Spare parts management for durables

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Introduction

Abstract

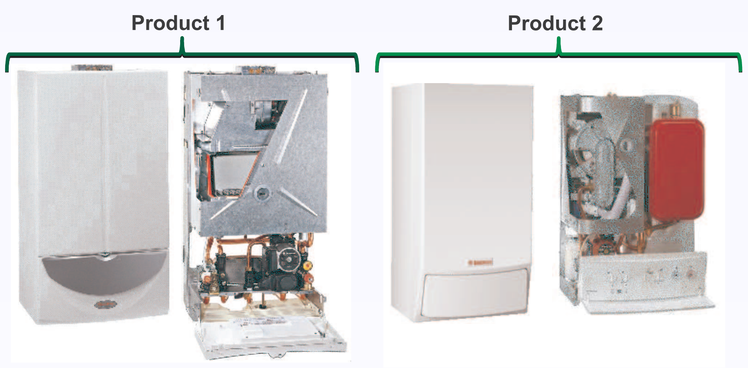
The objective of this presentation is twofold. Firstly, we present a real-life case study for service parts management under product recovery and secondly, we provide an overview on potential research questions arising from analyzing the case.

Research Issues

- What motivates product take back and centralized remanufacturing in a non-cooperative supply chain?
- How to set transfer prices to encourage supply chain members to participate if the OEM does not have direct access to used products?
- What are benefits for the OEM aside from cost improvements?

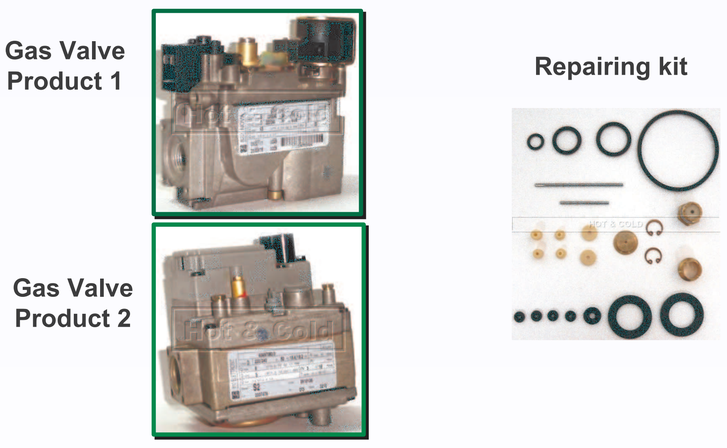
Case Study: The product

We consider an Italian manufacturer of gas heating boilers with a sales volume of about 200 million € in 2005. Two product examples out of of a wide range of about 60 different models with prices ranging between 1,000 € and more than 2,000 € are shown below.



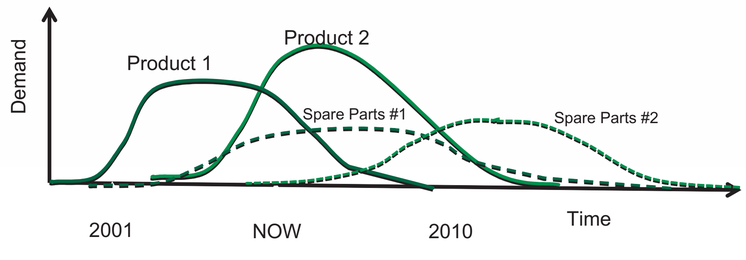
Two successive models of gas heating boiler.

A boiler has an average life-time of about 10 years, during that period a number of components might fail because of wearing out. Gas heating boilers consist of about 15 different modules out of three categories: non failing (e.g. casing), repairable, and non-repairable (e.g. burner). Out of the repairable class the most expensive (about 6% of products value) is the gas valve.



Gas valves and parts needed for repair.

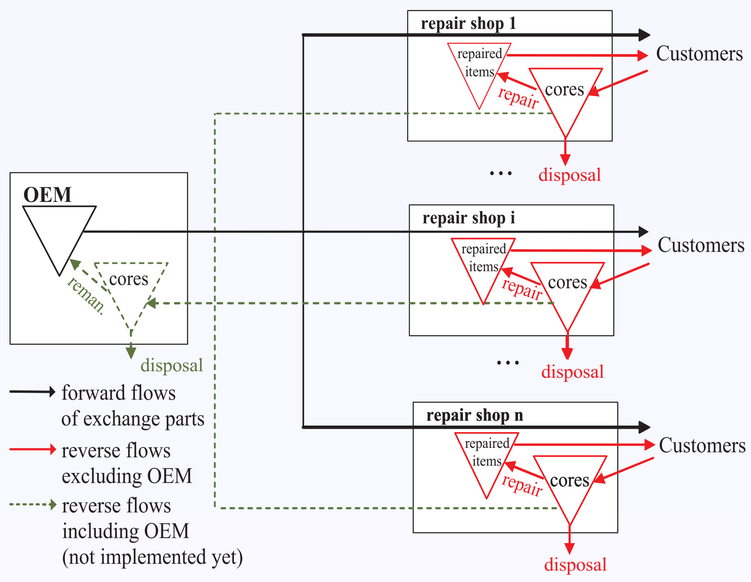
Since a boiler more frequently is used during the winter period, demand for spare parts is subject to seasonality. This effect is superimposed by life cycle effects, e.g. since demand for spare parts the OEM faces is larger during the warranty period than afterwards.



Product and spare part demands.

Case Study: After Sales Service

After sales service is provided by a network of 600 independent repair shops (see figure below). There are two options to service: either (1) repair shops immediately replace the component by a new one they order from the OEM (black solid lines, no lead time) or (2) if they have a used but already repaired one available, they use the recovered component (red solid lines). Repairing of used cores consists of 4 steps: disassembly, cleaning, substitution of components, and reassembly. These operations are performed in batches, since set ups using cleaning liquid are expensive. Even so, repair shops earn a higher profit with repaired than with OEM-replacement parts, and customers prefer those parts due to cheaper prices. Thus, only when out of stock are spare parts ordered from the OEM.



A two stage reverse supply chain.

Case Study: Implications for OEM

An uncomfortable situation

- OEM faces only a small part of end customer demand for spare parts with high variability
- OEM is obliged to satisfy any customer demand for spare parts when components are broken and would prefer replacement using OEM parts, but
- OEM has no direct control on option used to fulfill demand for spare parts.

The OEM is deliberating how to encourage repair shops to buy more OEM-replacement parts. How does this impact demand variability? Whether to engage in remanufacturing?

Objectives of the OEM

1. Increase reliability of spare parts supplied to customers (low quality third party components used for repair)
2. Understand failure behavior and improve quality
3. Earn additional profit due to increase in sales
4. Gain experience in remanufacturing

Methodology: A basic framework

- We consider a stylized two period profit maximizing framework (like, e.g., Majumder and Groenevelt (2001); Ferguson and Toktay (2006)).
- There is independent decision making of OEM and repair shops (in difference to the case examined by Deneijer and Flapper (2005)).
- A buyback price is used by the OEM to provide incentives for returning broken components.
- Remanufacturing at the OEM yields as-good-as-new spare parts. Customers prefer cheap repaired spare parts, although these are seen to be of lower quality than exchange parts.

Methodology: Decisions dynamics

- **Initial** Buyback price is set by the OEM. Zero Stocks.
- **First period** Repair shops face demand and order replacement parts at the OEM one by one. Thus, the OEM faces full demand. Repair shops decide on whether to keep and repair broken parts, to return them, or dispose of them. Then, the OEM is to decide upon remanufacturing or disposing of returned parts.
- **Second period** In the second period, repair shops use their repaired items inventory to fill demand and order for remaining demand at the OEM. The OEM first fills demand using remanufactured items and later it produces for remaining demand.
- **Finally** All remaining items need to be disposed of (or recycled).

First Results: Deterministic demand

- Returning broken parts to the OEM becomes attractive for repair shops, if buyback price outweighs profit differences between exchange and repair options.
- Repair shops either return **all** broken parts **or** just those which they **can not use**.
- If buyback price is sufficiently high OEM faces full demand in both periods.
- Thus, even without remanufacturing, buyback might make sense if there are scale effects in disposal (material recycling) realized by OEM.

Outlook

Work in progress:

- In the **stochastic demand case** repair shops use a newsboy like criterion for repair decision and might want to repair less than demand expected. We expect risk pooling effects to occur at the OEM, i.e. the OEM would remanufacture more items than repair shops in total.

Further extensions:

- Life cycle issues: final order
- Additional option: joint setting of transfer price for spare parts and buy back price

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