

# Remanufacturing in the Information Age

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**Abstract:** The goal of this tutorial is to provide a compact yet comprehensive introduction to service design in the wind energy business. The tutorial aims at giving the participants the theoretical and practical background in design principles considering the specific domains the services are designed for. During the live demonstration it is shown how different services can be integrated transparently in a mash up application. The target audience of the tutorial is master and PhD students as well as employees from companies who are interested in gaining an insight in service design.

**Keywords:** Remanufacturing, Service Design, PREMANUS

## 1 Introduction

For centuries mankind has attempted to exploit the resources available to it through the reuse of objects and artifacts. However, as wealth of modern man has grown, the financial necessity to utilize the lifetime of these objects has dramatically declined, especially in developed countries with high focus on manufacturing.

The demand for new products also placed undue pressure on the world's resources, creating an ethical imperative to conserve and reuse. Remanufacturing is the process of bringing used products to "like-new" functional state with an equivalent quality assurance.

As this activity provides profitability whilst reducing land-filling and usage of virgin material, it is a financially viable as well as a sustainable business concept.

## 2 Product Usage and Life Cycle

One of the key issues deterring the uptake of remanufacturing is the information gap which is created when products leave the OEM. The information gap is the result of the lack of data on product usage and its lifecycle.

In general, the product user possesses much greater knowledge regarding a product as he has used it, repaired it, and replaced components. This, in turn, results in the fact that the input to the remanufacturing process is of unknown quality. The lack of reliable

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information on product usage and lifecycle leads to missed opportunities with respect to increased economic or environmental impact.

The goal of the EU-funded project PREMANUS is to overcome the asymmetric distribution of information in the End-of-Life (EoL) recovery of products, with a special emphasis on remanufacturing. To achieve this goal, PREMANUS provides an on demand middleware which combines product information and product services within one service oriented architecture. In addition to closing the information gap, the PREMANUS middleware would compute EoL-specific KPIs based on product usage data and make recommendations to its users regarding the viability (in terms of profitability, scope, and time) of remanufacturing a product.

### **3 Services for the Wind Energy Business**

SKF is one of the industrial partners in the PREMANUS consortium and has a large presence within the wind turbine industry. They are a major supplier of full bearing sets for the gearboxes and other parts of the turbine system. SKF also develops and markets a conditional monitoring system which actively supervises and records data from more than thousands of wind turbines worldwide.

Wind turbine gearboxes have not had the operating life-expectancy that was first expected. The typical period before either a major overhaul or replacement is required is between six and ten years, rather than the 15 to 20 years originally intended. This phenomenon has created a demand for repair, remanufacture and upgrading of gearboxes within the wind turbine industry.

Based on the eco system provided by PREMANUS, SKF has developed a prototype application to integrate different kind of infrastructure components like Business Decisions Support Systems (BDSS), Condition Monitoring Systems (CMS), measurement devices etc.

All different components have been aggregated within one mash up application and can be accessed through one common user interface. Based on the application, new remanufacturing services can be offered for the (wind turbine) industry.

### **4 Summary**

Service design is essential in the wind energy business. The design principles have to consider the specific domains the services are designed for. During the life demonstration it is shown how different services can be integrated transparently in a mash up application