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„LOPEC - Logistics Personal Excellence by continuous Self-Assessment"

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Abstract

In a knowledge society where demands for skills, competencies and knowledge constantly increase and change, lifelong learning is a key strategy to adjust people's performance capabilities to new requirements and grantee employability in the world of work. Good examples for this are the current changes in the logistics environment. Regularly, new services and processes close to production were taken into the portfolio of logistics enterprises, so the daily tasks are changing continuously for the skilled works.
LOPEC aims in developing and offering special-tailored training for Lean Logistics and required basic skills for skilled workers on shopfloor level. Needed know-how for today's challenges in logistics will be transferred. Another aspect of LOPEC is the development and use of a personal excellence self-assessment that allows a person to assess and thus improve his/her own level of maturity in employability skills. Thus, LOPEC is aiming at people enhancement as entry ticket to lifelong continuous learning by increasing the maturity level of personal logistic excellence. A common European view for "Logistics personal excellence" for skilled workers will ensure that the final product is an open product, using international, pan European validated standards. As results LOPEC will provide training modules for post-secondary education in the area of Lean Logistics, required basics skills and offers transparency of personal excellence with a personal self-assessment software solution, regarding the personal maturity level of hard and soft skills at any time. It can be used as an innovative tool for monitoring personal lifelong learning routes as well as within companies as a strategic tool within Human Resource Development.

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1. Initial situation, challenges and motivation

The industrial sector is one of the most important assets of Europe's economic resources. With a contribution of almost 15% to the overall gross domestic product (GDP), it ensures 34.8 million jobs [1].

Facing global competition, companies are forced to continuously improve their manufacturing and logistics processes, machinery and equipment. For the implementation of modern and lean methods it is a crucial advantage to be able to use distinct capabilities of all possible employees [2]. Designing efficient processes challenges employees at all levels of the industrial hierarchy to be responsive and reactive to problems and to contribute to the continuous improvement of these processes, especially on the shop floor [2,3]. The same applies to the changeability of companies, which can be substantially driven by the abilities and qualifications of employees [4]. Regularly, new services and processes close to production were developed or were taken into the portfolio of logistic enterprises, service providers and fields. For the execution and management of these logistics tasks, new principles, approaches and methods were raised and applied within the last years. This includes implementation trends like the transfer of lean manufacturing methods to the field of logistics [5].

Skilled workers need the competence to change and adapt logistics processes through applying innovative methods, tools and techniques on operation level to meet customer requirements. Potentials for optimization should be recognized and realized by the workers themselves, without permanent

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instructions from management level. But the lack of skilled workers will increase in the next years [6]. In addition, a mind set by the skilled workers towards life-long learning must be established. Hence, lifelong learning is a key strategy to adjust people's performance capabilities for new requirements [7] because in a knowledge-driven society, demands for skills, competencies and knowledge constantly increase and change. But for skilled workers of the secondary educational level, the entrance into lifelong learning, starting with access to the tertiary educational level, is usually not possible or at least very difficult due to educational laws, certification requirements connected with the existing school education. Because of these aspects, the access to know-how in Lean Logistics usually remains undisclosed for skilled workers [8].

Nowadays, many organizations support their skilled workers by in-house trainings to close this gab. But they meet the challenge to design organizational personnel development and to support individual personal development in a coherent and balanced way [9,10]. The dilemma of business, professional and private related objectives and its procedure of measurement is especially present in countries where labour plays a key role in manufacturing plants [11]. Currently, only assessment concepts to evaluate the position of a business in the market are available. The term "assessment" should not be confused with the other three 'A'-terms (Audits, Appraisal and Award). Often, they are mixed up and lead to a misunderstanding regarding the aims of self-assessment. The existing concepts and systems cannot be used to assess a "personal position of a skilled worker" regarding different maturity levels within his/her world of work and competences in Lean Logistics.

2. Scientific objectives and project goals

To implement the above mentioned challenges, the employed skilled workers have to be qualified and trained towards independent learning in order to design, plan and manage logistic systems at any time according to state-of-the-art of science and technology. Based on this demand, a common European vision is needed that claims major efforts to be oriented:

- on micro level, towards the support of a lifelong learning approach in European companies to ensure professional labour with continuous state-of-the-art knowledge and high performance skills,
- on meso level, towards securing, maintaining and building-up of production sites in Europe by own strength, especially by high employment and increasing empowerment of employees,
- on macro level, towards the speeding-up of the rate of industrial transformation in Europe.

The current situation and challenges can only be solved by a close cooperation between the vocational education and training (VET) organization and the world of work. Individual training modules can be compiled for skilled workers by understanding the demands of the professional life. The VET can contribute to the world of work to increase the employee skills and engagement, to raise the motivation of the skilled workers, to establish a more rapid training of new skilled workers as well as to strengthen the attraction for skilled logistics workers on the labour market. Understanding the different needs of skilled logistics workers across Europe will help to set up a customized self-assessment system as a contribution for continuous lifelong learning.

The focus of the research efforts at the Technical University of Vienna, Fraunhofer Austria Research, University of Reutlingen, is motivated through the following scientific objectives on a strategic perspective:

- Promotion of a common European view of "Logistics personal excellence" and its relevance not only for the management, but also for shop floor workers.
- Development of an educational environment for Lean Logistics in combination with the required basic skills to enable the knowledge transfer from management level to operation level.
- Definition of a learning pathway that allows skilled workers to participate in tertiary education. Thus, the gap between secondary and tertiary level as well as between continuing vocational training and higher education will be closed.
- Integration of the innovative training approach "learning factory" for life-long learning for skilled workers in the logistics sector.
- Development of a new approach of a self-assessment and a user training strategy towards "Personal Excellence in Lean Logistics". The methodology aims at providing a basis for a more systematic personal as well as professional development within the logistics sector.
- Usage of results as an international showcase for excellence in lifelong learning to persuade industry of transferability from personal to business improvements.

Based on the scientific objectives, the following operative project goals are required to obtain the desired results:

- Determination of competencies and skills needed by a skilled worker in the context of Lean Logistics.
- Deflection of learning targets and definition of a systematic procedure to reach them.
- Setting up of a platform for life-long learning and as an instrument for advanced training in logistics techniques for employees at different levels of education.
- Establishing empowerment training (basic skills) and Lean Logistics learning modules for experienced skilled workers as a step to be enabled to graduate in a bachelor program.
- Implementation of the developed training modules into a blended learning approach, consisting of a web-based learning platform in combination with hands-on training in the learning factories of the project partners.
- Development and design of a self-assessment by adapting the business excellence approach towards a personal excellence approach. Therefore, the EFQM (European Foundation for Quality Management) model of excellence [12,13] will be used as a basis. The model addresses the

gap between organizational and personal self-assessment [14].
- Implementation of the personal self-assessment method into a software system as part of the software application "Group Opinion Analyzer" (GOA) that was developed by the previous European research project "SAETO" (Self-Assessment for Educational and Training Organizations) [15].
- Piloting the new solution in the four partner regions, with at least 12 test cases to collect feed-back from industrial end users.

3. Specifications of the LOPEC project

3.1 Consortium of LOPEC

All partners of the research project are themselves education or training organizations (ETO) from both the public and the private sector with a good link to VET. The Reutlingen University has a very close connection to the industry, resulting in the establishment of a corporation "Knowledge Foundation" for both continuous vocational training and academic education, with the curricula based on the needs of industry. Fraunhofer Austria has experience in developing business games, hands-on educational workshops and setting-up operation of a learning factory, which provide interactive training. Both universities, as well as the third academic partner, the department of mechanical engineering at the University of Split, are active in higher and advanced education and applied research in cooperation with industry in the fields of logistics, supply chain management, factory planning, process optimization and lean production. With the social research centre of the University of Dortmund, Eurofortis SA, an adult education provider, IBK-Management Solution GmBH and the project coordinator, the consortium contains four of the original SAETO partners, thus facilitating knowledge transfer, expertise and experience within applying EFQM.

3.2 Definition of LOPEC target group as end-users

As described previously, LOPEC aims at skilled workers on the shop floor level. The project and its educational activities do not only focus on labour directly involved in production, the blue collar worker, but also on indirect or supporting labour, the white-collar worker. So both, a person who performs manual operation, typically in manufacturing or assembly, and a person who performs managerial or administrative work, typically in an office environment are addressed. Those types of classification result in the so-called "grey-collar worker" (Figure 1).

In the LOPEC project a grey-collar worker is an individual that acquired technical or economical skills through professional training or apprenticeship. Furthermore, the grey-collar worker requires leadership skills and social competences to promote improvements and changes within his or her work-group. This implies that the person is already a team leader or at least has the potential to become a team leader, who works well with others in a group setting and makes productive contributions through talent, knowledge and good work habits. At best, the grey-collar worker organizes people and resources toward the effective and efficient pursuit of predetermined objectives and has potential to stimulate the group to high performance.

Position	Shop Floor Worker	Shop Floor Worker	Shop Floor Manager	Employee	Employee	Department Head	Plant Manger
	Blue-Collar / Non-skilled Worker	Blue-Collar / skilled Worker	Team Leader Shop Floor	White-Collar Worker	White-Collar Worker	Team Leader	Executive Manager
Job title examples	Warehouse Worker Shipping Department Forklift Driver	Assembly Operator Machine Operator Process Planning Engineer	Technican Maintenance Manager Operations Manager	Purchaser Designer Supply Chain Manager	Secretary Assistant Support	Logistics Coordinator Logistics Controller Lead Buyer Logistics	Director Corporate Logistics Regional Logistics Manager Lean Team Leader
Direction of expertise	Non-skilled	Technical		Economic	Administrative	Technical and/or economic + leadership & finance	

Focused by LOPEC: **Grey-collar Worker**

Fig. 1. Definition of LOPEC target group as end-users.

The methodological approach of LOPEC contains two important aspects that are integrated in one solution. On the one side, the self-assessment in terms of Lean Logistics, and on the other side, the self-assessment for the evaluation of the personal and professional development. Both approaches are presented in Section 4 and 5.

4. First LOPEC project results

The educational goal system of LOPEC is based on the fundamental mindset of Lean Management and Operational Excellence [16], with the essential objective on customer focus.

4.1 Definition of the LOPEC learning content

The grey-collar worker should be qualified to identify and to reduce waste sustainably to perfection. Parallel, he or she has to be experienced in additional disciplines and tools so that optimization tasks in regards of Lean Logistics can be developed, implemented and evaluated. If the individual grey-collar worker has no higher education diploma or a general qualification for university entrance, the gap of the required basic knowledge has to be identified and closed too.

After reviewing the key literature, e.g. [17], the learning content of Lean Logistics got detailed into approx. 105 learning modules, with the categories as shown in Figure 2, each allocated to in-plant logistics or supply chains. As supporting subjects, 45 tools got detected as a need for grey-collar workers to be able to apply correlated Lean Logistics tools and methods. Analyzing available and recommended pre-courses from different universities and countries resulted in three consolidated basic courses "Technics", "Mathematics" and "Informatics".

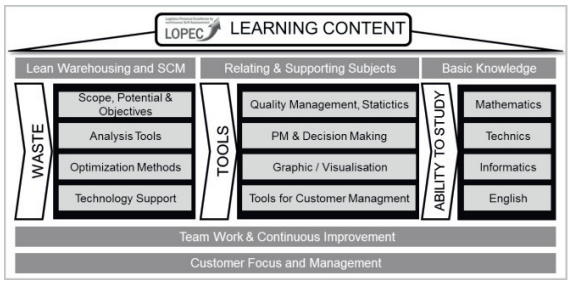

Fig. 2. LOPEC content framework.

To support the learning progress of the learner and to build knowledge in a structured way, a learning path for Excellence in Lean Logistics was designed within LOPEC. This learning path divides the learning modules into 5 maturity levels which represent a performance improvement sequence (Figure 3).

In terms of Lean Logistics, Level 1 implies the philosophy of Lean Logistics and its principles, in particular the types of waste and material and information flow. Furthermore, analysis tools and optimization tools for the workplace of the grey-collar worker are focus of this Level. Level 2 expands Level 1 with workplace related material movement and handling issues up to production logistics, the wider working environment of the grey-collar worker. Level 3 concerns analysis tools and optimization methods regarding warehouse management, e.g. container strategies, c-part management or driverless transport systems. Additional, Level 3 covers the changeover from intra-logistics to supply chain management, which is the key aspect of Level 4, with has topics such as vendor managed inventory. Level 5 examines tools and methods that do not only affect the production and logistics sector and theirs correlation to external suppliers but also organizational, financial and leadership-specific aspects in terms of Lean Management.

To support the learning, understanding and especially the application of the Lean Logistics content, additional tools have to be known and practiced. Therefore, the chapters "tools for project management & decision making", "quality management tools", "statistical tools", "graphical tools & visual management", "creativity tools" and "tools for customer management" have been integrated into the content framework for each level.

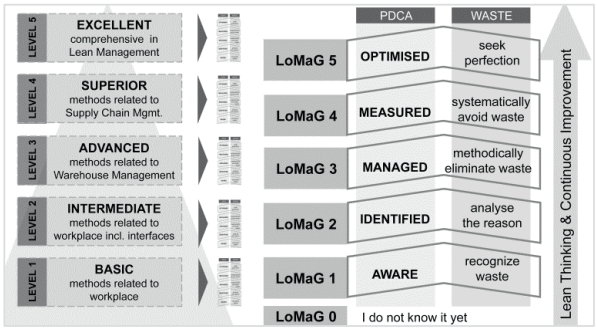

Fig. 3. Maturity Excellence Levels in Lean Logistics and Logistics Maturity Grades (LoMaG).

Considering required logistics tools and methods focused on work place (Figure 3), the basic knowledge subjects "mathematics" and "technics" (Figure 4), were analysed and as a result correlated to Maturity Level 1. In this context the learning units "materials" and "material handling" as well as "basic calculating" were most frequently applied. Additionally analysis of assignment supported the conclusion, that the application of computer technology is not stringently necessary for process optimization and avoiding waste regarding the LOPEC logistics methods on Level 1.

From Level 2 on, wider working environment, more complexity and interface related tasks require additional software and communication tools. In consequence of this assumption and the following analysis of Lean Logistics and additional tools, the basic course "Informatics", for example including the learning units "software", "e-Mail", "IT security", was assigned to Level 2.

Based on the focus "supply chain management" and in this context potentially persons of contact from abroad, an English skill of "B2" according to the "Common European Framework Language" (CEFR) is commended from Maturity Level 3. The present English skill should be proved by a certificate or comparable verification.

Technics		Mathematics		Informatics	
Physics basics		**Basic calculating**		**Informatics history**	
TEC101	History of physics	MAT101	Numbers	INF101	Informatics history
TEC102	Core theories	MAT102	Fractional arithmetic	**Hardware / Periphery**	
TEC103	Laws of physics	MAT103	Exponentiations	INF102	Hardware / Periphery
TEC104	Physical values	**Algebra**		**Software and Licences**	
Mechanics		MAT104	Algebraic terms	INF103	Software and Licences
TEC105	Classical mechanics	MAT105	Linear equations	**Operating systems**	
TEC106	Modern theories	MAT106	Quadratic equations	INF104	Operating systems
Strength of materials		**Roots and Logarithms**		**Online basics**	
TEC107	Strength of materials	MAT107	Roots	INF105	Web-Browser
Thermodynamics		MAT108	Root equations	INF106	Search engines
TEC108	Thermodynamics	MAT109	Logarithms	INF107	E-Mail
Material handling		MAT110	Logarithm equations	**IT security**	
TEC109	Material handling equipment	**Trigonometric**		INF108	Security concepts
TEC110	Conveyor systems	MAT111	Angles and Circles	INF109	Malware
Materials		MAT112	Trigonometric functions	INF110	Network security
TEC111	Material classification	MAT113	Trigonometric identities	INF111	Internet services
TEC112	Material properties	MAT114	Trigonometric equations	INF112	Communication
		Differential calculus		INF113	Data Management
		MAT115	Basics Differential calculus	**Big Data**	
		MAT116	Rules of derivation	INF114	Big Data
		MAT117	Extreme value		

Fig. 4. LOPEC basic knowledge learning units.

The current basic knowledge of the worker will be tested by single/multiple choice tests in Level 1 and 2.

4.2 Development of a Lean Logistics self-assessment (LOPEX) for continuous personal and professional development

Furthermore established logistics knowledge and skills have to be measured. The assessment procedure and the respective measurements covering all criteria must be developed to the appreciation level of a skilled worker to get short-term and long-term benefits towards life-long learning. A model was needed, that scales the achievement avoiding "waste" as essential point of Lean Logistics. Therefrom, the further way of proceeding is based on the PDCA-Circle by William Edwards Deming [18]. As result of the researched maturity models, a self-assessment ("LOPEX") with six

Logistics Maturity Grades (LoMaG) was developed. Grade 0 means, that the worker doesn`t know the learning content/method yet. As a result of the adapted PDCA-Circle to Logistics Maturity Grades, the approach refers to "Aware" (Grade 1), "Identified" (Grade 2), "Managed" (Grade 3), "Measured" (Grade 4), "Optimized" (Grade 5).

Grade 1 and 2 indicate that the learner theoretically knows the learning content and that he or she can decide if the individual method or tool is relevant for his or her work place or production environment. The grades 3 to 5 measure the ability to apply and continuously optimize relevant methods by quantifying gained results in comparison to the previous ad hoc procedure.

To demonstrate the operative execution of the presented model, an example of a self-assessment question, using the Lean Logistics topic "clocked route traffic" [19], is following:

- LoMaG 0 – Unknown:
  "I am not familiar with this method."
- LoMaG 1– Aware:
  "Clocked route traffic is a method for production logistics."
- LoMaG 2 – Identified:
  "I can explain essential reasons for the usage of clocked route traffic."
- LoMaG 3 – Managed:
  "I can decide about static and dynamic routes and schedules as well as loading and unloading points."
- LoMaG 4 – Measured:
  "I can argue the advantages of clocked route traffic in comparison to single trips in our production."
- LoMaG 5 – Optimized:
  "I am involved in the optimization of cycle times, hauls and load trailers used."

The shop floor worker has to classify his or her knowledge and ability of application within the six grades. After choosing one grade, the assessment tool requires an argumentation or reference to validate the given answer.

Achieving Logistics Maturity Grade 4, which proves credits for further education, aiming at acquiring the needed recognition to enter a job-related bachelors program in logistics, requires the score of at least Logistics Maturity Grade 2 and overall sixty percent in each level.

4.3 Implementation of the LOPEC learning content into a Learning Management System

The developed learning units, modules and tests will be implemented in ILIAS, a web based Learning Management System (LMS). ILIAS meets all technical and didactical requirements for the application within LOPEC.

The developed LOPEC learning path can be easily transferred to ILIAS. Each course category will present one of the five Maturity Excellence Levels and contains the assigned Lean Logistics and basic knowledge learning units. The different roles and permissions for the LOPEC administrators, authors, trainers and learners are supported by a complex role and permission system. To monitor the learning progress numerous kinds of tests, especially single/multiple choice tests, can be implemented. Furthermore ILIAS is published under the General Public License and is free of charge.

ILIAS, as Learning Management System for the LOPEC solution, was also assessed in the validation by examination of the learning objectives, a survey of the skilled workers and trainers as well as a reflection process with the involved experts, the advisory board as well as industrial representatives.

5. Personal excellence model (PEX)

In the scientific discourse a wide range of interpretations of personal excellence exist. LOPEC consists out of a mix of two essential aspects [20,21]: (1) self-management, dealing with methods, skills and strategies toward the achievement of personal and business objectives, as well as (2) self-development, dealing with developing a personality via activities, e.g. improving self-knowledge, self-awareness or social abilities, developing strengths and talents.

For LOPEC, the term "personal excellence in lean logistics" primarily includes participatory and empowerment aspects from grey-collar workers asking for more ability and capacity to act for their logistics related tasks in their respective but even in their extended work environment now and in future. Additional the vertical porosity, moving towards the higher tertiary educational level, is supported.

5.1 Requirements and challenges of a personal excellence assessment approach

While in the EFQM model, especially in criterion 3, the excellence of the personnel, i.e. the whole workforce, is in the focus of a management view, mainly structured by the organisation's objectives and strategic options, personal excellence looks at the individual state of affairs, individual learning and improvement which always necessarily includes more than the organisational objectives.

As a consequence, the personal excellence model "PEX" founds a compromise to meet both stakeholders' interest and considers the following components simultaneously:

- the personal development of the individual, including aspects of his or her personal career as well as aspects of work-life balance
- the requirements with respect to the development of the individual as actively responsible part of an organisational culture, a department and a team
- the professional competence development of the individual in the framework of lean logistics in a management setting marked by the pursuit of excellence stakeholders of personal excellence

For personal excellence, the stakeholder model underlying the EFQM model of organisational excellence gets adapted as shown in figure 5 with the substantial substitution of exchanging the stakeholder from the company to the individual ones.

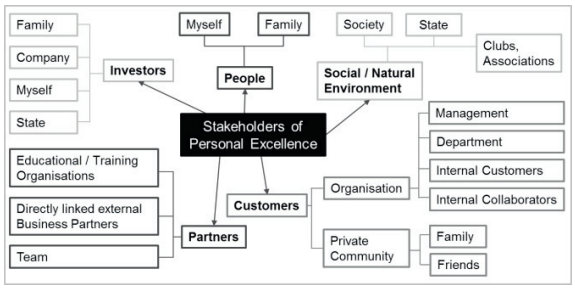

Fig. 5. Stakeholder of Personal Excellence.

5.2 Development of an EFQM-based model of personal excellence

PEX is based on the model of organisational excellence represented by EFQM, including the fundamental concepts, the nine criteria and its scaled assessment procedure with its different international levels. As shown in figure 6, PEX provides a stable nevertheless adaptable tool model with a scaled assessment that makes personal development towards personal excellence in Lean Logistics from grey-collar workers from a management perspective measurable.

On methodical level, PEX refers to the software solutions linked to the GOA SAETO family of self-assessment tools, developed in previous Leonardo da Vinci research projects.

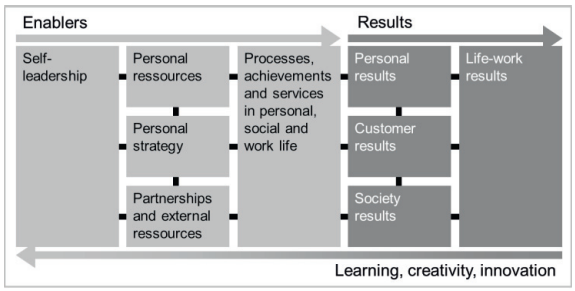

Fig. 6: LOPEC PEX Model based on EFQM

6. Conclusions and future work

To validate the systematic approach of the project, a pilot run will be implemented in four regions (AT, CZ, DE and LV), with at least 12 pilot implementations, from March to June 2014. The partnership for this project consists of one partner for each of the target regions plus a transfer given from the former SAETO projects.

The piloting procedure contains the following milestones:

- Nomination of invited learners and selection of a trainer who supports the learner within the piloting organization,
- Setting up of a learning agreement, framework conditions and training targets between all stakeholders,
- Selection of relevant learning units within Lean Logistics Level 1 by the learner in agreement with the trainer,
- Review of selected units according to the defined priority,
- Start of optimization activities according to gained knowledge,
- Execution of self-assessments: LOPEX and PEX,
- Discussion of areas for personal and professional improvement between learner and trainer,
- Upgrade to next level, if one level is completed.

Additional, a kick-off-workshop, a midterm-exchange and a feedback meeting enhances the coordination between the local project partners with each pilot user.

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