2016 GE Digital Solution Competition Case Study

April, 2016

Transformers Team

Outline

1. Great gaps between current system and practical needs
2. Our Solution: RFID + Predix Cloud
3. How new post-sale service process works
4. System functions & unexpected situation solutions
5. System overall evaluation

1 Present post-sale service process: Tool keepers travel with tools; half-automation & half-manual operations

Register new tool into tool box:
- Find barcode in operation book
- Give each tool ID and barcode

Travel with tool box

Find tool keeper

Borrow Process
- Scan tool barcode
- Input quantity of tools
- Input engineer employee ID
- Input other remarks

Update to Excel

Find tool keeper

Return Process
- Search employ ID, find record
- Update status

Update to Excel

Travel back with tool box

Put tools back to tool center

Note: 1. Red color denotes manual operation, while black denotes automation.

2. Graphics meaning: *Tool Center* *Customer Site* *Tool Keeper* *Engineer*

1 Great gaps exist between practical needs and current system, which demands new system maximizes automation and covers all-aspect post-sale service with well-designed hardware & software

Current Problems:

- **Low system reliability：**
  - 500-1000 transactions/day, sometimes beyond Excel processing capability and causing system collapse
- **Low efficiency:**
  - Too much manual operation
- **High cost:**
  - Tool keepers need to travel with tools every time, leading to high labor cost
- **Unable to realize cross-platform tool management**
  - Excel cannot track tool data in other tool boxes and centers

New System / Process Requirements:

- **Maximum automation**
  - ↑Efficiency, ↑system reliability , ↓ risk of making manual mistakes, ↓ labor cost
- **Cover all-aspect post-sale service**
  - Capable of tracking tools throughout whole process of post-sale service
- **Well-designed and cooperated hardware & software**
  - Precondition of all functions
- **Practical feasibility**
  - Technically, financially, and implementationally feasible

2 Our Solution: RFID + Predix Cloud, together to realize off-line process digitalization and cross-platform management

1. Add RFID tags into tools, tool boxes, IDs, trucks, etc.

2. RFID readers obtain information via tags.

3. Data transmitted to local servers.

Predix Cloud Platform

4. Data updated to Predix Cloud Platform.

5. Conduct cross-platform and whole-process management by terminal devices.

2 New System Basic Settings: Tool center is like a library, and the whole off-line and on-line process are integrated in ONE SYSTEM

Off-line Mark Method

Durable Tools
(e.g. wrench)

- Most durable goods use RFID tags as unique tool ID
- For tools that are too small or not suitable for RFID tags, print temporary RFID tags to mark them

Consumptive Tools
(e.g. mainboard, nails)

- For medium and high-value tools(e.g. mainboard, hard disk),add RFID tag as unique ID
- For low-value tools (e.g. nails, cheap chips), each category share the same ID, and record their quantity

Others
(Employee IDs, trucks, tooling boxes)

- For each single piece, give it a unique RFID tag

Note: Customize RFID tags suitable for tools, using special paste, imbedding or thermoprint methods according to practical needs.

Tool Center is like a library: Store tools based on some certain rules, have security doors(RFID readers)

All on-line and off-line activities are integrated in ONE SYSTEM

- **All related information is stored in the system:**
  - Clients: name, contact, address…
  - Tool Center: address, tool information
  - Tools: RFID tag, name, tool center, shelf info, quantity…
  - Employees(including engineers, managers, tool center staff etc.): department, name, contract…
- **Off-line activities will be updated to the system via RFID technology**
- **Manager, client, engineer, tool center staff can check the process** (e.g. tools using status and service progress)

3 NEW post-sale service process: from client post-sale service request to tools back to tool center

1 **Client** propose post-sale service request

2 **Manager** assign engineers to solve this problem

3 **-Engineer** generate electric tool list in the system
-Set expected tool return date

4 **-Tool center staff** find tools in need and pack into tool box;
-Another Tool center staff check tools and list

System compute tools pack value

Low-value tools

5 **Express company** deliver tool box to customer site

6 **Customer site(engineer):**
- Engineer check tool box;
- Use tools;
- Hand over tool box to express company, and mark tool status in the system

7 **Tool center:**
- Tool center staff check tools
- Put back tools into center

High-value tools

5 **Tool keeper** travel with tool box to customer site

6 **Customer Site:**
- **Borrow:** tool keeper scan tool box, engineer ID and tool RFID tag
- **Return:** tool keeper scan tool RFID tag, and remark tool status

7 **Tool center:**
- Another tool center staff check tools
- Put back tools into center

Note: 1. ***Red color denotes manual operation in the leasing and returning process.***

2. Graphics meaning: *Tool center* *Customer site* *Client* *Manager* *Tool center staff* *Engineer*

3 Cooperated hardware & software guarantee online and offline procedure all in SYSTEM and update to PREDIX Cloud

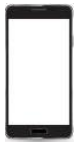
Hardware Design

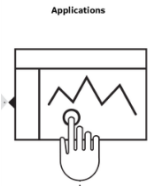
- **RFID Tags:**
  - All tools, tool boxes, employee IDs etc. either have a unique RFID tag, or have temporary ID, record quantity in system
- **Tool Center:**
  - Set like a library, with tools stored and RFID reader and alarm as security door
- **Tool Keeper Travel Kit:**
  - Tool box(all tools and box have RFID tags), mobile RFID readers(1-2 readers per project), computer connected with RFID reader to update data

Software Design

- **ONE SYSTEM:**
  - Online processes (post-service request, assign engineers etc.) are operated on system directly
  - Offline processes (borrow & return tools, check tool status etc.) are updated to system via RFID
- **Predix Cloud Platform & web applications:**
  - Both online and offline information transmitted to Predix Cloud Platform
  - Enable to conduct cross-center, whole-process management

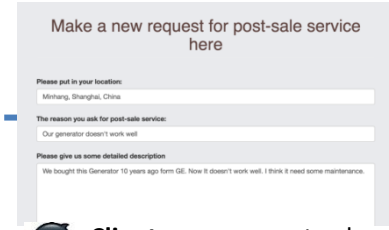




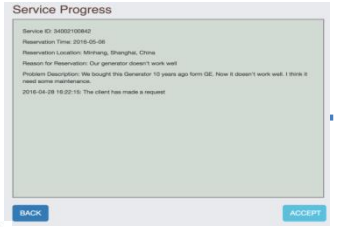


3 System Operation Demo: From client request to project finished

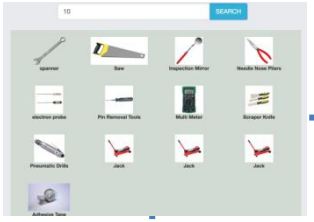
BEGIN



Client propose post-sale service request

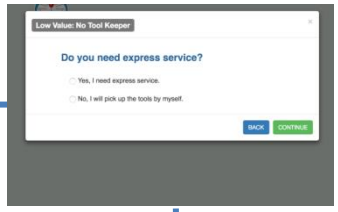


Manager assign engineers to solve this problem



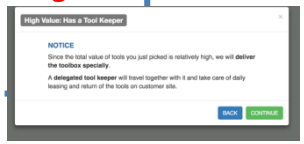
Engineer generate electric tool list and invite other engineers

Low-value tools

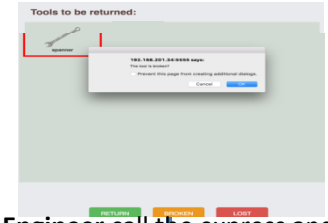


Engineer choose tool delivery mode: express / self pick-up

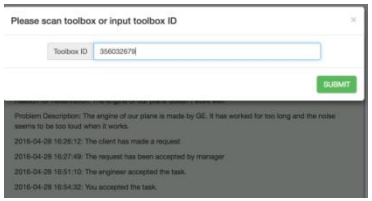
High-value tools



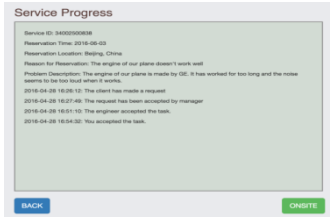
System notice engineer that tools will be delivered by tool keeper because of high value



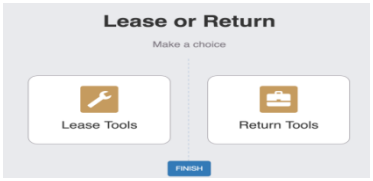
Engineer call the express and confirm return status in system after finishing the project



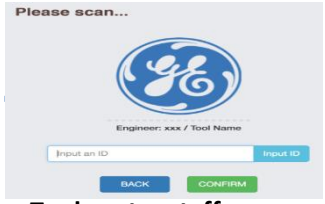
Tool center staff scan or input toolbox ID



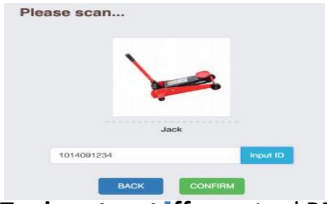
Tool center staff accept tool keeping task



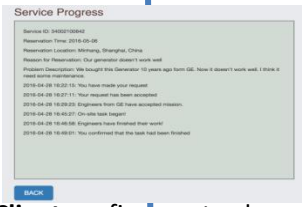
Tool center staff choose model: lease or return



Tool center staff scan engineer employee ID



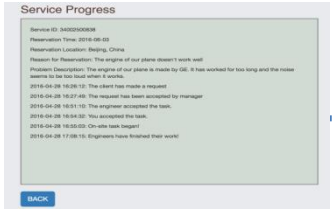
Tool center staff scan tool RFID tag to borrow tools for engineer



Client confirm post-sale service has finished

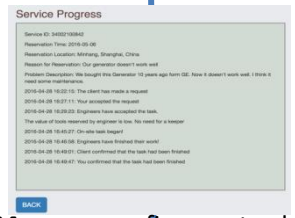
END

Client & Manager confirm service has finished



Tool center staff confirm that engineer finish this post-sale service

Tool center staff return tools (in this case, remark broken status)



Manager confirm post-sale service has finished

END

4 New System has SIX basic functions

Process Tracking

- **For managers, engineers, tool center staff, and clients:**
  - Start and proceed process in the system (e.g. Clients propose post-sale service request, managers assign engineers in charge)
  - Check the process status (like Taobao, you can see where the tool box is)

Inventory Management

- Tool center staff can check center inventory(real-time and expected) status at any time
- Predict tool renew and maintenance based on advanced algorithm
- Automatically send out tool complementation request if tool quantity is below warning line

Durable Years Notification

- **Tool notification: all** related tool information(have purchase time, durable years…) is stored in system. When use time arrives at some percentage of durable years, renewal and maintenance notification will be sent
- **RFID tag notification:** like tool notification, system will send out renewal notification when use time arrives at 90% of durable years

Tool Return Reminder

- According to expected tool return time written by engineer, the system will send a reminder message to engineer, to ask for confirmation of return date. Engineer can revise return date when receiving reminder message
- If engineer doesn't return tools by return date, tool center staff can contact engineer and confirm tool use status

Tool Renew and Transfer

- When renewing tools, RFID tags will be added to most durable tools, while others either have a temporary ID or record in quantity. New tool information will be updated in the system at the same time
- When tools transfer among different tool centers, tool center staff only need to change "tool center "information of tools, and record transferring

Abnormal Situation

- **Black list:** for engineers or tool center staff who cause too many tool loss (quantity and value), they will be marked as "Black List" in the system. Managers can check these blacklist and specific situations
- **Abnormal tool consumption:** for low-value consumptive tools, if they are consumed too many in a certain time, the system will inform managers

4 Unexpected Situation Solution & System Advanced Application

Situation ONE: New Tool Request

- **Description:**
- When engineers conduct on-site maintenance and repair work, they find they forgot to apply for some tools or need to apply for some other tools

Solution

Engineers need to log in the system, and follow the same process like the former tools pack

- *If the project already has a tool keeper, new tools pack will be sent by express company*
- *If the project doesn't have a tool keeper, tools pack will be sent either by express or tool keeper based on tools value*

Situation TWO: Information Correction

- **Description:**
- When returning tools, engineers or tool center staff input tool status (return / broken / lost) incorrectly

Solution

- *Staff who made mistakes report to managers, and managers apply to revise data and mark reasons in the back-end*
- *Revision of existed data will produce a new record, including original, revised information and reviser ID, for future verification*

Future Advanced Applications

- *From Power Group to **other GE Business Groups (aviation, healthcare…)***
- *From Tool Management to **other corporate management (stationery, equipment…)***

5 Our solution meets and even beyond case requirements, considering both feasibility and benefits

High Feasibility

Technological: both feasible in hardware and software

- **Hardware(RFID):**
  - Mature and mass-production technology
  - Adapt to adverse working conditions: water-proof, shake-proof, high temperature resistant, various sizes(can reach 8mm), easy to embed into other products
- **Software(Predix & web applications):**
  - GE has been developing Predix Cloud Platform and web application accessible to various equipment

Financial: reasonable and medium cost

- RFID tag is about RMB 0.8/unit
- RFID reader is about RMB 500/unit
- Tool center security door is about RMB 4,000/package.

Meet and Even Beyond Original Requirements

Whole-process tracking & management

Almost full automation

System reliability

Cross-center and cross-box management

Highly efficient

Multiple functions