SKF: Rotating Equipment Performance, a Shift in Perspective—From Transactions to Outcomes

Philipp Schmid

1 Introduction

AB SKF (Swedish: Svenska Kullagerfabriken, which is translated as "Swedish Ball Bearing Factory" in English) is a Swedish bearing and seal manufacturing company founded in Gothenburg, Sweden, in 1907. The company both manufactures and supplies bearings, seals, lubrication and lubrication systems, maintenance products, mechatronics products, power transmission products, condition monitoring systems, and related services globally.

When it comes to business models, there exist different types of business. SKF offers direct and indirect business via distributors and sales to original equipment manufacturers as well as to end-users. Additionally, SKF serves various industries from automotive, railway, wind, metals, and other industries. As part of a strategic initiative, two value propositions were created: Products and Rotating Equipment Performance.

The Rotating Equipment Performance (REP) proposition meets the needs of customers who operate critical machinery by maximizing performance. The offering includes performance-based contracts, implying that machinery performance determines the remuneration.

From inception, SKF has been an innovative company, plowing a different path and business model than conventional industries. The company began with the invention of a double-rowed, self-aligning ball bearing design that solved the constant misalignment issues the mill in which the founder was working experienced.

Due to the misalignment problems the mill (and others in the area) had, their machinery kept catching on fire, resulting in a costly halt to production. As a result, insurance companies were reluctant to provide these industrial factories with

P. Schmid (✉)
SKF Group Headquarters, Gothenburg, Sweden
e-mail: skfweb@skf.com

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coverage. So, when Sven Wingquist, the founder, invented the SKF self-aligning bearing, instead of selling them to the industries, he proved to the insurance companies that they solved the root cause of the fires. As a result, the insurance companies extended coverage to the textile mills with one condition: They had to buy and use the new SKF bearings.

2 Initial Situation

In general, there is an industry trend toward cheaper manufacturing, which means that there is pressure to produce at lower production costs. At the same time, the products produced in these plants see a shorter technology life cycle.

When it comes to sales, there is a shift from a product perspective toward service, value, and the outcome of a product. Customers increasingly prefer buying the outcome (e.g., transportation) instead of owning the product (e.g., car/truck). There are no single purchases anymore. Customers buy a flat rate.

For SKF industries, especially in process industries like steel production, pulp and paper, mining and mineral processing, and many more, bearings are considered spare parts. Once they break down, they are replaced. Bearings are purchased by availability and cost.

Under these circumstances, the customer and supplier are driven by different things and, inherently, cannot work together to achieve a better outcome. Purchasers are focusing on price reduction through hard negotiations. Suppliers try to keep price levels high. With this, there is less room for improvement and collaboration.

However, when a more in-depth understanding of customers' KPIs is known, it helps find better solutions.

SKF generally began like most manufacturers—make and sell the equipment—but with an emphasis on end-user productivity and energy efficiency. However, over time, and as an industry leader, it shifted from a manufacture-and-sell model to a Rotating Equipment Performance (REP) model and now also offers an equipment-as-a-service model (or a Rotation for Life program).

The REP model provides clients with performance-based contracts. It enables the client to plug into its vast database and connect with the company's pool of experts to access data-driven insights into the client's machine's performance from wherever he pleases and solve problems fast.

The SKF REP cycle consists of five key phases:

- Assess
- Detect
- Maintain
- Solve
- Rebuild

A client's needs and pains usually fall into one or more of these categories simultaneously, and, whatever the case, SKF moves to rectify it to ensure a smooth operation on the part of the client.

In its Rotation for Life program, SKF focuses on meeting performance targets agreed upon by a client and SKF for the client's critical rotating equipment. To do this, SKF selects the right products and services for the client's equipment and works to ensure a smooth operation of the client's rotating machine. The goal of the Rotation for Life program is to implement a customized REP strategy for its clients. This REP strategy covers the full range of SKF products and services. Furthermore, instead of billing clients per transaction and purchase of products, SKF enters into a long-term, performance-based contract in which it collects a fixed monthly fee (Svenska Kullagerfabriken [SKF], p. 7). This allows customers to move from a capital expenditure (CAPEX) model to an operational expense (OPEX) model.

3 Solution

The idea is to create an individual value proposition for customers based on their KPIs and shared understanding. A structured approach is the value proposition canvas from Osterwalder. Within this concept, the customers' jobs to be done, pains, and gains are described. On the supplier side, there are pain relievers, gain creators, and products and services.

Finding an individualized value proposition takes time, but it is a solution that better fits the customer's needs and the supplier's portfolio. The first value proposition needs to be taken into a contract. This can be a challenge as the proposed service or product might not fit the standard terms of services that are in standard legal documents from both sides.

A first value proposition or contract could be considered a hypothesis. Based on feedback, even better value propositions can be evaluated. This is very often a service rather than a product. In the end, a customer needs a result. A product is a means to achieve this and not always the only solution.

Some of the benefits of the Rotation Equipment Program are as follows:

3.1 Improving Output

The REP helps increase machine availability, performance rate, and quality—all of which help boost a client's business output.

3.2 Trimmed Total Cost of Ownership

The total cost of ownership (TCO) is not just the capital spent on buying equipment. Unplanned downtime, energy usage, maintenance, spare parts, and even labor can all

contribute. Improving performance with SKF REP can help a client's business save in all these areas.

3.3 Use Digitalization to Increase Uptime

SKF Enlight Centre dashboards provide unique data insights on the client's machinery. Connection to expert machine diagnostics aids the client in detecting problems on the go, and before they badly affect critical machines. The customer also accesses a vast store of data to provide the business insight needed to transform the way business is conducted and machines maintained. The client can store and share data from his entire business in the SKF Cloud. With digitalization, clients can increase company agility, safety, reliability, and sustainability.

3.4 Reduced Reliance on Scarce Talent

Save time and cost of recruiting, training, and retaining people with scarce and expensive skill sets. SKF is an expert partner that can be called on at any time. It boasts all the talents a client needs and more, thereby eliminating the need to hire new talents or expend more resources training and retraining them.

3.5 Safer Operations

Reduced downtime from incidents allows increased productivity and performance. SKF can help make one's ways of working safer as well as navigate EHSS regulations.

3.6 Increased Sustainability

Increased sustainability reduces energy consumption, waste, and spare parts to save costs while delivering to meet sustainability requirements.

3.7 Data-Driven Decision-Making

At the heart of the REP, for customers, data-driven decision-making is harnessing all of SKF's technologies, domain knowledge, digital capabilities, and the vast store of data to make better business decisions from the interpretation of that data. SKF (SKF, p. 4) says that it boasts the ability to link into customers' digital ecosystems and also link its customers to her REP Centre dashboards from where they can interpret the data they have access to.

The business landscape has completely changed. In this current age of business, to thrive in any industry and become IIoT and industry 4.0 aligned, businesses have to make decisions based on well-interpreted data rather than guesswork. According to Gottdenker (2020), "data-driven insights are the new gold" and can put you ahead of your competition. However, to have such valuable insight, one would have to collect Big Data and build data competencies that will enable them to turn the data collected into financial and operational growth. Many organizations lack the time and resources needed to collect Big Data or the technical know-how to collect and turn them into useful AI-driven industrial analytics.

Moreover, there is a world of difference between data and information. Many companies invest heavily in collecting data but have been unable to process that data into useful information and insight for business and revenue growth. When we look at companies right now, only a minority of data is collected. This represents a considerable waste.

Several obstacles stand in the way of making data-rich decisions. Two major challenges to implementing Big Data initiatives are:

- *Lack of proper knowledge regarding the right variable to track*: For many, the right variables to track for proper business and machine operation are still guesswork. Moreover, without even knowing the right variable to track, analyzing the data tracked becomes a challenge.
- *Lack of skilled data scientists*: The data scientists needed to track and analyze Big Data for most companies are simply insufficient because many organizations do not have the resources to support as many scientists as required.

Several more challenges exist, including insufficient business intelligence tools and problems with the hygiene of the data collected. Without Big Data, artificial intelligence-driven industrial analytics is a massive challenge because data fuels AI-driven analytics.

In light of all these challenges faced by many SKF customers regarding the collection, analysis, and interpretation of data, the SKF REP business model is the best solution. With over 110 years of experience and data collected and analyzed, its solutions are suitable for its industries. When a customer connects using a solution like the SKF Enlight Centre, he has access to all this data and can make meaningful interpretations for his business and machines.

SKF draws on this rich data and information to deploy AI-driven customer-centered solutions. The company can, for instance, deploy data- and AI-driven condition monitoring of a customer's critical machinery to ensure they are in proper working conditions, detect problems (or potential problems) early, and solve the problems for the customer. It can carry out proper maintenance of a customer's equipment and remanufacture where necessary.

Some of the services that SKF can provide her customers to ensure they make data-driven business decisions because of her rich store of data and AI-driven solutions include:

1. *Engineering knowledge*—benchmarking, understanding customers' needs and opportunities for improvement, application expertise, ensuring performance, and KPI targets
2. *SKF Digital Platform*—secure and easily accessible data storage, IoT, and Big Data analytics
3. *Data collection*—including condition monitoring data, lubrication, maintenance, process, production, and spare parts
4. *Actionable insights*—visualization through dashboards to support decision-making and actions in real time that optimize asset performance and KPI measurement.
5. *Supply chain*—real-time info on the spare parts for specific machinery, enabling a new and more efficient spare parts management and supply chain
6. *Predictive maintenance*—utilizing remote diagnostic resources and system-based tools
7. *Field maintenance*—a full range of maintenance support services
8. *Remanufacturing*—identifying when to perform a cost-efficient remanufacturing process while reducing carbon footprint and optimizing the life cycle cost of the assets

3.8 Artificial Intelligence Services and Condition Monitoring

Wireless condition monitoring and the ability to interpret the data generated by machinery and components is a cornerstone the SKF REP offers. The SKF Enlight AI, for example, is an industrial analytics solution based on AutoML (automated machine learning). It works to complement existing condition monitoring, including SCADA.

Here is how it works:

Industrial machines have hundreds to thousands of sensors permanently collecting assets' data. If technicians were to inspect machines to collect this data manually, they would be lost and unable to detect the data necessary to forecast a machine breakdown and prevent unscheduled downtime. (By the way, the cost of unscheduled downtime to the global process industry alone is about $20 billion, according to Glazer (2020).) Technicians would have to rely on a lot of trial and error to determine the root cause of failure in order to restore production. According to Glazer (2020), an estimated 17 days of unscheduled downtime per year result from executing failure root cause data collection this way.

However, with a system like the SKF Enlight AI continually analyzing the data produced by the thousands of sensors and checking for irregular data patterns, the system can detect upcoming machine failure and alert technicians long before manual threshold conditions are ever breached. This is because the automated machine learning is super-efficient at sifting through the enormous data to decide the optimal algorithm for analyzing the data stream.

The AutoML-based SKF Enlight AI has self-learning algorithms that continually analyze Big Data the asset sensors sent. From the data, it can detect any anomalies

and also provide technicians with real-time alerts of machine condition and any upcoming machine failure. The alerts provided to technicians are in user-friendly formats that they can understand.

With such condition monitoring in place, operation and maintenance repair staff are presented with specific knowledge of the particular sensors that detected anomalies. This allows them to establish the root cause of machine failure faster and speed up the remediation process (SKF).

Not only is SKF Enlight AI based on the leading edge AutoML technology, but it also takes advantage of the expert knowledge of SKF's diagnostic services. It can provide highly scalable predictive maintenance services that are cloud-based and do not require the clients to install any software or hardware for its deployment (SKF). Clients are not just presented with the ability to identify problems beforehand; they are offered a solution to resolving those problems and guidance on how to prevent future occurrences.

Artificial intelligence services and condition monitoring using the SKF Enlight AI center help prevent not only unscheduled downtime but also labor costs and overtime, labor repair costs, damaged production output, excess inventory, and other variable costs, among others.

A concrete example is a steel manufacturer. The company relies on continuous equipment uptime to meet their production goals. Failures of critical rotating machinery cost millions. This REP agreement created a true partnership to achieve best-in-class productivity. Catastrophic failures can be avoided by identifying issues early in critical rotating equipment and implementing solutions that minimize downtime. Detecting problems early allow for streamlined inventory orders and well-planned maintenance activities that reduce costs, improve worker safety, and boost productivity.

Figure 1 summarizes both the services and the journey that SKF has undergone toward performance and servitization. The SKF bearing products and adjacent technologies are all digitally connected.

4 Conclusion

It is highly recommended to invest time in better understanding customers' jobs to be done, pains, and gains. One needs to be open to listen to the customer and not come with an existing product portfolio. Two example cases to illustrate the importance of customer-specific solutions and how it can be beneficial to customers follow.

The first is a situation where SKF had to remanufacture products at a coal-fired power station. SKF states that the company had discovered that six of their roll wheel bearings needed to be overhauled because they had been pulverized. SKF went on to assess the machines. After a successful inspection and failure analysis, it concluded the bearings could be restored despite the damage to them. So instead of taking 7 months' lead time to replace the bearings with new bearing sets, SKF remanufactured the bearings in 6 weeks. As a result, the company saved more than 12,000 Australian dollars in new bearing purchases. Another 1.5 million

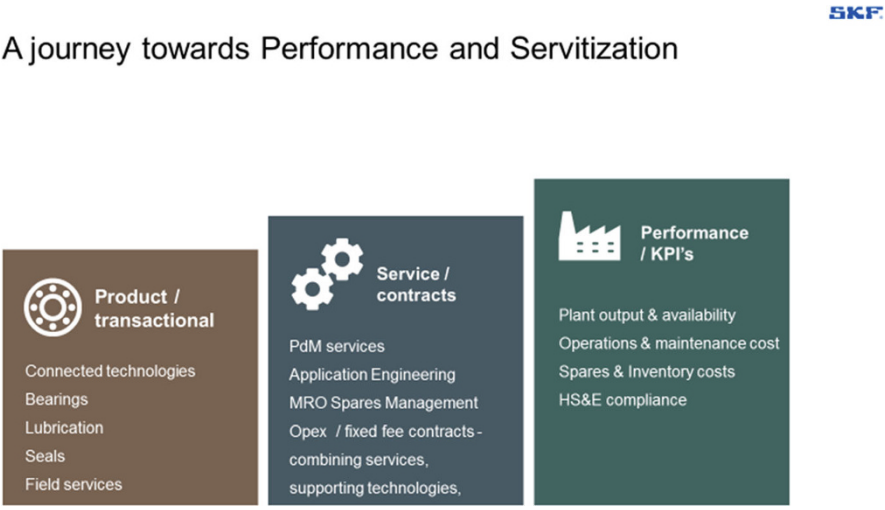

Fig. 1 Journey to Servitization. Own illustration

Australian dollars (the approximate amount of 5 months' worth of lost revenue resulting from reduced power production had new bearing sets been required) was also saved.

The second example case illustrates the importance of delivering customer-specific solutions. It comes from SKF's partnership with a pulp and paper manufacturer in Europe (SKF). In this case, SKF deployed its maintenance-related services for this manufacturer, forging a long-term maintenance partnership program. The result and benefit of this partnership to the manufacturer was a 45% reduction in bearing spend and a 55% reduction in downtime in 7 years. In the first 12 years of SKF introducing a condition monitoring solution system, the company also experienced a 75% increase in productivity. Ultimately, the company achieved a 99% reliability target after 17 years of partnership.

Had SKF only focused on the manufacture and sales of products rather than deploying solutions that were tailored to customers' pains and needs, it would not have been able to help these companies save and achieve the money and target it helped them save and reach, respectively. SKF realizes that it is no longer sensible to only sell products as singular solutions. It continues to evolve into offering packages that incorporate several product offerings and the knowledge and expertise it boasts.

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