



## VALUE ESTIMATION OF END OF LIFE VEHICLES AS A SOURCE OF COMPETITIVE ADVANTAGE FOR DISMANTLING STATION

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**ABSTRACT. Background:** End of Life vehicles become an emerging problem because of the type of waste which they are. Each country is creating own recycling network where ELVs are well secured and recycled. Poland is a country where the system is not working correct because of a high absorption of ELVs by illegal dismantling entities which are more competitive than legal elements of recycling network. The problem is well known but there is still lack of solution. The purpose of this article is to present the concept of tools for the valuation of ELVs in order to improve the competitiveness of disassembly stations.

**Methods:** The research methodology consists of a literature review as well as observations, surveys, BPMN and UML diagrams. On the basis of literature review and observations the problem was identified. The surveys were elaborated in order to identify requirements for the concept of the tool. BPMN and UML diagrams were used to model the processes in dismantling station and the information flow between the user and the tool.

**Results:** There was established a concept of the tool - ELV's Calculator which support decisions of ELV's value estimation.

**Conclusions:** Improving competitiveness of legal dismantling station is extremely important issue in order to provide safe for Environment and People and economically justified ELVs' management. Legal entities have to follow the law what makes their business cost higher. This paper provides a solution of encouraging people to return ELVs to legal dismantlers by offering them price adequate to market demand.

**Key words:** End of Life Vehicle (ELV), dismantling station, recycling network.

### INTRODUCTION

End - of - Life vehicles (ELVs) become a major problem from the perspective of the implementation sustainable policy. ELV is a vehicle which is a waste according to the Directive 2000/53 [2000].

Appropriate ELVs management is not an option but it is necessity related to the sustainability issue. From one point of view ELVs are the source of raw materials ( e.g. ferrous, non-ferrous metals, glass, plastics and rubber) which properly processed decrease the demand for unrenewable resources. On the

other hand, components used in vehicles are dangerous for human health and natural environment (e.g. fluids such as petrol, oil, hydraulic liquids, batteries; airbags; etc.), which should be secured and utilized according to the law [Kosacka et al. 2015].

Dismantling station is a main object in a recycling network which is responsible for properly processing of ELVs according to Recycling Act of ELVs (polish adaptation of Directive 2000/53 [2000]). If ELV is processed in legal dismantling station, negative consequences for the environment, people and economy are reduced. Although the biggest problem of polish recycling network is a big absorption of the stream of ELVs by illegal

objects - representatives of GA (hereafter: grey area). If the input stream to the legal dismantling station is not sufficient to cover operational cost of the business, those objects are closed and the stream of vehicles is absorbed by illegal entities. In the consequence there are recorded losses for the economy, environment and society.

In this paper it was assumed that the legal dismantling station would be more competitive if there was better estimation of the input stream - value of ELVs which are supplied to the dismantlers. In the result less ELVs would get to GE, what is not a sustainable business.

The concept of the tool for ELV's value determination is presented. At the end of this

paper are stated conclusions and is described conception of a tool for more adequate estimation the value of ELV.

During the work there were used the following researches methods as: interviews with employees, observations, brainstorming, BPMN, UML.

## CHARACTERISTIC OF END OF LIFE VEHICLES IN POLAND

ELVs become an international problem, particularly in Poland [Golińska 2014], what is a result of the vehicle fleet characteristic (Table 1).

Table 1. Characteristic of the vehicle fleet in Poland and European Union (EU)  
 Tabela 1. Charakterystyka parku samochodów osobowych w Polsce i UE

Characteristic	Poland	EU
Passenger cars number (2013)	19 389 446	256 531 171
Average growing trend (2005-2013)	5,85%	1,76%
Average age of a vehicle (2011)	15 years	8,6 years
Age structure of vehicles:		
0- 5 years	9,6 %	30,8%
+10 years	78.6 % .( 51,2 % are vehicles +15 years)	37,5%

Source: own elaboration based on [OICA 2014, SAMAR 2012, ACEA 2014]

There were 19 389 446 passenger cars in Poland in 2013, what was 7,6% of the vehicle fleet of the whole EU [OICA 2014]. The total number of vehicles each year is growing (average growth of 5,85% between 2005 and 2013), what is affected by high level of imported cars after Poland accessed EU in 2004 (from 1.05.2004 till the end of 2007 there were imported about 3,5 million used cars [Krzyk, 2008]. Imported used cars are old (age structure), what causes the increase of the averaged car age (polish vehicle is almost twice older than in EU).

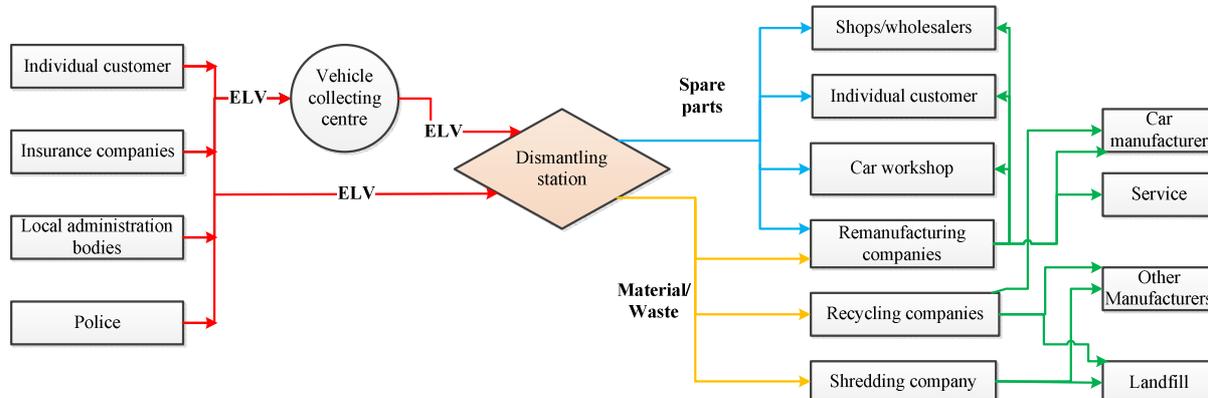
Research of Werner - Lewandowska confirms that the trend of growing number of vehicles and theirs aging structure will persist [2013]. The existing system is not efficient enough to handle such huge amounts of old vehicles [Golińska 2013].

A large number of old cars makes Poland Europe's "automotive heritage park" [Kosacka, Golińska 2014]. It can result in treatment polish market as a main place ELVs disposal in the next decade [Golińska 2013], what can be perceived as a chance if there will be a sustainable management of ELVs (source of materials).

Old, used cars at the end of life stage should be utilized in recycling network. Although in Poland vehicles are used even they have above 30 years. It results in high costs of maintaining old vehicle fleet incurred by car owners (higher fuel consumption) but also all Society (lower level of safety and bigger pollution).

## DISMANTLING STATION - REQUIREMENTS AND PROBLEMS

According to ELV Directive each country has to establish recycling network for ELVs



Source: Kosacka et al. 2015

Fig. 1. Polish recycling network  
 Rys. 1. Sieć recyklingu w Polsce

In the recycling network only dismantling stations are intended for processing ELVs. Vehicles which enter the dismantling company may be obtained from a number of sources including: vehicle collection points (agent), insurance companies, local administration body, police and individual suppliers (car owners). As the result of processes realized in dismantling entity there are generated two output streams: spare parts which can be reused and parts and materials for recovery and recycling.

Dismantling stations are responsible for the following tasks [Nowakowski, 2010]:

- Vehicle collection;
- Storage of ELVs;
- Liquids removal;
- Vehicle disassembly;
- Sorting and transport parts and materials.

Due to the fact that ELVs are potentially dangerous for the natural environment, the dismantling stations are constantly monitored and are required to achieve the goals related to the increasing recycling and recovery rates (from 01/01/2015 there should be achieved the reuse and recovery rate of 95%, recycling rate of 85%).

collecting and processing. Polish recycling network is consisted of many entities, particularly running illegal business, where there are irregular supplies of ELVs [Kosacka et al. 2015] (Figure 1).

In 2014 polish recycling network consisted of 970 dismantling stations and 139 vehicle collection points [FORS] The number of those objects is still growing but is still not enough.

Polish dismantling stations are facing many specific problems described in [Golińska 2014]. The most relevant problem refers to the absorption of ELVs by GA. Taking into consideration information about polish vehicle fleet (age structure, number of vehicles, technical condition) experts affirm that about 1 000 000 of vehicles should be deregistered each year. Although an increasing trend in a number of ELVs deregistration (182 153 in 2007, 383 567 - in 2014) [CEPiK] only almost 40 % of all ELVs are directed to recycling network created by legal entities., while rest of them are processed in illegal objects (GA).

Illegal entities are more competitive instead legal dismantlers because they can offer higher price for ELVs. It is a result of lower cost of the dismantling business which is not ran according to the law requirements (appropriate dismantling eco-friendly infrastructure is expensive). There was prepared the comparison of legal and illegal dismantling station from the sustainability perspective (Table 2).

Table 2. Legal and illegal dismantling station comparison in the context of sustainability  
 Tabela 2. Porównanie legalnej i nielegalnej stacji demontażu w kontekście zrównoważonego rozwoju

Assessment criteria	Legal dismantling station	Illegal dismantling station
Employment	+2	0
Working conditions (harmfulness for workers)	+1	-2
Influence on local community	0	-2
Government cost	+2	-2
Country development (GDP)	+2	-2
Environment pollution	+1	-2
Energy consumption	+1	-2
Recovery and recycling rate	+2	-2
<b>Total</b>	<b>+11</b>	<b>-14</b>

Source: own elaboration

In the presented comparison there was used the following scale of the influence: -2 is very negative, -1 is negative, 0- neutral, +1 - positive, +2 very positive.

There were considered different assessment criteria characterized sustainability. In each case legal dismantling station had better result, because it has got appropriate infrastructure, protective measures for workers, it creates workplaces for new Employees and generated the GDP, it has impact on the local community (noise, vibration) but there is no necessity of fighting by the government with legal objects. Moreover legal entities are taking care of recovery and recycling rate what is equivalent to lower Environment pollution (particularly hazardous substances).

In order to ensure sustainability in dismantling process legal entities should have sufficient stream of ELVs, consequently they should be more competitive than illegal dismantlers. Authors of the papers perceived a chance of better competitiveness achieved by more adequate estimation of the value (price) of the ELV which is supplied to the legal dismantling station. The price will encourage people to return ELV to legal dismantler.

## VALUE ESTIMATION OF ELV ASSUMPTIONS

There were conducted surveys in polish legal dismantling stations.

Pilot studies were carried out in one of the biggest dismantling station. After review with the owner of the business and observations there was identified the problem with the price estimation of the supplied ELVs as the main reason of inadequate input stream of ELVs.

At the second stage of the studies researches made the interviews about that problem with other 10 dismantling stations. There was identified that some of dismantling stations establish price for the ELV according to the price list, others calculate the price according to the real weight of the car and assumed value of 1 kilo. To support that there was made an Internet research while there was verified on websites of legal dismantling station how they determine the price of the ELV. It was proved that most of them (about 90%) use only the information about the weight of the car, what will result in price inadequate to market requirements.

After reviews with dismantlers there was prepared list of ELV's features which should be considered during ELV's price estimation (Table 3).

In order to increase the competitiveness of legal dismantlers there was prepared the concept of the tool for ELV's value estimation -ELV's Calculator (Hereafter: EC). In the EC preparation there were taken into consideration ELV's features (Table 3) and requirements for

the EC which were the effect of the analysis of dismantling station special features arising from the specification of the business and size of the company (Table 4) (most of dismantling stations are Small and Medium Sized Companies).

Table 3. ELV's features influenced price for the ELV  
 Tabela 3. Cechy Pojazdu wycofanego z eksploatacji wpływającego na jego cenę

ELV's feature	Description	Influence of the value	Verification method
Completeness of the vehicle	Complete vehicle has got all parts which can be later be sold as spare parts (but they have to be not damaged also at the same time)	Increase	visual inspection
Damages	In the damaged vehicle additional profit from the spare parts selling is impossible.	Decrease	visual inspection
Vehicle popularity	If the vehicle is popular, the demand for spare parts is higher, what in the consequence may result in higher profit for dismantler.	Increase	Database according to the market research and experience of Employees
Additional equipment (gas-fittings, Unique components)	If the vehicle has got gas-fittings, it will be heavier so the price should be higher. If the vehicle has got unique components because it was the special version of the car, the value will be higher.	Increase	visual inspection
Weight of the car	If there is a difference between weight from the registration certificate and real weight more than 10%, the value should be reduced.	Decrease (difference more than 10%)	comparison of the weight

Source: own elaboration

Table 4. EC's requirements resulting from dismantling station characteristic  
 Tabela 4. Wymagania wobec EC wynikłe z cech stacji demontażu

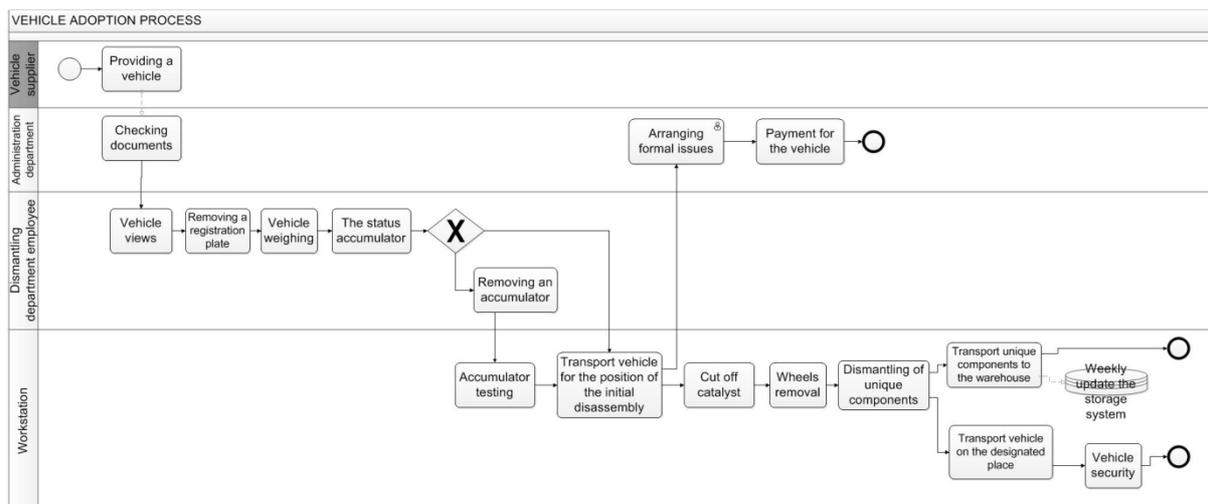
Requirement	Description
Simplicity	EC is easy in operate. There is no need for additional training for Employees.
Service speed	EC allows to fast service of the customer (under 5 minutes) e.g. during short phone call.
Edit ability	The tool should provide the possibility of introducing changes without help of the IT specialist. All required data (e.g. update of the popular cars database) should be possible for every worker.

Source: own elaboration

The EC should be simple, provide fast service of the customer and have a possibility of introducing some changes. The basic assumption for the EC was that estimation the value of the ELV will be made according to the weight taking into consideration only Composition of raw materials. With the technology of the production changes, material composition of passenger cars was changed. For the research, there was assumed raw materials composition from [Nowakowski, 2010].

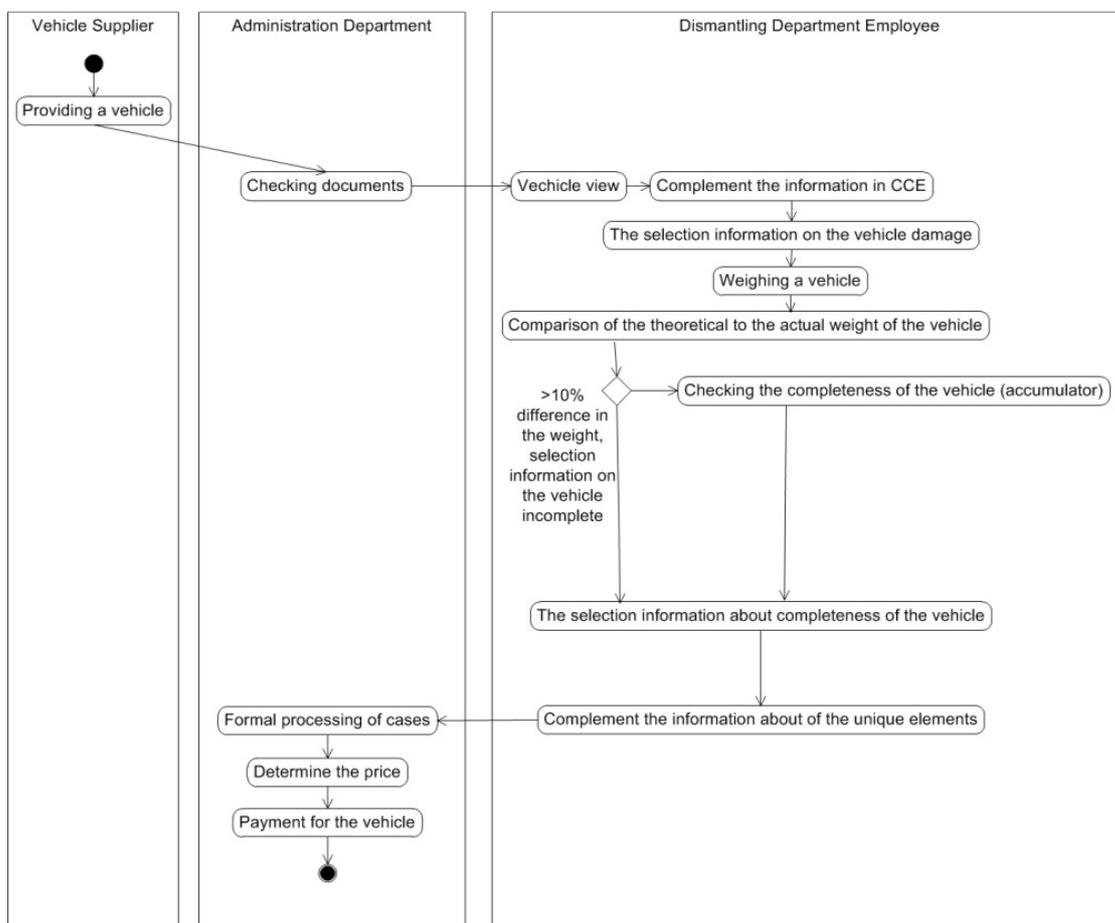
## ELV'S CALCULATOR STRUCTURE

Before step in designing the tool was performed analysis of the processes that occur during the adoption of the vehicle to the dismantling station. For the analysis, were established the BPMN diagrams that graphically showed the essence and the relationships between the various actions (Figure 2).



Source: Kosacka et al. 2015

Fig. 2. The process of adoption of ELVs  
 Rys. 2. Proces przyjęcia PWE



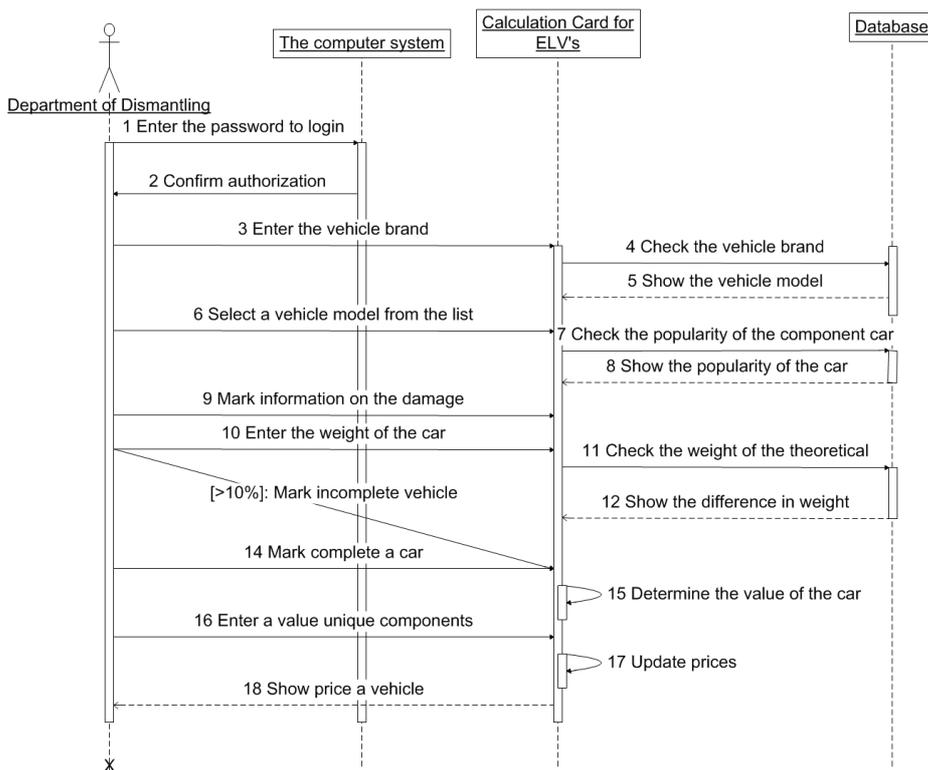
Source: Own elaboration

Fig. 3. The activity diagram  
 Rys. 3. Diagram czynności

Figure 2 was presented the adoption process. The adoption process is consisted of many steps including: checking the documents, removing parts (e.g. battery, catalyst, wheels), viewing the technical condition of the vehicle, etc. Passing through the complex steps, the value of vehicle can be estimated. According to that information the vehicle's owner will decide on the destiny of the item - it may be provided to the legal entity or illegal one. From the perspective of the dismantling station, the adoption process is crucial. The number of received vehicles affects the dismantling process profitability. At that stage the value of the vehicle depends on the perception and the experience of the worker. Moreover the adoption might be done by different employees which presents various mental states. That may be a cause of mistakes during assessing the vehicle value. In addition, during the adoption of the ELV it is a huge variety of information

that is affected to the value of the vehicle including the weight of the ELV, content of basic parts (e.g. battery) or additional parts or technical condition of the vehicle. Taking into account, all required information supports in carrying out the adoption process. On the other hand, no standard procedure of ELV's value estimation leads to high level of the subjectivism of employees resulted in incorrect value estimation and decreasing the competitiveness of legal dismantling station.

Taking into account, all required information needed in adoption process can be presented as an activity diagram with the use of Unified Modeling Language (UML) (see Figure 3). With the activity diagram, interdependencies among all operations in the adoption process can be clearly presented.



Source: Kosacka et al. 2015

Fig. 4. The sequence diagram  
 Rys. 4. Diagram sekwencji

Employee of the dismantling department is responsible for verifying the technical condition of the vehicle. After visual assessment, the ELV should be weighted.

According to the Polish law there is applicable 10% difference between the real weight of the perceived ELV and its theoretical weight. If the difference is more than 10% the vehicle is treated as incomplete one. The more

incomplete vehicle is, the payment for it is lower. In the next step, the battery is removed and tested if it is existed in the ELV. If there is no battery, the price is deduced. Any damage on vehicles will affect on the price as 25% reduction compared to the nominal price for undamaged vehicles. In contrast, the price may increase when vehicle contain some unique elements such us ornamental slats (e.g. car after tuning).

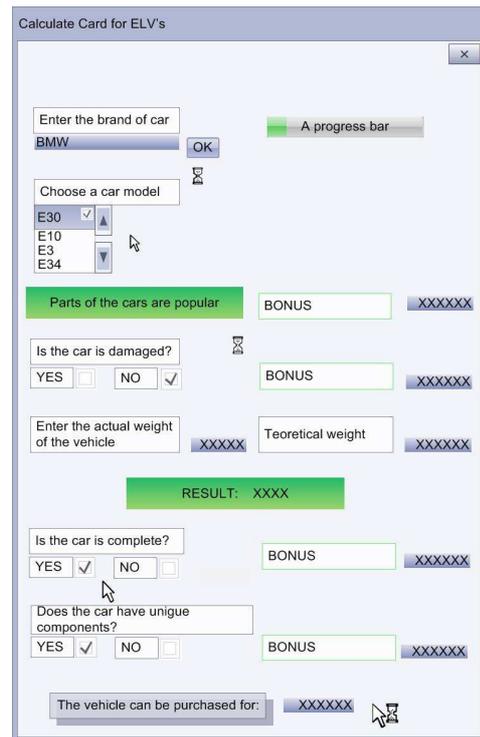
After elaboration of the activity diagram, the sequence diagram can be developed as shown in Figure 4 to describe interactions between parts of the system as a sequence of messages exchanged between them. There are interactions between: employees (representing the department of dismantling) and the computer system where available EC tool is installed for the prepared database.

The prepared tool is available for the user after authorization (there should be enter the password) to make the whole process of ELVs' to be secured. The user should complete the information of ELV's brand, model and technical condition (to verify damages). Then, the weight of vehicle should be input. After that, the difference between theoretical and actual weight of the vehicle can be calculated by the tool and displayed at the screen. If the difference is less than 10% the car is treated as complete (the status complete is marked) what will increase the value of the vehicle.

Based on the input data, the initial price can be estimated which can be increased if the

unique items exist. Then, the final price will be sent to the following task.

The sample user interface of the proposed system is presented as Figure 5. Designed interface allows employees of the disassembly stations to enter some data manually. However, there are still data that need to be downloaded from the database (e.g. model). The types of used data are described in Table 5.



Source: Kosacka et al. 2015

Fig. 5. Interface CCE  
 Rys. 5. Interfejs CCE

Table 5. A description of the types of fields in a form designed  
 Tabela 5. Opis typów formantów w zaprojektowanym formularzu

Types of formants	Example of use in the form	Description
Text field	1. Formant entering vehicle brand 2. Formant entering the actual weight of the vehicle	These fields are used to supplement the information
List box	1. The list box which applies the model selection	In the list appears on the model of the vehicle brand
Check box	1. Fields: whether the vehicle is damaged, whether the vehicle has an LPG	The field is a combination of labels: YES and NO
Calculated field	1. Fields 'result'	The fields show the proposed price per vehicle
Field of Progress	1. A progress bar	The box indicating percent of complete the information on the form

Source: own elaboration

Designed interface created specific application scenario, which organizes the needed information for the evaluation of ELV and dismantling operation. It contains dot fields associated that charge the value of the associated database item and unrelated fields, which typically display additional information.

The proposed tool help in facilitate the work of employees and shorten the operation time of the adoption to the dismantling station that will affected to increasing competitiveness of disassembly stations.

## CONCLUSIONS

The paper presents the problem of polish recycling network related to the ELVs management. ELVs are waste which appropriate processed in legal dismantling stations is neutralized and well managed from the perspective of recycling. That business is sustained in opposite to illegal entities running business only from the perspective of achieved profits what makes business unsustainable.

The problem of absorbing the stream of ELVs by illegal entities is related to bigger competitiveness of illegal companies offering better price for vehicle. The authors presented the conception of a tool which helps in the price estimation of ELVs and increases competitiveness of the legal dismantlers in term of reasonable price and short operation time.

According to requirements for the dismantlers, there were established ELV's features as well as dismantlers characteristic that is affected on the decision making of the dismantlers.

Proposed tool is developed based on material composition of vehicle that is difficult to be measured accurately. The main disadvantage of the tool is that the basis for the estimation is shared for raw materials in the vehicle structure according to the assumptions of the dismantling station owner. This is the weak point of the tool which requires

additional researches for the further improvement.

The main advantage of the tool is the simplicity and possibility of editing. The tool is prepared in the spreadsheet available in each dismantling station. Moreover, there is easy access to the data in term of the price of each raw material as well as percentage share that can be easily updated. Created tool allows users to easily set the price ELV. This function supports the dismantling station to be more competitive suppliers ELVs than the "green zone", which is the key point for improving the functioning of the network of recovery in Poland.

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## REFERENCES

- Centralna Ewidencja Pojazdów i Kierowców (CEPiK), Retrieved from <http://www.cepik.gov.pl/statystyki> (accessed August, 05, 2015)
- ELV DIRECTIVE, 2000, Directive 2000/53, EC of the European Parliament and of the Council on end-of life vehicles.
- European Automobile Manufacturers' Association (ACEA), 2014, Retrieved from [http://www.acea.be/uploads/publications/PCKET\\_GUIDE\\_2014-1.pdf](http://www.acea.be/uploads/publications/PCKET_GUIDE_2014-1.pdf) (accessed January, 30, 2015).
- Golinska P, 2014, Implementation of ELV Directive in Poland, as an Example of Emerging Market Country", Environmental Issues in Automotive Industry. Springer Berlin Heidelberg, 247-259.
- International Organization of Motor Vehicle Manufacturers (OICA), 2013, Retrieved

- from  
<http://www.oica.net/category/vehicles-in-use> (accessed January, 30, 2015).
- Kosacka M., Golińska P., 2014, Assessment Of Sustainability In Dismantling Station-Case Study. *Research in Logistics & Production*, 4(2), 135-145.
- Kosacka M., Kudelska I, Golińska-Dawson P., 2015, How properly value ELVs? - concept of the tool of ELVs assessment for dismantling station. Case study. *Proceedings of the 25th International Conference on Flexible Automation and Intelligent Manufacturing (FAIM 2015)*, 208 -215.
- Krzak J., 2008, Recykling samochodów [Car's recycling], *Infos*, 5(29). Wydawnictwo Sejmowe dla Biura Analiz Sejmowych, Warszawa.
- Nowakowski P., 2010, Logistics system of collection, dismantling and recycling of end-of-life vehicles. *Transport Problems*, 5(4), 81-86.
- SAMAR, 2012, Retrieved from [http://www.samar.pl/\\_/3/3.a/72164/3.sc/11/park-samochod%F3w-2012-w-ofercie-ibrmsamar.html?locale=pl\\_PL](http://www.samar.pl/_/3/3.a/72164/3.sc/11/park-samochod%F3w-2012-w-ofercie-ibrmsamar.html?locale=pl_PL) (accessed January, 30, 2015)
- Stowarzyszenie Forum Recyklingu Samochodów (FORS), Retrieved from <http://fors.pl/wp-content/uploads/2014/01/stacje32.pdf>, (accessed August, 05, 2015)
- Werner - Lewandowska K., 2014, Perspektywa rozwoju remanufacturing części samochodowych w Polsce [The remanufacturing of automotive companies in Poland - development perspective], *GMiL*, 6, 27 -35.

## SZACOWANIE WARTOŚCI POJAZDU WYCOFANEGO Z EKSPLOATACJI JAKO ŹRÓDŁO BUDOWANIA PRZEWAGI KONKURENCYJNEJ STACJI DEMONTAŻU

**STRESZCZENIE. Wstęp:** Pojazdy wycofane z eksploatacji (PWE) to coraz większy problem ze względu na charakter odpadu jakim są. Każdy kraj buduje sieć recyklingu, w której PWE są odpowiednio zabezpieczone i poddawane recyklingowi. W Polsce system nie działa dobrze ze względu na to, że występuje duża absorpcja PWE przez nielegalnie działające przedsiębiorstwa zajmujące się demontażem, które są bardziej konkurencyjne niż legalne jednostki. Problem jest dobrze znany, lecz nie ma jego rozwiązania. Celem artykułu jest zaprezentowanie koncepcji narzędzia przeznaczonego do wyceny wartości PWE celem poprawy konkurencyjności legalnej stacji demontażu.

**Metody:** Przeprowadzono badania literaturowe jak również obserwacje, wywiady oraz wykorzystano diagramy BPMN i UML. Na podstawie przeglądu literatury oraz obserwacji został zidentyfikowany problem. Celem przeprowadzonych wywiadów było opracowanie narzędzia. Diagramy BPMN i UML zostały wykorzystane do zamodelowania procesów realizowanych w stacji demontażu oraz przepływów informacyjnych między użytkownikiem narzędzia a narzędziem.

Wykorzystane zostały następujące metody badawcze: analiza źródeł literatury, obserwacje, wywiady, diagramy UML i BPMN. Na podstawie analizy literatury oraz obserwacji zidentyfikowany został problem. Ankiety były przeprowadzone celem identyfikacji wymagań dotyczących narzędzia. Diagramy natomiast zostały wykorzystane do modelowania procesów w stacji demontażu oraz przepływów informacji między użytkownikiem a narzędziem.

**Wyniki:** Opracowano koncepcję narzędzia - Kalkulator PWE celem wsparcia podejmowania decyzji w zakresie szacowania wartości PWE.

**Wnioski:** Zwiększanie konkurencyjności legalnie działających stacji demontażu jest bardzo ważnym zagadnieniem w kontekście zapewnienia bezpiecznego dla ludzi i środowiska oraz ekonomicznie uzasadnionego zarządzania PWE. Legalne stacje demontażu muszą działać zgodnie z prawem, co podwyższa ich koszty funkcjonowania. Przedstawiony artykuł dostarcza rozwiązania, które ma zachęcić właścicieli PWE do dostarczania PWE do legalnych obiektów przez zaferowanie im ceny odpowiedniej do wymagań rynku.

**Słowa kluczowe:** Pojazd Wycofany z Eksploatacji (PWE), stacja demontażu, sieć recyklingu.

## BEWERTUNG EINES AUßER BETRIEB GESETZTEN FAHRZEUGS ALS FAKTOR ZUM AUFBAU DER WETTBEWERBSFÄHIGKEIT EINER DEMONTAGE-STATION

**ZUSAMMENFASSUNG. Einleitung:** Die außer Betrieb gesetzten Fahrzeuge stellen wegen Charakter des dabei entstandenen Abfalls ein immer größer werdendes Problem dar. Jedes Land baut ein Recycling-Netz, in dem die betreffenden Fahrzeuge entsprechend sichergestellt und recycelt werden, auf. In Polen funktioniert ein solches System nicht richtig, denn es besteht die Erscheinung einer unerwünschten Übernahme solcher Fahrzeuge seitens der illegal betätigten Demontage-Unternehmen, die wettbewerbsfähiger als die legalen Demontage-Einrichtungen sind. Das Problem ist allgemein bekannt, es gibt jedoch keine gute Lösung dafür. Das Ziel des Artikels ist es, das Konzept eines Tools für die Bewertung eines außer Betrieb gesetzten Fahrzeugs zwecks Verbesserung der Wettbewerbsfähigkeit einer legal betriebenen Demontage-Station darzustellen.

**Methoden:** Es wurden Literaturrecherchen, Wahrnehmungen vor Ort und Interviews durchgeführt, sowie die BPMN- und UML-Diagramme in Anspruch genommen. Anhand der Gegenstandsliteratur und der Wahrnehmungen vor Ort wurde die Problemstellung ermittelt. Das Ziel der durchgeführten Interviews war es, ein brauchbares Tool für die Lösung dieser Probleme auszuarbeiten. Die BPMN- und UML-Diagramme wurden für die Modellierung der in der Demontage-Station verlaufenden Prozesse und der zwischen dem Tool-Anwender und dem Tool selbst bestehenden Informationsflüsse angewendet. Es wurden dabei folgende Forschungsmethoden wie: Analyse der Literaturquellen, Wahrnehmungen vor Ort, Interviews und die BPMN- und UML-Diagramme in Anspruch genommen. Auf Grund einer entsprechenden Literaturrecherche und der Wahrnehmung der Problemstellung wurde das Problem identifiziert. Die Interviews wurden zwecks der Bestimmung der das Tool selbst anbetreffenden Herausforderungen durchgeführt. Die Diagramme dagegen wurden für die Modellierung der in der Demontage-Station verlaufenden Prozesse und der zwischen dem Tool-Anwender und dem Tool selbst bestehenden Informationsflüsse angewendet.

**Ergebnisse:** Es wurde ein Konzept für das Tool in Form eines Kalkulators für das au?er Betrieb gesetzte Fahrzeug zwecks der Unterstützung von Entscheidungen bezüglich der sachgemä?en Bewertung der betreffenden Fahrzeuge ausgearbeitet.

**Fazit:** Die Erhöhung der Wettbewerbsfähigkeit von den legal betätigten Demontage-Stationen gilt als eine sehr wichtige Frage im Kontext der Gewährleistung eines für die Menschen und die Umwelt sicheren und wirtschaftlich begründeten Management-Systems für die au?er Betrieb gesetzten Fahrzeuge. Die legal betriebenen Demontage-Stationen müssen jedoch gesetzmä?ig betätigt werden, was die Betriebskosten erheblich erhöht. Der dargestellte Artikel bietet eine Lösung, die die Besitzer von au?er Betrieb gesetzten Fahrzeugen dazu bewegen soll, die betreffenden Fahrzeuge an die legalen Demontage-Einrichtungen, die ihren Kunden einen den Marktanforderungen entsprechenden Preis anbieten müssen, abzuliefern..

**Codewörter:** außer Betrieb gesetztes Fahrzeug, Demontage-Station, Recycling-Netz.

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