Holistic Quality Control Through Individual Control Loops

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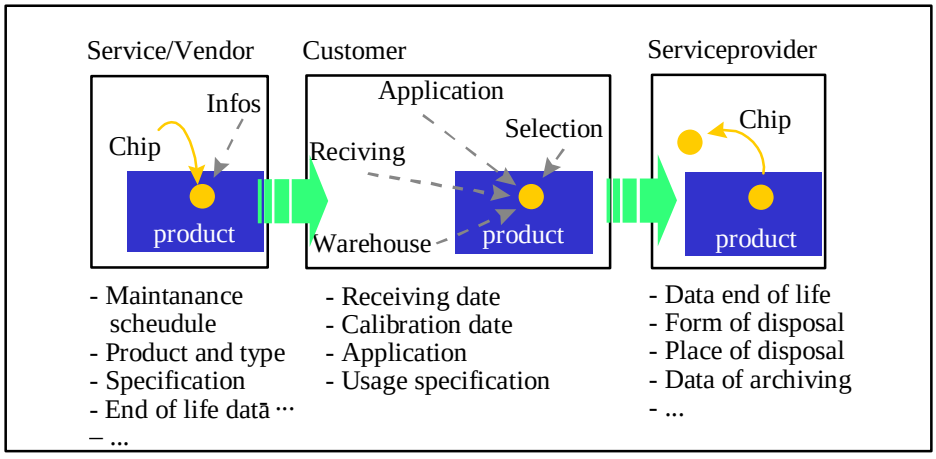
The initial situation is describe as one in which the future orientated production faces the customer demand for individuality. This underlines the needs to secure constant process and product flow. This can be achieved through a holistic planning and control concerning the entire logistic chain. Tools to ensure the quality of products and processes have been developed in a three year research study. The methods of the classic Quality Function Deployment have been upgraded to meet the challenge of producing customer unique products. Individual Customer demands can be translated into technical data serving as base for the product focussed process planning. To control the newly introduced functions and the quality of process and products forward orientated control loops have been implemented. Thus potentials to solve quality problems in the running process will be detected. Hence an occurred production default will be removed before the production has ended assuring a near zero default production. Applying this method individual production to low costs for production and customer becomes possible.

Objectives / RF-ID Functional principles

The logistic process of tooling distribution for a customer, manufacturing facility or a service organization, i.e. storage, handling, quality control (e.g. re-calibration) and other applications can be controlled and followed with a carefully integration and use of new RF-ID (Radio Frequency-Identification Device) technologies in the process.



Picture 1: Information flow

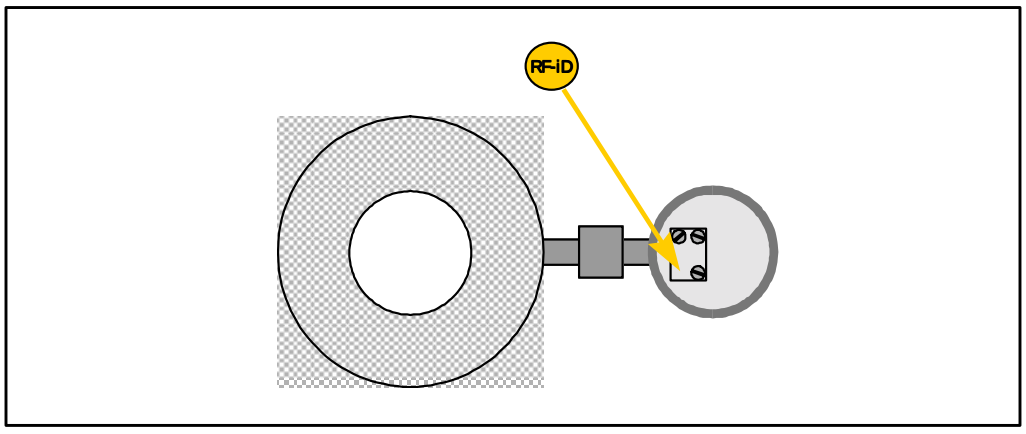
The RF-ID chip is a contact-less identification system with integrated Read/Write capabilities. The data transfer between the interface (Read/Write Head) and the RF-ID module is performed by the read/write pencil like head. Through it's antenna it generates an unmodulated RF field and transmits the necessary supply power (>300µA)

to operate the RF-ID chip. When a known data record has been transmitted via the read/write head the RF-ID module will return this data stream in full duplex mode. Thus to ensure data integrity, the interface compares the original data with the received data. The data is retained on the chip EEPROM without power.
It will function only if accurately implemented, system wide (e.g. SAP, any other PPS system) and throughout the entire process chain of logistic events, starting with the manufacturer and supplier and ending with phasing out (out of tolerance, no more in use, etc.) of tool products in an environmental controlled fashion. See Picture 1, Information flow.

Process quality enhancement

One pre-requisite in order to achieve this is, that the entire process (information and data flow) should be examined i.e. from vendor (tool manufacturer & supplier) to tool owner, the customer, usage by the customer and return to the home base station (tool owner). As well as the tool owner internal data information flow of tool information which will be needed to store the tool (shelf, transportation-box) and ”ready the tool for re-use”. It is important to integrate all relevant tool data, e.g. calibration, maintenance and it’s documentation into the process with result orientated emphasis.

The actual process for administration of all tools in lease and loan is more or less manual. This process may be very time consuming for quality, administration an safety procedure assurance. Incoming and outgoing tools have their ID number and calibration number on a sticker which are related to external processes by a lot of certificate- and other administrative data.



Picture 2: Weight-load Indicator Tool

The (manual) process could be improved and accelerated by (half-)automation and data storage directly on the parts (tools and equipment). The sticker label may be kept for quick identification and temporary purposes.

With selected service tools, a reference model (for the field) has been developed based on actual process scrutiny results. To control the data flow, e.g. quality data, shipment and certifying data, etc. a data retainer in form of a RF-ID chip (device) has been placed and used on each service tool (physically mounted on the tool surface) selected for the process.

Purpose

1. Development of an identification system to establish a thorough quality control system of all relevant data and information of the tool life cycle;

2. Streamlining (decrease internal administration) existing DP systems through automation of data input and output of reference tools;

3. Simplification of congruous tool data;

4. Quality optimization of logistics through simple tool data acquisition,

5. In case of product liability, instant availability of complete, thorough data records for each tool, retained with the tool;

6. Easy, accurate data acquisition for goods receiving, dispatch and shipment;

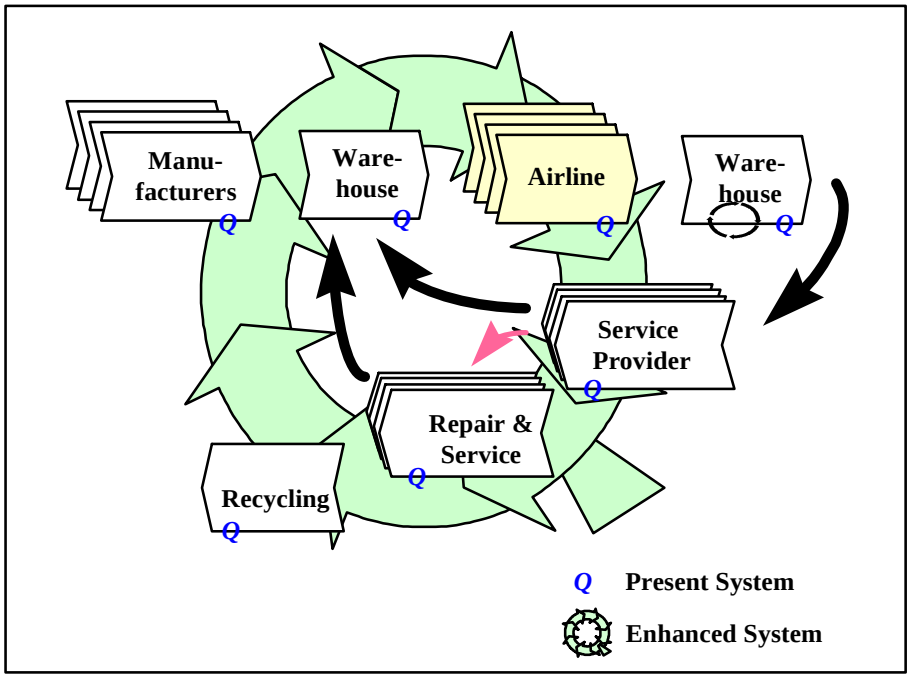
7. Billing of tool user (customer) in accordance with actual tool usage, automated;

8. Enhance customer satisfaction, internally, externally.

Process analysis and implementation of quality control loops

A reference model has been developed in 5 phases with use of selected tools. The project partner (tool owner and service provider) and Fraunhofer Institute for Factory Operations and Automation IFF, examined the entire tool process thoroughly together. A number of tools were selected on empirical values during the initial defining phase. This was followed by the general analysis of the present tool service and distribution system. All technical and administrational aspects for each single process had been scrutinized for serviceability, usability and relative value for the entire process.

The advanced process analysis was extended, including every vendor and supplier for any tool selected for the project. It was the tool supplier (manufacturer) responsibility to specify where the RF-ID device had to be placed physically.



Picture 3: Enhanced logistic concept

The following steps were performed:

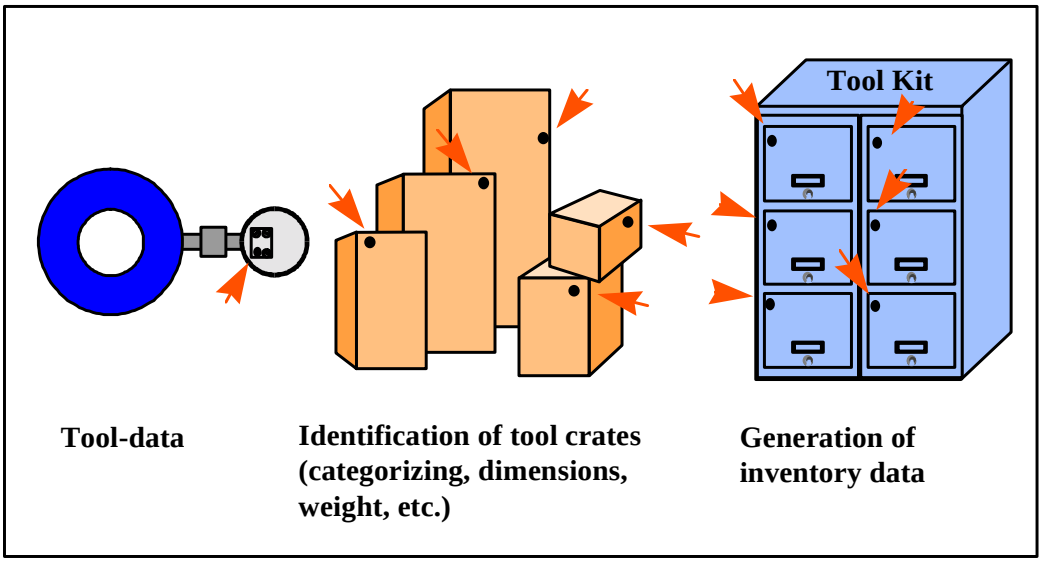
Analysis of the logistical vendor procedure. The vendor manufacturing process and calibration process of product. Expediting the product from vendor to (tool owner) user. Data analysis, e.g. vendor data, data input into tool owner and vendor data platform (SAP, MAPICS, etc.), data transparency on all tool owner, vendor need to know Departments and subsidiaries world wide. Delta development of necessary data flow in hard- and software, see picture 1.

Further requirements are the development of enhanced processes. With the objective to improve existent and/or further logistical procedures. This will result into several complete logistical processes which must include all players, which possibly will be the manufacturer, vendors, user and also inspection/calibration companies, etc. for the tools, see picture 3. In order to control and update the logistical data necessary to run the process a data media, retained on the product (tool), is required. The RF-ID chip will serve as such a media. With the RF-ID chip placed onto the tools (products) all relevant tool-data collected throughout the entire tool life cycle can be stored on the RF-ID device (remote data). The data is mirrored with the tool owner database system. Thus it can be used to evaluate and accumulate all relevant data for any purpose e.g. to picture the complete quality data over the entire tool (product) life cycle.

The concept phase will lead to the implementation of the concept. Which gradual transfer of the concept into the operation. All project partners are required to participate. All relevant control systems necessary to perform the data transfer within the logistical chain (inter-company data exchange) will be involved within this phase of implementation. Some of the database systems may be:

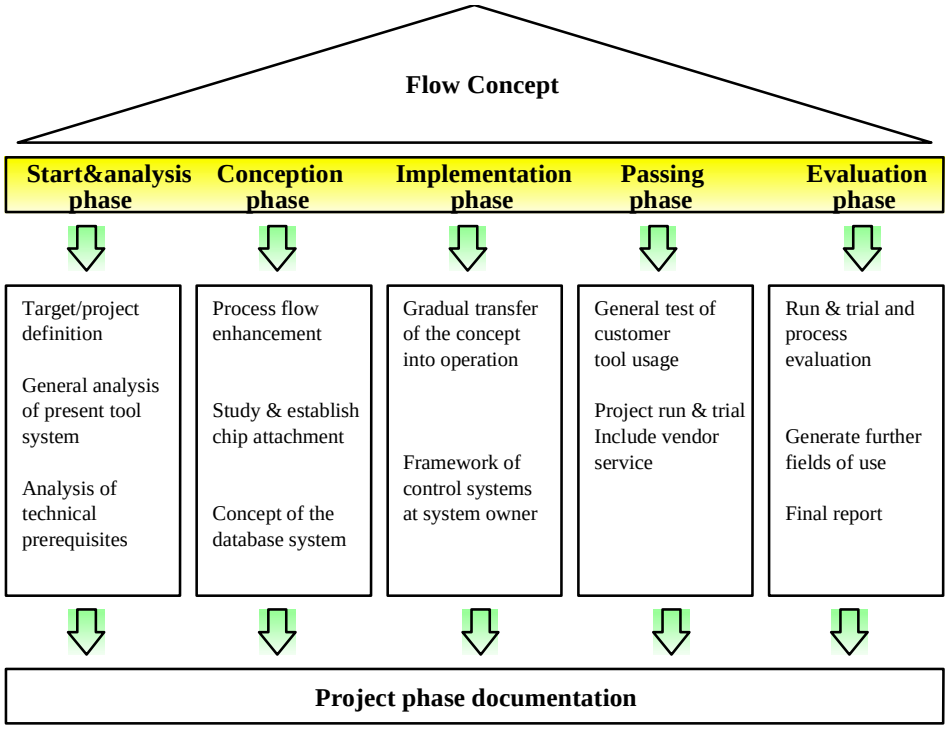
- Quality control system
- Logistical control system
- Safety control system
- Administration and billing

There are no particular methods to install the RF-ID device on the tools (product). The installation of the RF-ID device on the tool (product) is tool design (e.g. housing) dependent.



Picture 4: Example of RF-ID device installation

After completion of the concept step a major in-depth test phase will follow. Due to the RF-ID device residing on the tool, (remote data media) it should now be possible to follow the entire chain of logistical events including the service process. It is therefore fundamental that all participating companies update their relevant data fields on the chip device, assigned to them. This will be one basis for a continuos tool life cycle evaluation. To collect, or alter i.e. read/write data a Psion Workabout (miniature computer) which has a particular read/write pen connected is used to transmit data onto the chip. The system can be programmed for read only, write only, it can separate data fields for exclusive read or write only, it can be personalized for partly or total read/write permission. A personification of the RF-ID device is also possible. The data on the chip can be encrypted.



Picture 5: Flow concept

For the final qualification cycle it is necessary, that a number of selected tools are used by customers, passed through maintenance and calibration cycles in a repeated fashion. It is also prerequisite that a data base shall be created. This base should able to collect data parallel to the present system to retain the data which is essential for chip tracking, project follow up and all other relevant data records for the build up & design of the reference model.

The implementation and use of RF-ID device will:

1. provide accurate, real time inventory control and management;

2. help to eliminate some of the labor intensive, inaccurate paper systems;

3. provides further automated transaction capability;

4. work in dirty or harsh environments;

5. identify customer tooling and the shipment control;

6. speed up the identification of tool provider, customer and vendor calibration certification abroad;

7. identify quality problems; help to identify the source of error and eliminate the source;

8. access service tool data world wide without a data link to the home office.

Conclusion

Using the new process and technology-based systems (RF-ID) for selected ground service tools used by airlines to service their flying equipment based upon the entire tool life cycle, proofed to be successful. With a tool owner and provider a reference model has been created in order to improve customer satisfaction in every aspect. This model is currently under further development in order to be used in other applications. It is evident that, if the analysis of all sharing processes had been performed successfully and thoroughly that it will result into continuous self-regulating quality circumferences.

It has been affirmed in the reference model, that the use of RF-ID chip systems will improve the entire process and product quality of the tool life cycle. In long term aspects, it will continue to contribute to the improvement of the tool provider, tool logistics. It is very much likely that because of the results of the reference model, general usage of RF-ID devices will expand at large within the industry.

RF-ID device technical data

The RF-ID (Radio Frequency-Identification Device) chip is a contact-less identification system with integrated read/write capabilities. The data transfer between the interface (read/write head) and the RF-ID module is performed by the read/write pencil like head. Through it’s antenna it generates an unmodulated RF field and transmits the necessary supply power (>300µA) to operate the RF-ID chip. When a known data record has been transmitted via the read/write head the RF-ID module will return this data stream in full duplex mode. Thus to ensure data integrity, the interface compares the original data with the received data. The data is retained on the chip EEPROM without power.

Technical data, (particular brand):

Storage capacity	2 Kbytes
Read time per byte	500µs
Write time per byte	10 ms, max
Data retention	10 years
Read/Write distance	0…3mm
Temperature range	+/- 150°C

This technique may drastically enhance and improve customer service and customer satisfaction. Shelf regulating quality results are possible with this approach, provided

that all involved processes are properly analyzed and resulting data is used on the RF-ID technology in an ”in process fashion”. It can be considered as the ”Bar Code follow on Technology”. All known, current field implementation have very impressive and encouraging results.