Reliability Improvements in Network maintenance at RBTT Financial Holdings Limited

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Abstract: This paper describes the approaches and methods used to improve the efficiency and reliable operation of the telecommunications facilities and equipment of the network at RBTT Financial Holdings Limited. A recent project was initiated to establish process benchmarks for the ongoing evaluation and improvement of the maintenance effort, using Total Quality Management (TQM) and Reliability Centered Maintenance (RCM) tools. The project resulted in substantial improvements in the operations as evidenced by the increased throughput of requests and reduction of repeat visits to the sites. The cost of operations was reduced through the introduction of inventory control. Further work undertaken subsequent to the initial study is also outlined in the paper.

Keywords: Network maintenance, CMMS, TQM, RCM

Introduction

This paper presents the initiative and results of a project on designing and implementing a Computerised Maintenance Management System (CMMS) and a Preventive Maintenance (PM) programme at RBTT Financial Holdings Limited. The project initially started with the analysis of the operations of the Alternate Delivery Services (ADS) Department of

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the bank. The study was undertaken on the Communications Department which is involved primarily in the installation and maintenance of voice and data communications for all of the bank's operations as well as the backup power (e.g. UPS and Generators) which utilised in the Network. This Network includes Telephony, PBX, Wireless, Local Area Networks, and Metropolitan Area Networks. A quality analysis was done within the department using tools such as Pareto Analysis, Cause Effect Diagrams, and Process Flow Charts. The analysis optimised the various tasks relating to voice, data and power operations. New procedures were developed, documented, and implemented and the CMMS itself was also geared toward ensuring that these procedures are followed.

CMMS Requirements

The CMMS was regarded as a necessary tool to assist the effective operation of the department. Several key components of the CMMS and associated critical features are identified as in Table 1.

(Insert Table 1 about here)

Table 1. Key components of the CMMS

Work Order System

The Work Order system was the Heart of the CMMS as this drove the other activities listed. It was implemented to track and execute tasks as they related to Planned Work, Emergency Work, and Routine Work. Planned work was expanded to include routine checks on support equipment (e.g. PABXs, Leased Lines, Telephone Lines, Recordings etc.) that detected cases of failure or marginal performance. The Work Order form served as confirmation of the user's request as well as authorisation to purchase the materials required for completion of the requested job. There has been a reorganisation within the bank which resulted in the responsibilities for day-to-day maintenance being assigned to a Department operating a Help Desk System. The processes and controls in the Work Order System remain mostly unchanged.

Preventive Maintenance

PM was introduced with the aim of performing routine inspections, test measurements, and adjustments. A historical record was to be kept particularly for the traffic readings, with a Traffic Analysis module established to inform the provisioning of facilities being installed to meet traffic demands. The other areas such as RCM analysis of the PABX equipment would also see the reliability of the equipment being improved by identifying appropriate inspection routines, PM routines, and corrective actions. The use of PM in the department was seen as being relevant in the following areas:

- Monitoring of traffic patterns to detect trends for appropriate remedial actions;
- Identify deterioration in equipment to initiate corrective action;
- Verification of records related to facilities and equipment;
- Detection of facilities that are not functioning or being inappropriately utilised; and
- Inform future engineering and design of the Network.

A phased approach was utilised for the implementation of the PM programme. A representative and controlled group of equipment was chosen and in conjunction with the maintenance manuals, RCM inspection routines, PM tasks, and corrective actions were identified for various equipment and their components. This initial set focused on the major and most expensive equipment (top 20-40%) to maximise the initial impact of the programme.

Design of CMMS

The analysis and design involved primarily the use of systems analysis and TQM tools to determine the composition, flow and controls of the CMMS. This also guides the structural design of the database system used for management of overall CMMS operations.

Flow Charts

The original flow process to a level of minimum detail is shown in Figure 1. It was modified to represent the proposed process in sufficient detail to guide the development of the new system as given in Figure 2.

(Insert Figures 1 and 2 about here)

Figure 1. Original flow process

Figure 2. Modified overall process flow

Data Flow Diagrams

These were developed from the process flow and flow charts to identify the file systems, processes, and inputs needed. They also detailed the flow of data among the various processes, files and sources. The Overall Data Flow Diagram is given in Figure 3. Similar

Data Flow Diagrams were developed for purchase orders and inventory control. Detailed descriptions of all processes were also compiled.

(Insert Figure 3 about here)

Figure 3. Overall data flow diagram

TQM Analysis

The following TQM tools were used to analyse the processes involved to identify areas of poor quality and unnecessary delays leading to the changes and controls that were needed in the existing process. To allow more accurate analysis, two major sub-processes were defined: 1) request for installations, and 2) request for maintenance. Several tools were used and elaborated as follows:

Cause-and-Effect Diagrams

Cause-and-Effect Diagrams were used to identify the factors that could prevent the processes from achieving the desired results and to determine corrective measures. The Cause and Effect diagram for Installations is given in Figure 4. A similar diagram was developed for maintenance requests. A number of the causes were identified and corrective actions put in place:

- Cross-functional training of technicians resulted in easier assignment of tasks when there were several jobs to be performed on one trip as was often the case.
- Additional technicians were hired and more tools were purchased leading to more effective completion of scheduled work. In the original scenario, planned

maintenance was often subordinated to real time demands much to the detriment of reliability of the equipment. It also resulted in higher costs for outsourcing of basic services.

- An additional vehicle was acquired to ease travel to the twenty locations being serviced.
- A revolving fund was set up to purchase consumable stock resulting in bulk purchases at lower unit costs.

(Insert Figure 4 about here)

Figure 4. Cause-and-effect diagram for installations

Pareto Charts

Based on the Cause-and-Effect Diagrams, Pareto Charts were constructed using historical data for request for installations and requests for maintenance. A Pareto summary for installations is given in Table 2. The major causes of poor quality in the case of installation were:

- Request received late
- Delay in delivery of materials
- No equipment capacity
- Inaccurate information

In the case of late delivery of the equipment, a revolving fund was set up for pre-purchase of items which were to be charged back to the various cost centres as the material was used. For an inaccurate request, the user was requested to sign off on the request or drawings that were submitted for execution while ensuring that the request and accompanying drawings contain details on all the work that is to be completed. For requests received late and lack of equipment capacity, closer ties with the premises department were built into the process to allow the department to pick up both requests and the need for expanded equipment capacity in a timely manner.

(Insert Table 2 about here)

Table 2. Pareto summary for installations

Histograms and Control Charts

Histograms were drawn using the difference between the install date and due date for installations and the time taken to complete the request in the case of maintenance. These data were also used to construct control charts. Standards were defined and used for ongoing monitoring of performance.

Database Development

The Data Flow Diagram, Process Flow, and Flow Chart guided the Relational Database design exercise and so identified the files, forms, and reports that were needed in order to mechanise the process. It also identified the procedures, policies, and integrity checks that were needed to support the operation of the system. An Entity life History model was developed to guide the procedures and events that were to be associated with various files in the database.

Reliability Centered Maintenance (RCM)

RCM operates on the premise that every system has an inherent level of reliability beyond which it is not feasible to contemplate or attempt additional maintenance as no tangible benefits will be realised. The system uses Hierarchical Diagrams that assist with the identification of weak points and a systematic analysis to identify and document the relevant monitoring, servicing, and assessment routines that should be applied to the system being studied.

Reliability Centered Maintenance was applied to the operations of Generators and maintenance routines were developed and put into effect for execution daily, weekly, bimonthly, and annually. Monthly and quarterly servicing were amalgamated, thus resulting in cost savings as it was determined that by internal starting and checking of the Generator by RBTT staff the majority of problems could be detected and where failure was not eminent, the corrective or servicing work could be scheduled for the next service visit.

Current Status

Based on the success of the project described in this paper, the approach of RCM coupled with TQM tools is being utilised for a Component Failure Impact Analysis on the Group’s Infrastructure. The objective of this analysis is to use the hierarchy of the Network Infrastructure to identify potential single points of failure or points of unreliability and with the help of TQM analysis eliminate or reduce these weaknesses in design and maintenance. RCM will then be used to define the necessary assessment, monitoring, and servicing routines that will improve the reliability of the systems studied.

In order to develop Service Level agreements and Service Improvement Plans, further work envisages an Availability Study for the core services as outlined below:

- Scrutinise Fault Reports and compile a summary of frequency and duration of outages;
- Compile a list of the 20% of causes responsible for 80% of the downtime;
- Carry out an in-depth analysis of the major causes using the cause-and-effect diagrams;
- Benchmark the service levels in terms of types of failures (i.e. critical, major and minor) based on control charts;
- Carry out a component impact failure analysis and draw out the design and points of failure that can affect service. For each point of failure identify using RCM design changes, service/maintenance routines, monitoring requirements and assessment routines to improve the reliability for the systems;
- The general routines will be staggered so that there will be three levels of Service – Gold, Silver, Bronze that will inform different design and maintenance strategies. The user to select a programme based on the costs they are willing to pay and the desired service levels; and
- The TQM and RCM process will be used to inform design changes in terms of adding redundancy, Quality Assurance, and Contingency plans.

Conclusions

At the time of the initial analysis and study, there was little material or tools available with respect to proper processes and controls in the IT Environment. The advent of the

ITIL standards from the British Government's Organisation of Government Commerce and the barrage of IT applications utilising ITIL standards allow the focus on maintenance routines and systems that move from the processes and controls themselves. The advancements in software technology in this area also eliminate the burden of data processing and trending operations.

Maintenance work can focus more on issues of design and analysis of events/problems as signaled by thresholds being exceeded and trending of key performance information. Both TQM and RCM tools provide a steady framework for measurable and deterministic results. They are keys for attaining design improvements, cause-and-effect analysis, and the establishments of Service Level Agreements of the bank. As a result, Service Level Agreements can be tied more to realistic and measurable performance with respect to user expectation. A definitive price tag can be placed on achieving various Service Levels.

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Table 1. Key components of the CMMS

Component	Critical Features/Comments
Work Order System	• Scheduling and planning - Planned, routine, and emergency work.
Inventory Control	• Tracking minimum order quantities • Generating and tracking reorders for equipment • Requisitions for the use of materials • ABC inventory control
Scheduling tool	• Prioritise and schedule against manpower availability. • Handle backlog • Measurement of Work hours (standard hours)
Historical Database	• Fault history • Maintenance history • Maintenance cost
Request Management	• Log request • Analyse requests • ID delays in handling request • Prioritise • Feedback to management and users • Performance reports
Tracking of tools and equipment	• Dispatch of tools • Installation and relocation of equipment • Inspection of tools and equipment • Periodic Inventory of equipment

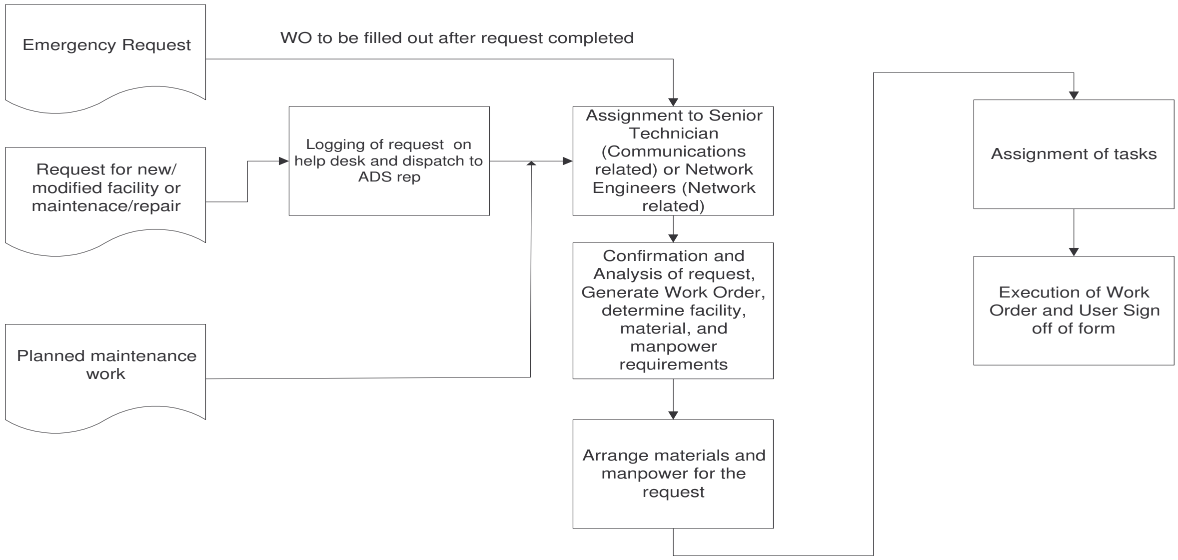

Figure 1. Original flow process

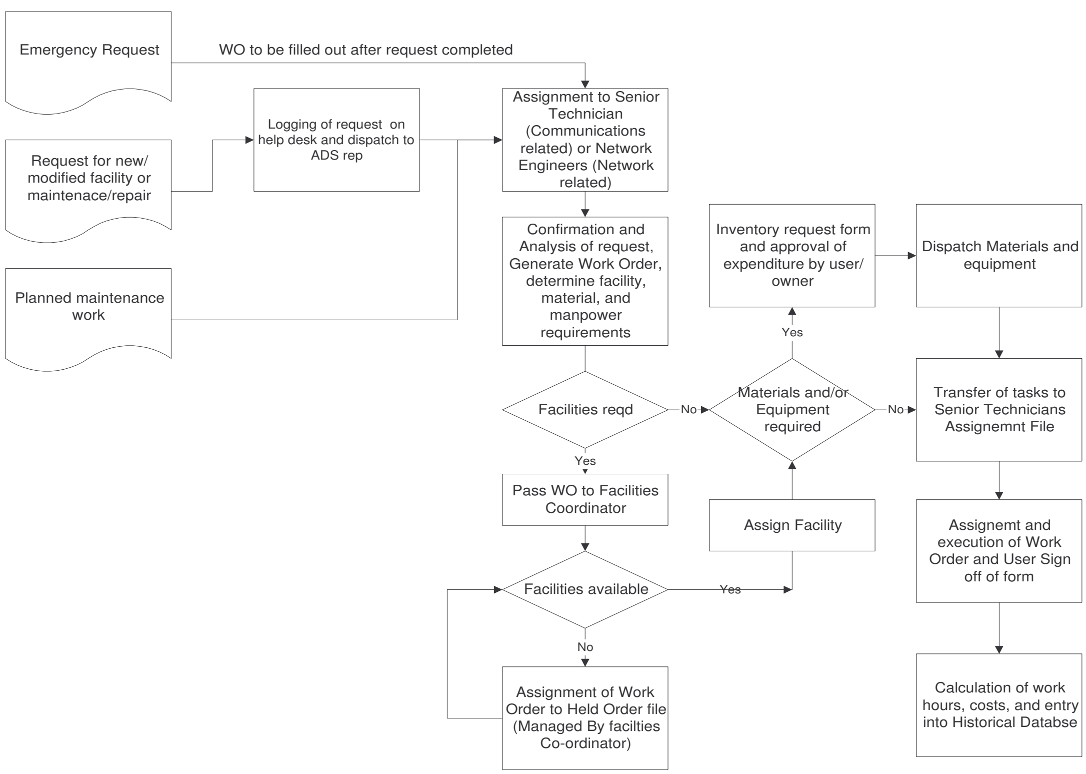

Figure 2. Modified overall process flow

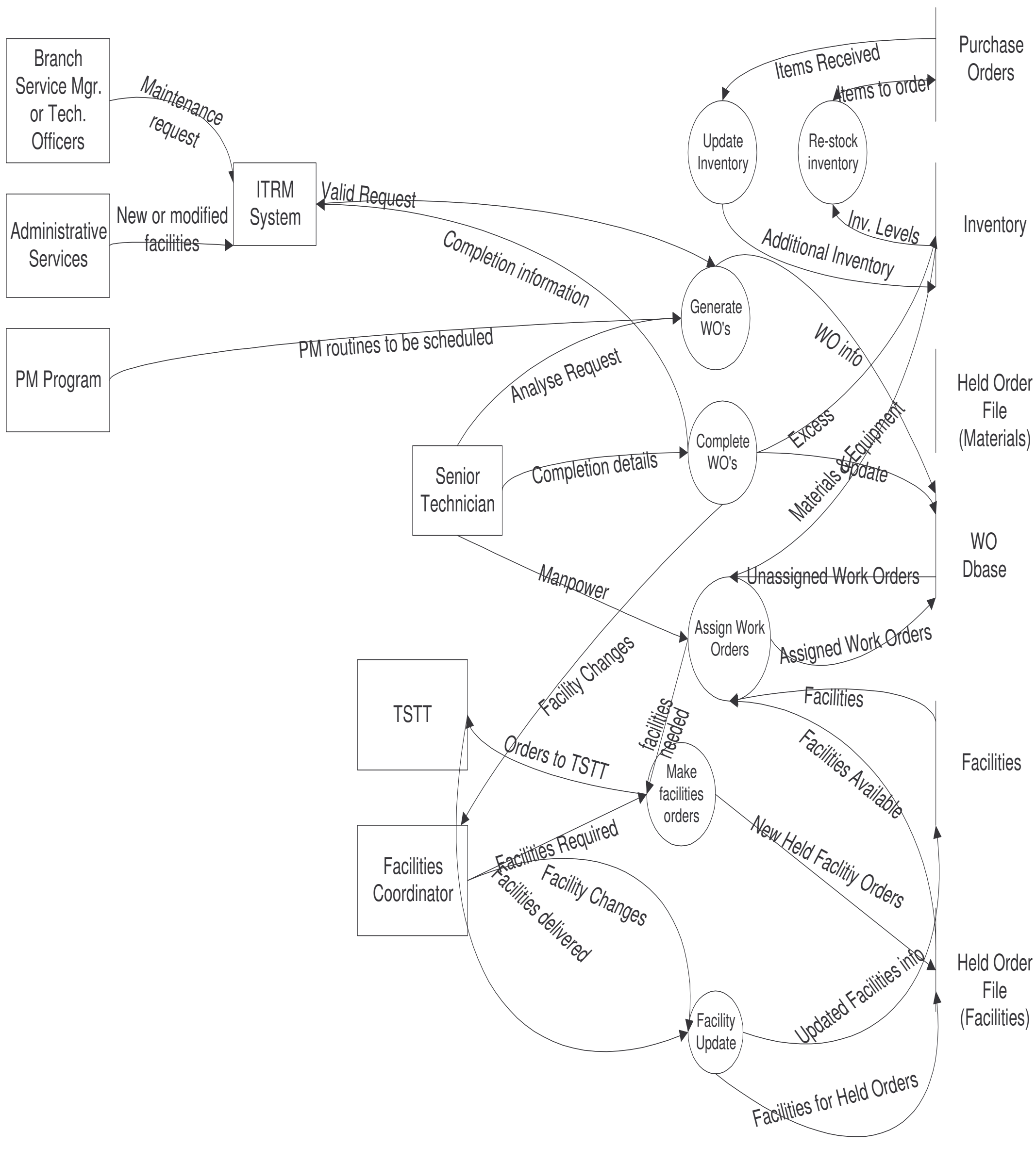

Figure 3. Overall data flow diagram

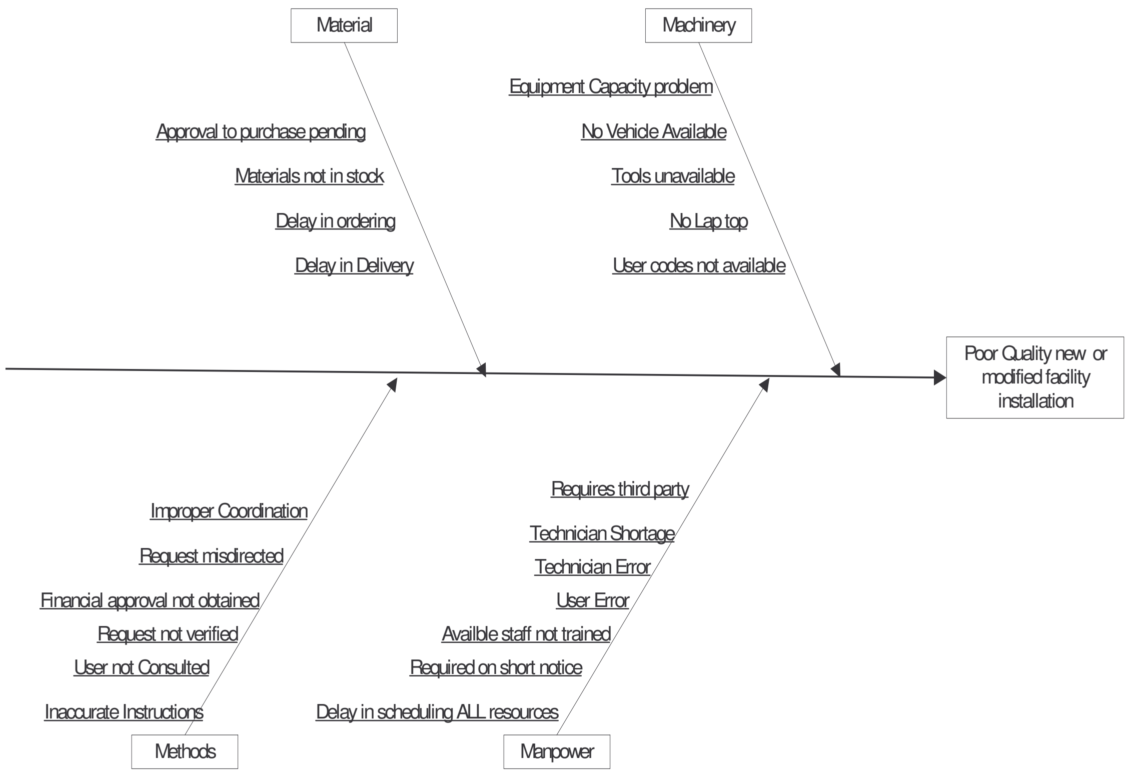

Figure 4. Cause-and-effect diagram for installations

Table 2. Pareto summary for installations

Causes of Poor Quality	Occurrences	Cum. Faults	Cum. %
Request Received Late	10	10	31.25%
Delays in Delivery	6	16	50.00%
No capacity on equipment	6	22	68.75%
Information inaccurate	3	25	78.13%
Delay in Approval	2	27	84.38%
No confirmation received on requirements	2	29	90.63%
Problems with coordinating resources	2	31	96.88%
No laptop to programme	1	32	100.00%