The LeanPPD project is a 7.8 ML€ EU funded programme, involving twelve European academic and industrial partners. It addresses the need of European manufacturing companies for a new, agile, competitive, innovative and sustainable business model. In the global competition, European companies might be able to serve their customers better than ever by providing value-added, knowledge-intensive and highly customized product and service solutions in a shorter time span.

Lean manufacturing has already spread out its benefits, and the competitive advantages that can be gained through its implementation is waning. Now it is time to ensure the transformation of the whole enterprise into a lean environment, in order to respond to customers and market demands for value creation, incorporating sustainability, culture and customization. This is what the Lean Product and Process Development (LeanPPD) project strives to achieve.

What is the LeanPPD project?

The LeanPPD project is a significant change in enterprise performance can come from the adoption of lean thinking throughout the entire product lifecycle.

Lean thinking supports companies in the elimination of wastes that exist in the product lifecycle, starting from the development phase (e.g. inefficient communication between team members), as well as wastes in the end product (e.g. scrap due to poor design).

The LeanPPD consortium is working to go beyond the identification and reduction of wastes in product development. It supports value creation of new, affordable and sustainable products, that can foster quality, innovation and customization. This is what the Lean Product and Process Development (LeanPPD) project strives to achieve.

The LeanPPD working model

To achieve the objectives of the project the consortium agreed on several main enablers of a LeanPPD model. The working model centralizes on the concept of Set Based Concurrent Engineering (SBCE). This product development process model can revolutionize the traditional point based engineering model many European companies are using to develop new products. SBCE enables maximum value and eliminates design rework starting from early in a design process. To support SBCE the LeanPPD model incorporates three other tools: (1) A Product Development Value Mapping Tool (PD-VMT), with particular focuses on value creation and waste elimination in product development; (2) Knowledge Based Engineering (KBE); and (3) a Set Based Lean Design Tool (SBLDT). Furthermore, a Product Development Process lean assessment tool, called SMART Lean-T² readiness tool has been developed and validated within the project.

This issue of the LeanPPD Newsletter presents a selection of the initial results of the project.
“Lean Product and Process Development: A waste minimization, a value creation design process in a learning and continuous improvement fashion. The new paradigm for European competitive frontier”

In order to establish Lean product and process development, the Toyota way of product development (PD) will be used as the foundation. Toyota PD focuses on three central elements: value, knowledge (or learning) and improvement.

The LeanPPD community believes that such focus has enabled Toyota to please customers through optimal designs and minimal design rework. In order to achieve this they developed a process that is referred to as Set Based Concurrent Engineering (SBCE). However, there is no formal published methodology of this process or how to execute it in practice.

In this project the SBCE model has been taken as a fundamental model to be explored in detail with practical implementation within the industrial partners. The research activities involved in this model are:

- Customer value research
- Mapping design space
- Concept sets development
- Pre-production planning
- Design concept convergence
- Detail design and production launching

In each phase of the research practical methods, tools and guidelines will be developed to support the execution of SBCE. These tools will be developed with the application of industrial partners’ business cases. The SBCE model will also contain a Set Based Lean Design Tool (SBLDT) developed to help designers to translate and product customer values within their designs.

The SBCE model can be used by other European companies to excel in PD by creating value in their products in a short period of time, and at the same time compete in the global market. Through dissemination activities the LeanPPD SBCE model is planned to be spanned to SMEs across Europe.

The LeanPPD Product Development Value Mapping Tool (PD-VMT)

There are many phases within product development, most of which generate vast amounts of data. This can result in data disconnect points causing delays, added cost and general frustration to the team. The use of an integrated tool to support all of these phases e.g. CAD/CAM or KBE removes this disconnect and thus levels the flow of information. The same level of disconnect between process improvement tools, such as Business Process Management, Value Network Diagrams, etc., also exists. However, there is no single tool to encompass all of these elements of process improvement. Thus, the objectives of the PD-VMT are to develop tools and approaches for value creation, waste elimination and product life-cycle based cost optimization within product design and development.

The model consists of three layers of information: (1) a data model (ontology) containing known entities of waste and value; (2) standard data in order to minimize data re-entry; and (3) Adapted data based on company data gathering. From these three levels of data companies will be able to generate a personalized process analysis improvement plan.

Since the methodology will be validated within Business Cases it will benefit other industrial sectors outside the LeanPPD consortium. In particular, for European SMEs this method will be easy to adopt.
**The LeanPPD Knowledge Based Engineering (KBE)**

Design is a knowledge intensive process where new materials, technologies and design features are constantly evolving and being created to meet the ever changing customer requirements. Such knowledge that has been created should be identified, captured, and reused for future design projects in the LeanPPD model.

The LeanPPD KBE model is primarily aimed to perform the structuring, sharing and reusing of design knowledge created within engineering function, across engineering functions and between difference departments (e.g. between design and manufacturing function). The KBE model provides the following as outputs:

1) LeanKLC (lean knowledge lifecycle): a methodology to systematically capture, re-use and create Knowledge in PD along with its software demo (called KBE demo).
2) A3 methodological approach: that helps to represent the provision of created knowledge and aid the generation of future lean product design. This can be done through identifying problems, measuring, and generating potential solutions in a continuous learning process mode using the so-called A3 problem solving approach.

In general, the KBE model of LeanPPD has five requirements to fulfill:

1. Bring together relevant previous projects in order for the designers to initiate a new set of designs.
2. Enable a search function in order to locate and retrieve the most relevant project information.
3. Provide a function to visualize knowledge required to support engineering decision taking.
4. Provide a mechanism to dynamically capture the knowledge created by engineers throughout the product development process.
5. Provide a function to recall the key lessons learnt at the various stages of the product development process.

Companies that can effectively utilize the previous knowledge can radically reduce the time to market and improve the innovation level, and KBE supports this leverage.

The model will be tested in industrial case studies and can be disseminated to European SMEs.

**LeanPPD Transformation Toolkit (lean t²)**

Lean thinking and its applications have always been a continuous improvement effort. Lean product and development needs a continuous tracking of PD performances to enable companies to lead their journey to LeanPPD.

The LeanPPD Self Assessment and Transformation Tool provides a ready made platform to assess the maturity level of companies in the application of product design and development lean thinking. Lean t² incorporates qualitative and quantitative metrics of lean practices, and companies can use it to measure their leanness and can map where they stand in the lean journey.

The tool uses a five step change process to help partner companies identify their “AS-IS” state and define “TO-BE” state.

Quantitative and qualitative key performance indicators (KPIs) have been developed to create the proposed 5 levels of the LeanPPD Self-Assessment Tool, with acronym SMART (Start, Motivate, Apply, Review, Transform). This tool is based on the balanced scorecard model. Further, the tool proposes an anonymous benchmarking method that companies can use to compare their performances with other similar industries.

The five levels of the LeanPPD journey are: 1) level 1 (Start) “No Lean Thinking with some awareness”; 2) level 2 (Motivate) “Getting Started”; 3) level 3 (Apply) “Basic LeanPPD Implementation”; 4) level 4 (Review) “LeanPPD Continuously Measured & Improved” 5) level 5 (Transformed) “LeanPPD Best Practices Identified and Shared (internally/externally)”. In the first step of the assessment some qualitative lean practices are used to ask and map partners companies across the different levels.

The lean practices have been clustered in four major perspectives; cost and time, new product development process, tools and multi-skilled people.

The second part of the assessment consists quantitative KPI’s to measure the four perspectives. Companies can select any measures that make more sense to their application from the list of measures given in a library. Therefore, using both qualitative and quantitative assessment it will be possible to map the current and future states of the leanness of a new product development process.

The tool is already available in web-based form for easy usage by the industrial partners.
The LeanPPD self-assessment tool has four perspectives to measure. Inside these perspectives there are 14 best practices that a company needs to become lean in new product development. However, the measurement is done at five levels of maturity that enable to map the as-is status of a company.

Each perspective contains 14 practices in terms of guided questions to be answered.

The questions can be asked at three team levels: individual level, group level, and organizational level. By carrying out the assessment at different levels it is possible to identify agreements and differences of opinion in the answers given to the practices.

The tool has been tested in most industrial partners of LeanPPD Project: In Indesit, a household appliance manufacturer in Italy, in Visteon an automotive supplier based in UK, in Rolls-Royce an aerospace industry in UK, and in Volkswagen (VW) a German based automotive company. The feedback gained from the validation makes the tool more robust and applicable to other European manufacturers to assess their product development leanness and can find out improvement potentials to excel in new product development performances. The LeanPPD community believes that such a tool can be easily transferred to SMEs, so that best practices from larger companies can be applied outside the LeanPPD consortium. And, the consortium is also carrying out dissemination activities of the tool by working with regional communities that can validate the tool in their local industries.

Assessment using the Transformation Toolkit (lean \( t^2 \))

The SMART self assessment tool gives a simple numerical value that aggregates the performance of different perspectives and places it into a spider chart.

By using a web-based platform (connected with a database) companies can easily use the tool to assess their PD performance in a given period and also track their improvement. The tool provides a report of the maturity level given to each practice, highlighting the practices in which the company should focus its improvement efforts.

Furthermore, the validation of the tool in different companies will enable the continuous improvement of the tool’s content and the report that it generates.
A Learning Kit for LeanPPD implementation

The concept of lean production is now evident in industries. The eight production waste as defined by Taiichi Ohno are something any manager can tangibly see.

However, wastes in product design and development process are not as easy to identify or to ascribe as waste. Neither is it easy to maximize customer value in product development. At the initial fuzzy front end of NPD considering alternatives, as predicated in a set based approach, could be considered waste. However, considering such alternatives may well enhance customer value. It is necessary at some point to constrain the engineers, who being knowledge workers think that whatever they do is for the better of the new product they are developing and for the better of the company. Studies show that 80% of engineers time is wasted on non-value adding activities. Wrong understanding of customer value, unnecessary meetings, waiting for information, receiving and giving wrong information, and un-utilized knowledge are some of the many wastes in PD.

Wastes in PD are specific in different industries and generalizing might not work to create a panacea method to eliminate these types of wastes. In the project, some learning methods and games are under development to help designers and project managers to reflect to themselves and find out wasteful design activities that affect performances. At the same time, using the learning kit learners will be able to introduce with the LeanPPD tools and methodologies.

The LeanPPD learning kit has four modules:

1. Learning MyWaste
2. NPD (new product development) simulations
3. SBCE game
4. Value and waste game.

Apart from the above four learning games, other means will be used for LeanPPD training purpose such as; software demos, documents, slides, CD, case studies, and so on.

Elements of the LeanPPD Learning Kit

1. Learning MyWaste

The first learning module under development is MyWaste. This is a simple method that offer designers and project managers an opportunity to reflect on the possible non-value adding wastes in their day to day design works. Moreover, the method offers the possibility to find improvement potentials to eliminate waste.

2. NPD Simulations

The second part of the learning module is NPD simulations. This system dynamics based learning game allows players to understand casual relationships between process variables characterizing the NPD process and performances. Participants can play with process variables and understand the impact of different decisions on time to market and cost.

3. SBCE Game

This game will allow players to understand the basics of the LeanPPD model. This game enables players to understand how keeping alternative design solutions can help designers to tackle future technical and market uncertainties.

4. Value & Waste Game

The definition of wastes in PD depend on company specific interpretation, and MyWaste is a tool that allows designers and managers to brainstorm critical wastes in PD and search for process improvements.

MyWaste: A self learning method to identify PD wastes and accelerate improvements

Learning MyWaste is part of the learning games that are under development. It has already been played by eight manufacturing companies in Italy. The game was developed based on the prevalent method of FMEA (Failure Mode and Effects Analysis). It lists a significant number of wastes that exist in the design process. Designers can add their own specific waste if they think it is not listed. Then, individual designers and managers fill the Probability, Severity, Detection, and Avoidability of each waste. For each waste, a priority index of intervention (PII) can be calculated. This allows participants to brainstorm the main wastes affecting their performances and search for improvements.

The waste library found in literature are included, nevertheless companies are constantly adding their own interpretation and definition according to their experiences.

A full report of the methodology and the industrial practices is presented at ICE2011 conference in Aachen, Germany. It is also presented at the GoLA (IFIP) serious game workshop in Espoo, Finland.

PD wastes and PII for a specific company
LeanPPD 2011 Calendar

- 5-7th April: LeanPPD 5th General Assembly Meeting, Bremen, Germany.
- 22nd September: The 1st Industrial LeanPPD workshop organized at Cranfield University, UK (http://www.cranfield.ac.uk/sas/aboutus/events.page52747.html).
- 29-29th September: LeanPPD 6th General Assembly Meeting, Fabriano, Italy.
- January 2011: LeanPPD 5th Community Workshop, Dell’Orto, Italy.
- March 2011: LeanPPD 6th Community Workshop, Milan, Italy.
- SMAU workshop has been held in Bari, Rome, Padova, and Bologna (Italy) in 2011 under the title - Laboratorio di Miglioramento ed Innovazione della Progettazione, and LeanPPD concepts has been introduced by Polimi teams.
- Please visit the LeanPPD website to see more upcoming events.

LeanPPD 2011 Publications