TECHNICAL UNIVERSITY OF CLUJ-NAPOCA

ACTA TECHNICA NAPOCENSIS

Series: Applied Mathematics, Mechanics, and Engineering
Vol. 61, Issue IV, November, 2018

HOW MATURE IS REVERSE LOGISTICS? – CONCEPT OF THE PROCESS AND RESOURCE ORIENTED MATURITY MODEL

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Abstract: *The paper presents background of reverse logistics maturity model. According to conducted theoretical research and own observations, it was stated, that the level of reverse logistics maturity depends on processes and resources used by those processes. The aim of this paper was to provide cross company valid maturity model for reverse logistics assessment which will be oriented on process and resources, considering various aspects of reverse logistics. The roots of the model lie in CMMI. Reverse logistics maturity model has become original approach in the field of logistics maturity research.*
Key words: *Reverse logistics, maturity model, CMMI.*

1. INTRODUCTION

Recently, it may be observed an increase of interest concerning problems connected with sustainability and reverse logistics. The presented paper is focused on reverse logistics issue, considering the fact that organizations seek opportunities to respond to pressure caused by: consumer, government and competitors in order to improve company's environmental image and its economic performance. However, reverse logistics is included into company's logistics system, what results in a growing number of papers on the specified topic, there are a lot of research works which are: theoretically oriented, present fragmentary approach to reverse logistics issues and do not help to manage and to improve activities undertaken in this context. As a result, it was claimed that companies are forced to fulfill legal requirements, although they are inexperienced with the reverse logistics management. Consequently, it was stated that there is requirement for supporting companies, particularly that there is a need for dealing with problems which does not occur with the forward flow (e.g. uncertainty and quality of returns). Considering the fact that there are included a lot of processes in reverse logistics activity, which add value to products, it was indicated that there should be used universal methods/tools which support companies in reverse logistics assessment and improvement. In authors opinion, if there is a need of improving, there should be identified foundations, what requires assessment. On the basis of authors previous research experience related to the sustainability assessment, in order to assess reverse logistics, there was proposed maturity model. Owing to the fact, that CMMI has been a maturity model used by many organizations all over the world, as reported in [3] it was recommended as a basis one for proposed model.

The presented model should fulfill a few essential factors. Firstly, it was assumed, that the major condition for the practical use of the tool by a company is model's simplicity, what has become the first guideline for tool's development. What is more, it should consider the complexity of reverse logistics activity and its diversification from the perspective of realized processes and required resources. However, there are available process oriented maturity models, it was claimed, that increasing complexity of the reverse logistics has required new approach, which would be not only process-oriented but also resource-oriented, what has not been available in the literature, so far. As a result there was identified a research gap. Taking that into consideration, there was defined a major research objective of the paper

to develop a concept of the reverse logistics maturity model, which will allow to assess the level of advancement in the implementation of reverse logistics processes, what is related with the use of adequate resources and on this basis, to determine the directions for further actions to ensure continuous development.

In the presented paper, the method proposal was described. It was stated, that the presented method should be useful for practical application, for each kind of industry and company size and it should be also simple for users, considering the reverse logistics over the wide range.

In order to achieve the main research objective, there were defined the following research questions:

- RQ1: What process should be assessed?
- RQ2: What resources should be assessed?
- RQ3: How to assess maturity of reverse logistics?

The remainder of this paper has the following organization. Section 2 gives a brief description of maturity models and reverse logistics. In the Section 3 there was prepared state of art on the subject of conducted research. Section 4 discovered maturity model for reverse logistics, which is oriented on processes and resources. Conclusions and recommendations for future research are set out in Section 5.

2. RESEARCH BACKGROUND

2.1 Maturity model

A maturity model term matches two notions maturity and model. A model is treated as a simplified representation of the world. The maturity firstly proposed by Phillip Crosby [4] is defined as the state of being complete, perfect, or ready [14].

Following Domingues et al., authors perceive maturity models as most common used tools of new generation, which encompass more than just quality requirements of customers, but also consider issues including: Environment, people, etc. [6, p. 165]. A maturity model is a representation of evolutionary progress toward achieving a maturity, with a logical path consisted of levels (stages) determined from the perspective of the assessment's objective, in order to ensure its effectiveness. Each maturity level comprises a set of goals and they are organized in a sequence, resulting in an increase in the object's capability of the organization. As a result, maturity model gives company a chance to assess maturity and to prioritize its improvement efforts.

Maturity models have become very often an object of research. According to SCOPUS database there have been identified on 26 May 2018, 975 results with maturity model in the publication title, when the first was published in 1983. The objective of the paper was not to analyze all maturity models, particularly, that there are available up-to date papers oriented on review of existing maturity models e.g.: [12, 17, 21]. On the basis of previous research conducted by authors of the paper, it was claimed, that maturity models are adaptable tools which provide effective assessment, although they are typically one-dimensional, with focus on process maturity, people capability or other objects of maturation, but the process-orientation is dominating [13, p. 22].

However, there are a number of maturity models that can be applicable into a business practice (e.g. software development, quality management, product development, SCM, supplier relationships, R&D, innovation, etc. [8], on the basis of previous experience of authors of the paper and popularity of the Capability Maturity Model (CMMI), it was selected as a model one for developing reverse logistics maturity model. The roots for this approach lie in the software industry with the Capability Maturity Model (CMM) that was reported in: [15]. CMMI is consistent with the international standard ISO/IEC 15504 [19, p. 884]. The objective of CMMI is to provide a guidelines for processes' improvement of the organization and its ability to manage the development, acquisition, and maintenance of products and services [2,p. 23]. The most well-known representation of CMMI is the 5-staged model, that describes an evolutionary path recommended for an organization, where there are five maturity levels including: Initial, Managed, Defined, Quantitatively Managed, Optimizing, as reported in: [2, p. 29-31].

The CMMI model was adopted in the presented study, however considering the paper's major objective it required resources inclusion and appropriate CMMI model modification, presented in the Section 4.

The most relevant guideline was to prepare model which fit the purpose, what means that it would consider complex structure of reverse logistics processes with resources and processes orientation.

2.2 Reverse logistics – process and resources

In order to answer research questions RQ1 and RQ2 authors made a literature review on the reverse logistics.

There has been observed a growing interest of the issues related to the reverse logistics, what is related with obsolescence of the model of taking, making, consuming, disposing, which is the contrary of the circular economy. The relevance of the reverse logistics has been risen as there have been identified many reasons for products' returns what was reported in: [9, p. 31- 32].

Although, there are a few commonly accepted definitions of the reverse logistics, proposed by: Dowlatshahi [7],Rogers and Tibben-Lembke [16], Stock [20], but in the paper there was adopted the proposal of the European Working Group on Reverse Logistics, REVLOG that defined reverse logistics as the process of planning, implementing and controlling backward flows of raw materials, in process inventory, packaging and finished goods, from a manufacturing, distribution or use point, to a point of recovery or point of proper disposal [5, p. 5]. The presented definition emphasized processes and resources context, with reference to paper's objective.

Following De Brito and Dekker [5] it was stated that the major elements in reverse logistics system of each company are processes and flows of material and information. Noteworthy are also stakeholders of actions made on reverse logistics, however from the perspective of the paper's major objective, processes and resources are the most important issues.

In previous study on reverse logistics [11] authors have indicated, that architecture of the processes of reverse logistics has been vital issue, however it has not been unambiguously defined, what resulted in the development of the reverse logistics processes structure, including [11]

- Collection,
- Evaluation,
- Storage,
- Recovery,
- Redistribution,

what requires adequate integration of all activities.

As the result there were defined processes which will be evaluated by a maturity model proposed in the paper, referring to the research question RQ1.

It was claimed, that resources are necessary condition to carry out processes. According to Business Dictionary, resources are everything what company has, what contributes/is used to achieve desired goal [10].

In authors opinion, the Resource Based View (RBV) theory also convinces about the importance of resources in the management. The RBV theory argues that firms pose resources, a subset of which enables companies to achieve competitive advantage, what was reported by Wernerfelt [22] or Barney [1]. This advantage can be maintain over long time what depends on that, how a company protects owned resources against their imitation, transfer, or substitution.

Considering resources importance, it was claimed that high level of proliferation of definitions and classifications has been problematic for research on resources. However authors are aware of various classifications of resources in the paper, there was adopted an approach of Seppänen & Mäkinen [18, pp. 397-398]. As the result there have been included the following types of the resources used in the model description in Section 4.

In authors' opinion, the presented classification of resources (Table 1) is adequate to embrace all resources used in processes in reverse logistics, what is an answer for research question RQ2.

Table 1

Resources classification [18, pp. 397-398]

Type	Description	Examples
Human	People and their features which are formed by a company.	Number of people, competences (education, skills, qualifications, knowledge, experience).
Financial	Financial resources available or achievable for a company.	External, internal founds, other.
Physical	Resources referred to assets which pertain to geographic location.	Technical assets (equipment, means of transport), location, buildings and land, inventory (material, parts and products).
Relational & information [1]	Describe relationships within company and between company and its stakeholders , including shared information.	e.g. Relationships with : employees, customers, suppliers, competitors.
Organizational	Consisted of assets independently possessed by a whole company.	Structure, culture, technology, know-how, brand.
Legal	Encompass the firm's assets that are afforded legal protection through property rights.	Patents, agreements, trade secrets, trademarks.

3. REVERSE LOGISTICS MATURITY MODEL – STATE OF ART

In order to justify research on the development of a reverse logistics maturity model oriented on processes and resources, there was made a literature review in the worldwide databases used in the research in the field of management and logistics: SCOPUS, Web of Science, IEEEXplore Digital Library. The review protocol of the research are presented in the Table 2.

[1] Primarily Seppänen & Mäkinen [18] divided those groups of resources separately.

Table 2

Literature review protocol

Element	Description
Keywords + Boolean operators	"reverse logistics" OR "reverse logistic" OR "product life-cycle management" AND "maturity model" OR "maturation"
Search field	Title
Time window	No limits
Language	English
Paper type	No limits
Inclusion criteria	Maturity model oriented on processes and resources

According to data presented in the Table 2, a systematic search began with the identification of keywords and their synonyms matched by adequate Boolean operators. As a result there were defined search strings. The search was limited to works in English with no time restrictions and no limits according to paper type. The English language was selected, as it has the largest number of publications and hence more likely to offer essential works on the reverse logistics issue. Authors recommended to use an inclusion criterion, expressing the major objective of the paper. The literature review was made on 26 May, 2018 and as a result there were not identified any works on reverse logistics maturity model oriented on processes and resources. This has proven existence of a research gap in the specified field of science.

To sum up, it was stated that results of conducted literature review research justified carrying out research in the area of reverse logistics maturity model determination.

4. CONCEPT OF REVERSE LOGISTICS MATURITY MODEL ORIENTED ON PROCESSES AND RESOURCES

In order to answer the research question RQ3, there was prepared a structure of the reverse logistics maturity model oriented on processes realized within reverse logistics and resources engaged into processes' introduction. The Reverse Logistics Maturity Model oriented on processes and resources (RLMM-pr)

developed in the paper was founded on the basis of:

- CMMI maturity model,
- Architecture of processes realized within reverse logistics,
- Resources used in processes.

In the paper there was adopted CMMI as the framework for prepared maturity model. In the proposed model, authors have used well-known maturity model, referring to the process approach. With reference to literature review made on maturity models (Section 2.1), it was claimed that CMMI is a model which has been frequently used because of its effectiveness. What is more in authors' opinion there are conditions favorable to modify it and add resources context, according to the main objective of the paper. The major purpose of the research was to determine the model in a broader context, which would go beyond the process approach and allow to assess resources used in a company.

Considering the process-orientation of the CMMI, there was used architecture of the reverse logistics processes described in the Section 2.2. It was stated that in the presented model there all reverse logistics processes would be evaluated, however each process should be assessed separately owing to the fact that it may represent different maturity stage.

As it was mentioned before, the last element of the model described in the paper, was a resources context. The main categories of resources were presented in the Section 2.2. During the evaluation with the prepared tool there should be specified a list of engaged resources, which may be different at various reverse logistics processes.

Taking that into consideration there was prepared a scheme of stages in the Reverse Logistics Maturity Model oriented on processes and resources (RLMM-pr), presented in the Figure 1.

According to Figure 1, there were included five stages of the Reverse Logistics Maturity Model, with reference to modified CMMI framework:

Stage S1: Initial

The reverse logistics process is characterized as ad hoc, and occasionally even chaotic. It means that there is even lack of awareness that those processes are conducted and they require some resources (r1-r…). Activities are not clearly defined and reported, what in consequence proves no repeatability.

Stage S2: Aware

The most important at this stage is awareness of existence of processes and resources and their influences on each other. However, processes are repeatable, they are not defined and measured, there is no measurement of resources, too.

Stage S3: Defined

The reverse logistics process for both management and engineering activities is documented, standardized, and integrated into all processes for the organization. In order to execute the process, the adequate resources are defined and established, assigning responsibility for performing the process. Lack of performance measurement for processes and resources makes impossible to manage them. A critical distinction between maturity levels 2 and 3 is the scope of standards, descriptions of processes and procedures.

Stage S4: Managed

Detailed measures of the processes and resources are collected in order to monitor and control the situation. Quantitative objectives of performance measurement system are based on the needs of the customer, end users, organization. However, processes and state of resources are monitored, they are not used in order to improve the situation, what is happening in the final stage (S5).

Stage S5: Optimizing

Continuous process improvement is enabled by quantitative feedback from the process, considering resources state of art, and from piloting innovative ideas and technologies. Strategic goals of the organization point out objectives of particular processes and resources. Real data about conditions of processes and utilized resources are used in order to improve the effectiveness of whole logistics system of the company.

Considering the following structure (Fig.1) of the presented maturity model dedicated for reverse logistics assessment, there was prepared

a General Reverse Logistics Maturity Review Tool, presented in the Table 3.

It was recommended to use developed tool for assessment of each reverse logistics process which is performed by a company. Considering that, firstly, verification of performed processes should be made. Secondly, there should be prepared a list of resources which appear in the used tool presented in the Table 3 (in diagnostic questions: 8, 10, 14). Those resources require

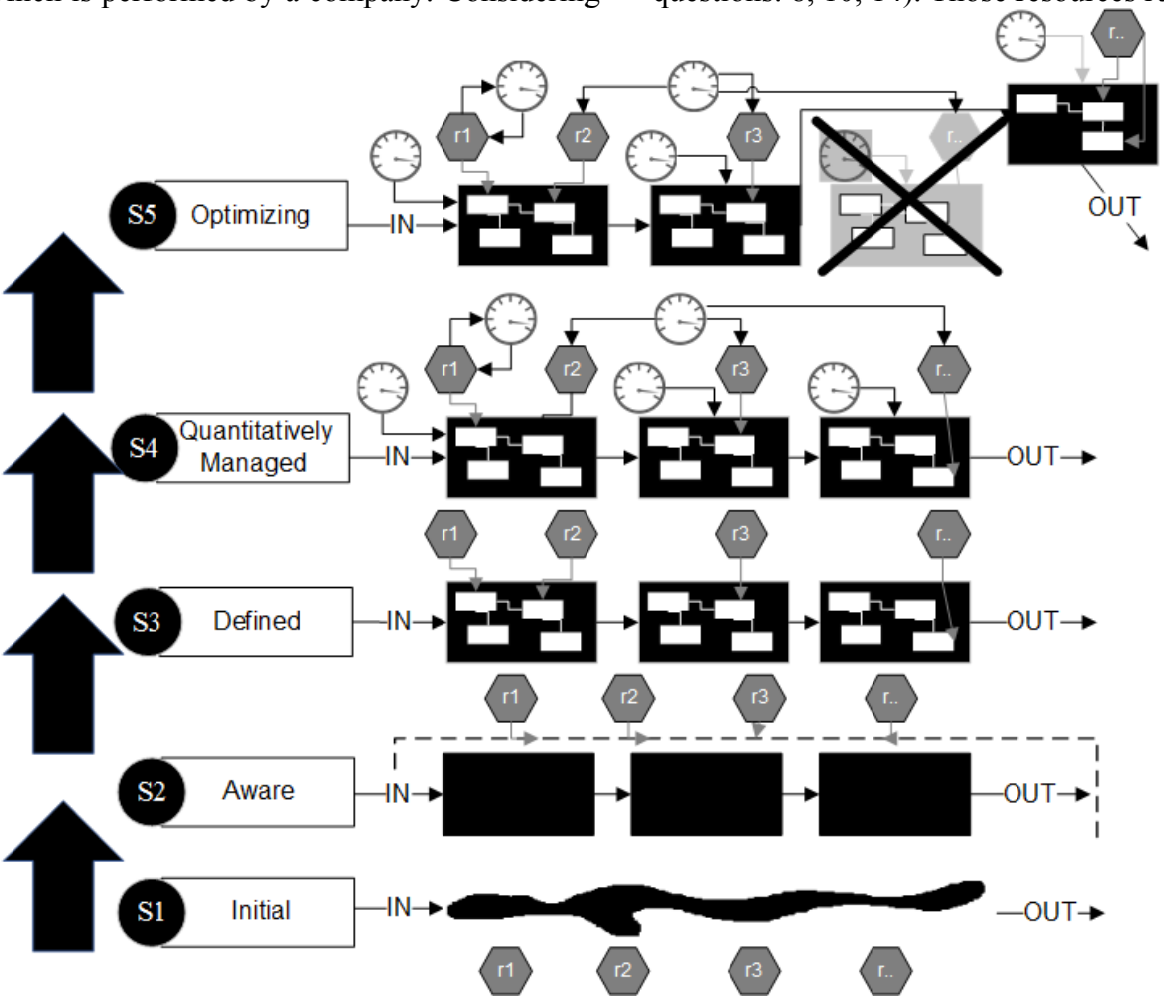

Fig.1. Stages of the Reverse Logistics Maturity Model [23]

specification according to the evaluated process because it was assumed that each process may engage various resources.

In order to assess the maturity level of chosen reverse logistics process there should be fulfilled all requirements presented in the Table 3 (signed as "x").

To sum up, with the use of the proposed tool (Table 3) the maturity assessment is possible, what is an answer for research question RQ3.

5 SUMMARY

To sum up, it was stated that the reverse logistics maturity model oriented on processes and resources presented in the paper is original approach as it was not found any other solution in the result of conducted literature research on that topic.

In authors' opinion, the proposed model may be used by enterprises as a method of managing

Table 3

General Reverse Logistics Maturity Review Tool

No	Diagnostic question	Stage				
		S1: Initial	S2: Aware	S3: Defined	S4: Managed	S5: Optimizin

											g
		Yes	No	Yes	No	Yes	No	Yes	No	Yes	No
1	Is performed work in a company is made in the form of processes?	**X**		**X**		**X**		**X**		**X**	
2	Do you use any resources to carry out the processes?	**X**		**X**		**X**		**X**		**X**	
3	Does processes and resources affect themselves?			X		X		X		X	
4	Are the activities carried out in the company repeatable?					X		X		X	
5	Are processes realized in the company recognized and described?					X		X		X	
6	Are there assigned responsibilities of performing processes?					X		X		X	
7	Are there any standards for process performing?					X		X		X	
8	Have You identified any resources required to perform each process ?					X		X		X	
9	Are processes measured??							X		X	
10	Is the state of the resources used to carry out the processes analysed?							X		X	
11	Are there any processes' records (maps of processes, procedures)?							X		X	
12	Are indicators for processes defined?							X		X	
13	Is the purpose of each process clearly defined?							X		X	
14	Do the results of processes' measurement affect management decisions related to the state of the resources used in the processes?									X	
15	Do the results of processes' measurement have an influence on processes' improvement?									X	

the company's reverse logistics activities including processes and resources.

Taking into consideration all information presented in the paper, it was stated that there were answered research questions RQ1-RQ3, and consequently, it was stated that the major objective of the paper was achieved.

Within the scope of research carried out by the authors of the paper, there are planned to conduct research on reverse logistics maturity in a developing country, Poland. Next step includes to verify model in a few companies on the basis of the case study method.

The directions for further research also indicate the need to expand the model with relationships between resources and processes. With respect to that, it was made a research hypothesis, indicating that resources may be used in various processes, however their influence on particular process may be different.

6. ACKNOWLEDGMENTS

This paper refers to the research conducted under Statutory activity, financed by MNiSW/Poznan University of Technology, project: Research on reverse logistics maturity of enterprise. (Project ID: 503227/11/140/DSMK/4152).

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CAT DE MATURA ESTE LOGISTICA REVERSE? - CONCEPTUL MODELULUI DE MATURITATE ORIENTATĂ A PROCESULUIŞI A RESURSELOR

Rezumat: Lucrarea prezintă fundalul modelului de maturitate logistică inversă. Conform cercetărilor teoretice efectuate şi observaţiilor proprii, sa afirmat că nivelul de maturitate logistică inversă depinde de procesele şi resursele utilizate de aceste procese. Scopul acestei lucrări a fost de a oferi modelul de maturitate validă pentru evaluarea logistică inversă, care va fi orientat spre proces şi resurse, luând în considerare diferite aspecte ale logisticii inverse. Rădăcinile modelului se află în CMMI. Modelul maturităţii logistice reversibile a devenit o abordare originală în domeniul cercetării privind maturitatea logistică.

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