high or rather high penetration while the rest bigger percentage declared adequate and not adequate. Respondents were positive that companies will participate, if they see it as a marketing tool and an opportunity for expansion. Environmentalists will definitely embrace the idea while there is a question mark on local authorities, since there is a 41% who see it possible to help, there is a 25% who agrees that they will help and there is a 34% - not low – that expect local authorities to be negative (*Appendix D, Recycling Stock Market-Technical Report, 2010).*

Questions 30 to 37 are depended to the potential obstacles that are identified in this effort. A 55% of the respondents were either moderate or pessimist regarding the implementation of idea and how easy this could be. They have identified that obstacles will be raised by organizations, governments, companies and experts. An approximate of 80% agreed that current market will be a possible source of conflict. In addition the environment may not be friendly since legislation issues could be raised as well. Among these, an approximate of 60% claimed that companies and consumers may not participate since the conditions will not be suitable to accommodate such a service. Moreover, it is

possible for the idea to be expensive. A 20% only declared that there are no obvious benefits from this service while on the contrary; an 80% agreed that the service has obvious benefits (*Appendix E, Recycling Stock Market-Technical Report, 2010).*

*5.2 Other descriptive statistics*

Further to the examination of frequencies, there are a number of correlations that were examined based in the relation of certain parameters. By applying *crosstabs analysis* on them there are extracted statistics and measures of association. For example in the intention to find how the participants have evaluated – per group – the new service (*Appendix F, Recycling Stock Market-Technical Report, 2010),* it is presented that consumers are more positive comparing to environmentalists and industry experts. In addition researchers seem to be positive and have found the idea interesting. On the other side, consumers and environmentalists found to have less positive opinions. In addition, the chi-square test which had a value of 0.01 proves that the difference of opinions is not due to chance variation, which implies that each category has a different range of opinions and depending in the specific sample we may generalize the outcomes. The chi-square test measures the discrepancy between the observed cell counts and what we would expect if the rows and columns were unrelated.

In *Appendix G (Recycling Stock Market-Technical Report, 2010),* is given the detailed analysis of *means* of the values. There are included the standard deviation as well as the minimum and maximum value that each question received accordingly. Almost in all questions (excluding 2) the standard deviation appeared to be bigger than 1, implying that there was a distance in opinions in the sample.

Respondents seemed to converge only in questions regarding (a) that the idea is interesting and (b) that environmentalists will support it. The biggest deviation appeared in the last question, where it is declared that there are no obvious benefits from the implementation of the service. Respondents identified this fact as a possible barrier but the opinions found to be much diverted (*SD 1,867*). Another significant deviation has been identified in the question about the ease of implementation of the idea. Although it was expected a negative result in this question (*SD 1,371*), it seemed that there were respondents that either believed in the implementation of it with no serious barriers or not.

Most of the results analysis, have been performed in terms of the (4) groups of participants, since it was considered of major interest to investigate the possible different approaches, attitudes and lifestyles of such groups.

*5.3 Methods ANOVA and Means Comparison*

In continuous there was an analysis performed in terms of comparing 5 different variables regarding the service, based on the collected results. These variables were: *(a) the evaluation of the service (Q8), (b) the intention of participation (Q9), (c) the affection in living standards (Q15), (d) the benefit to the region (Q16) and (e) the most popular characteristic of this service (smart way to recycle) (Q20).*

There is a linear relationship between the groups of participants in all five questions. Since (siq.) were less than 0.05 in all cases there are significant differences among groups in terms of the responses to the specific questions. As this result was really interesting, the ANOVA case was applied to the whole questionnaire using as a factor of research the group that each participant belonged to (*Appendices H- I, Recycling Stock Market-Technical Report, 2010).* On the contrary, the analysis of variance shows that there are a number of questions that have no significant differences regarding the responses. Environmentalists will definitely embrace the idea and this is a common evaluation within the 4 groups, although there will be raised obstacles from different parts in the effort to implement the idea. Moreover, it is possible that both consumers and companies will avoid participating, giving the fact of legislative issues, the conflict with the “status quo” of recycling industry and the high cost of idea’s implementation (*Appendix J, Recycling Stock Market-Technical Report, 2010).*

**6. Discussion of Findings**

The idea of Recycling Stock Market is interesting and attractive, but not easy to be implemented. There is a positive attitude and willingness to participate and support the new service but current situation will probably raise obstacles. This is a case of resistance to a new service which although may be challenging is usually faced as a threat. A well-established network of companies and organizations is difficult to be changed. Radical innovative approaches are not easily implemented beyond the given conditions either in market or society.

As an additional tool below it is given a table where on the left side is given parts from the literature and on the right side the corresponded findings from the study.

| Findings from literature | Relation with findings from the study |
|---|---|
| • People follow a behavior that is irrelevant to environment's sustainability<br>• Attitude is distinguished from behavior | • *Although a percentage of more than 70% of the participants agreed that RSM will benefit the environment and will save valuable resource, there was a 20% which declared that will not participate while another 25% was not so sure about its participation* |
| • There is a difference among what people perceive and what actually do | • *There is a 30% of respondent that expect non participation from the consumers* |
| • Whenever this is necessary we should not be afraid to mandate changes<br>• This concerns sustainability | • *Over a 70% argues that industry will raise obstacles trying to keep current situation unchanged* |
| • Anything could get a price if applied innovative tools that give value to its existence | • *Over an 80% found RSM a smart way for recycling since there is a tangible reward* |
| • OECD presents that recycling industry suffers from failures and discrepancies. A possible re-design should be considered seriously | • *An approximate 80% foresees that the new service will have conflict with recycling industry* |
| • There is a value-action gap in waste recycling which could be filled by developing awareness among targeted groups | • *Over 70% believes that RSM could change current recycling processes. Another 60% accept that this service will make them increase the frequency of recycling* |
| • Innovative community-based tools introduced by the World Bank | • *Over a 70% agrees that RSM will benefit the region where it will be applied* |
| • Economic benefits may be a significant factor that affects recycling behavior<br>• Subsidies in the recycling sector are a strategy that aims to strengthen local economies and change the direction to a higher recycling ratio | • *A 70% of the participants declared that RSM is a smart service because you can earn money from garbage* |
| • Recycling sector could become a significant factor for a region if adopt simple procedures and find minimum obstacles from legislation and paperwork | • *More than 60% believe that RSM will face legislation issues and it would be affected by the negative attitude from local authorities* |
| • Developing new comparative advantages in the period of crisis with the use of clean technology may lead to sustainable growth | • *Over 60% of the respondents see this service as a game* |

Results from the statistical processes of pilot and full questionnaire, were used to construct the conceptual framework of this service (*Appendix K, Recycling Stock Market-Technical Report, 2010)*.

Study's findings were adapted in the framework of new product development. As a result there have been constructed (a) the Porter's five sources model, (b) the industry attractiveness model and (c) a SWOT analysis (*Appendices L-M-N, (Recycling Stock Market-Technical Report, 2010).*

**7. Conclusions & Recommendations**

The full survey which took place in 80 participants concluded that consumers are willing to participate and to embrace the new service. Other players of the same market as well as current industry might raise obstacles. Recycling industry, their affiliate companies and local authorities that exploit recyclables, are not expected to support the service.

Considering that most of the respondents were consumers, this conclusion reflects their perception. They accepted the service as a smart way for recycling and show their care for protecting the environment and saving valuable resources.

It is recommended to focus the survey to participants from recycling industry and local authorities. It would be valuable to continue and investigate any other possibilities that could help this idea. It would be an alternative to examine, with the help of industry experts, the scenario of merging the idea's characteristics with other existed services. In this effort, it could be an asset to include the participating companies, since it has been proved that their power might be significant in terms of accepting and supporting the service.

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