TRANSFORMING FACILITIES MANAGEMENT WITH INFORMATION TECHNOLOGY

CHEN Cien Sheng Gordon, SEAH Lye Kang, SIA Kok Huat

ABSTRACT

Facilities Management (FM) involves several challenges in terms of manpower needs, process efficiency and information management. This article explains how DSTA is transforming FM with its IT-enabled Facilities Management (ITeFM) project to strengthen governance and enhance efficiency. It also highlights the organisation’s efforts in overcoming the photography policy in Singapore Armed Forces (SAF) camps to optimise the effectiveness of the project. Finally, the article outlines DSTA’s emerging use of Internet-of-Things and big data technologies under the FM Control Centre (FMCC) concept to elevate the level of FM operations for the SAF. With real-time monitoring and analytical capabilities, the FMCC is envisaged to transform FM operations with a comprehensive awareness of maintenance, health status and utilities usage.

Keywords: facilities management, ITeFM, FMCC, computerised maintenance management system

INTRODUCTION

DSTA’s Building and Infrastructure (BI) Programme Centre manages more than 6,000 Ministry of Defence (MINDEF) and Singapore Armed Forces (SAF) buildings, facilities and estates. Its scope of work includes a wide spectrum of service delivery through outsourced Facilities Management Agents (FMA) and Integrated Building Contractors (IBC). The FMA’s role is to provide maintenance management services, supervision and certification of work done by the IBC.

CHALLENGES IN FACILITIES MANAGEMENT

However, Facilities Management (FM) is often manpower-intensive and has inherent inefficiencies, as information and process flow rely heavily on hard copies and sequential workflows. Maintenance activities involve extensive manual data entries and are hence prone to errors and lapses. This issue is compounded by the voluminous transactions for large real estates.

The following factors should be taken into account when addressing these challenges to better support the SAF’s operational outcomes.

a) Greater Efficiency – To provide effective and efficient service, inefficient layers and duplicated efforts in FM processes need to be eliminated. This should be supported by a common and collaborative platform with real-time information and seamless connectivity across all stakeholders and supporting systems. Data should also be captured to ensure information accuracy and currency.

b) Better Governance – Strengthening the accountability of MINDEF and DSTA as stewards of public funds and resources requires processes to be streamlined and standardised to ensure an effective oversight of FM operations and the performance of contractors. All outsourced maintenance works should be completed and certified based on objective evidence, which is any documented information that can attest to the quality of an activity or item.

c) Enhanced Effectiveness – There is typically a lack in visibility on the status and performance of BI systems. Although some systems have basic monitoring capabilities, they are
disparate in nature and integrated loosely. This results in users having to perform fault and incident reports manually and often retrospectively. Moreover, turnaround time for response and recovery can be reduced and user experience improved.

**LEVERAGING INFORMATION TECHNOLOGY**

In recent years, there has been an increasing application of IT in the FM industry that is driven by the advent of 4G mobile connectivity and mobile applications (app). An example is the OneService Mobile App initiative launched in January 2015 by the Municipal Services Office.

**IT-enabled Facilities Management**

The IT-enabled Facilities Management (ITeFM) project was conceived by DSTA with the aim of leveraging advances in IT to transform FM operations. It comprises FM Mobile and the FM Portal (see Figure 1).

**Leveraging Consumer IT for FM Operations**

FM Mobile is a mobile app that allows selected SAF personnel to report BI defects conveniently, as well as for FM contractors to perform inspections and maintenance tasks. They are equipped with authority furnished camera-enabled tablets, which have Mobile Device Management software to prevent tampering, that allows them to capture maintenance data on-site and take photographs of objective evidence (see Figure 2). To support this implementation, existing hard copies of disparate inspection checklists and servicing sheets from different contractors were harmonised and digitised. BI equipment were also tagged with QR codes for tracking, accountability and verification purposes.

---

**Figure 1. Summary of ITeFM capabilities**

**Figure 2. A soldier using FM Mobile to report a leaking pipe**
Leveraging Enterprise IT for Maintenance Management

The FM Portal is a computerised maintenance management system that acts as a central tool for maintenance planning, execution and control.

A Common and Collaborative Hub

The FM Portal serves as a one-stop platform for communication among stakeholders within the FM community and provides them with real-time information such as the job request costing and the current job status. Hence, it prevents fragmentation in the response and decision-making processes, and enables a more agile deployment of resources. This means that the relevant parties can better understand issues and carry out the necessary actions or adjustments in a more timely manner. The objective is to create a more holistic and integrated end-to-end FM service delivery for a richer and deeper user experience.

Central Portal for Maintenance Planning, Execution and Control

The FM Portal, with a good workflow engine which clearly illustrate FM work processes, provides greater control over the voluminous transactions related to FM operations as well as more effective governance due to dedicated audit trails. It also allows FM personnel to monitor work progress and maintain oversight for all FM work and services more efficiently. In addition, the FM Portal automates labour intensive tasks such as the generation of maintenance schedules and computation of claims. This not only reduces manpower needs but also mitigates the possibility of human error. Moreover, the vast amount of data can be collected and harnessed to provide deeper insights into FM operations.

Facilities Maintenance Control Centre

Following the implementation of the ITeFM project, DSTA embarked on the FM Control Centre (FMCC) initiative to further enhance FM operations in MINDEF and the SAF by tapping technologies in the areas of Internet-of-Things (IoT) and big data (see Figure 3).

Leveraging IoT for Total Portfolio Visibility

The FMCC offers FM personnel a holistic view of the health status and performance of BI systems at any given time, even when they are not physically present. This is achieved by setting up a unified platform for the integration of building management systems and fragmented sensors (see Figure 4). In general, a faster response and recovery turnaround for incidents is expected with the FMCC.

Figure 3. A conceptual diagram of the FMCC
Leveraging Big Data for Enterprise Asset and Facilities Analytics

With information on past and current operating usage, analytic tools can be utilised to optimise the use of BI assets by increasing system lifespan and lowering total cost of ownership. Coupled with the appropriate benchmarking, DSTA can also better identify areas of abnormally high usage and shape user behaviour. This would potentially lead to cost savings from reduced energy usage. Additionally, the FMCC would enable DSTA to manage its FM operations centrally, hence achieving greater synergy and freeing up valuable manpower for higher value work.

OVERCOMING SECURITY CHALLENGES

Photography and devices with photo-taking functions have been strictly prohibited on SAF premises. With the introduction of security zoning in 2012, SAF personnel and visitors may carry camera-equipped devices into designated Green Zones, although photography is still prohibited.

However, the ITeFM project required SAF personnel as well as FM contractors and staff to be able to use FM Mobile and take photographs with the app in both Green and Red Zones. Restricting the use of FM Mobile to Green Zones alone would not be effective as most BI systems are located in Red Zones. DSTA hence recognised that the existing security procedures needed to evolve, with innovative technical and control measures designed to mitigate the risk of information leakage in a cost-effective manner and without encumbering work processes (see Figure 5).
By Design - Technical Control Measures

ITEFM operates within a network which only processes information up to a security classification level of Restricted. The transmission of information from FM Mobile to the FM Portal relies on a 4G mobile data network and is encrypted in accordance with security guidelines. Additional measures are also implemented to reduce the possibility of information leakage to a minimum. For example, photographs taken are inaccessible by other mobile apps such as Photo Gallery or File Manager in the tablet. Furthermore, photographs taken are deleted automatically once they have been submitted or when the user logs out of FM Mobile.

By Process - Procedural Control Measures

Preventive Measure

Standard Operating Procedures on Photography

Simple and unambiguous standard operating procedures (SOP) are established to define the boundaries of action clearly and provide clarity (see Figure 6).

<table>
<thead>
<tr>
<th>Dos</th>
<th>Don’ts</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Take photographs related to building infrastructure defects or works only.</td>
<td>• Do not take photographs of any object when unsure of its security classification – consult the Unit Security Officer when in doubt.</td>
</tr>
<tr>
<td>• Take photographs only when it helps or facilitates in the description of the defect or request.</td>
<td>• Do not take photographs of any weapons or weapon components.</td>
</tr>
<tr>
<td>• Always zoom in to capture only the relevant object or parts when taking photographs to ensure that other objects in the background are not captured.</td>
<td>• Do not describe the purpose or operational capability of the objects or parts involved.</td>
</tr>
<tr>
<td>• Submit photographs immediately via FM Mobile for the required approval from the Unit Security Officer.</td>
<td></td>
</tr>
</tbody>
</table>

Figure 6. SOP for photography on SAF premises
**Training and Education**

Personnel involved in the use of ITeFM are educated on the SOP during training and briefing sessions. It is reinforced via the electronic Acceptable Use Policy (e-AUP) which appears when users first log into FM Mobile (see Figure 7). A warning also pops up each time the camera is activated to remind users on the SOP for phototaking (see Figure 8).

**Punitive Measure**

Periodic audits on the vetted photographs may be carried out by security agencies. A warning will be issued for first-time violations and prosecution under the Official Secrets Act may be made for repeat offenders. Demerit points and fines may also be imposed on FM contractors.

** Detective Measure (Photo Vetting)**

Photographs taken by FM Mobile are transmitted to the FM Portal for vetting before they can be viewed by other users. However, they will not reside in the portal permanently as they will be deleted automatically if they remain unvetted for a predefined number of days. Vetted photographs will be moved to an offline archival site automatically after the work request is completed.

A concern that emerged was that vetting by a single group of personnel would not be efficient given the large amount of transactions and data generated by FM operations. To reduce veters’ workload, photographs would be routed to the correct approving authority depending on the context and identity of the photographer (see Figure 9). Taking a step further, photographs taken by SAF and DSTA personnel are exempted from vetting. The rationale was that this group of users are permanent staff who have been entrusted with sensitive knowledge in their daily work and can be trusted to be familiar with the SOP.

**NEW FM SERVICE DELIVERY MODEL**

The adoption of IT is an important shift towards the new operational concept of using photographs, time stamps and location tags to support objective evidences of work. This would strengthen governance and enhance efficiency without the need for another layer of checks and certification for most direct cases of work. Coupled with further consolidation of other maintenance management services, the new FM service delivery is poised to be holistic, cost-effective, agile and responsive to meet the evolving demands of FM operations (see Figure 10).

**CONCLUSION**

With FM operations growing fast, continuing with the traditional manual operations is no longer sustainable and effective. By leveraging enterprise IT and consumer IT for ITeFM, as well as IoT and big data for the FMCC, DSTA seeks to transform the way FM is undertaken. This is a small step towards Singapore’s vision of being a Smart Nation, but a giant leap towards FM that is empowered by IT and innovation.
### Figure 9. Photo vetting matrix for the Singapore Army and the Republic of Singapore Navy

<table>
<thead>
<tr>
<th>Scenario</th>
<th>During</th>
<th>Expected Volume: (relative)</th>
<th>Photo Taken by:</th>
<th>Photo Vetted by:</th>
<th>Remarks</th>
</tr>
</thead>
<tbody>
<tr>
<td>Preventive Maintenance</td>
<td>To capture evidence of work</td>
<td>High</td>
<td>IBC</td>
<td>DSTA FM</td>
<td></td>
</tr>
<tr>
<td>Corrective Maintenance</td>
<td>Fault/defects discovered during PMWS and beyond Cost Cap</td>
<td>Low</td>
<td>IBC</td>
<td>DSTA FM</td>
<td></td>
</tr>
<tr>
<td>Corrective Maintenance</td>
<td>Submission of FM Job Request</td>
<td>Medium</td>
<td>SAF Users (e.g. CCO, Building ICs, S4)</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Corrective Maintenance</td>
<td>COC for Minor Works ($&lt;7k)</td>
<td>Medium</td>
<td>FMA/IBC</td>
<td>SAF Users</td>
<td>Part of acceptance</td>
</tr>
<tr>
<td>Corrective Maintenance</td>
<td>COC for Major Works ($&gt;7k)</td>
<td>Low</td>
<td>FMA/IBC</td>
<td>DSTA FM</td>
<td></td>
</tr>
<tr>
<td>Routine Inspections</td>
<td>Land Building Inspection</td>
<td>Medium</td>
<td>DSTA FM</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Routine Inspections</td>
<td>Quarterly Camp Inspection</td>
<td>Medium</td>
<td>FMA</td>
<td>SAF Users (CCO)</td>
<td>Part of acceptance</td>
</tr>
<tr>
<td>Routine Inspections</td>
<td>Self-inspected by SAF Units</td>
<td>Low</td>
<td>SAF Users</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Defects Reporting</td>
<td>Ah-hoc discovery of faults/defects</td>
<td>Low</td>
<td>SAF Users</td>
<td>NA</td>
<td></td>
</tr>
<tr>
<td>Defects Reporting</td>
<td>Ah-hoc discovery of faults/defects</td>
<td>Low</td>
<td>FMA</td>
<td>SAF Users (CCO)</td>
<td>New</td>
</tr>
</tbody>
</table>

---

### Figure 10. New FM service delivery model

**Today**
- **DSTA FM**
  - Contract Management
  - Supervision
- **FMA**
  - Contract Management

**Enablement**
- Operational Workflow Streamlining
- Business Transformation
- IT-Enablement

**End-Goals**
- New FM Contract
- **DSTA FM**
- Revised & Re-consolidated Maintenance Services & Maintenance Functions

**Facilities Maintenance and Upkeep**

IT facilitates visibility and control that will reduce the current need for extensive on-site supervision and certification of work.
ACKNOWLEDGEMENTS

The authors would like to thank subject matter experts from MINDEF and the SAF, as well as colleagues from DSTA for their support in realising the ITeFM project. The authors would also like to express their appreciation to Mr Eugene Chang and Mr Lek Jiunn Feng for their leadership and contributions to the project.

ENDNOTES

1 DSTA’s FM team comprises more than 100 staff distributed over three regional offices at Gombak, Keat Hong Camp and Paya Lebar Air Base.

2 DSTA’s BI Programme Centre provides a wide spectrum of service delivery for MINDEF and the SAF, ranging from cleaning and grass-cutting services to the maintenance of complex monitoring and evaluation systems.

3 Today, DSTA and the SAF works with three FMAs and six IBCs. MINDEF and SAF facilities (including camps, bases and training areas) are grouped into 26 clusters. Each cluster has a FMA and IBC assigned.

4 A free mobile app for the public to provide feedback on municipal issues through a common platform. The app will route each feedback to the relevant agency automatically so that more timely service and response can be provided.

5 Red Zones are areas where classified information and equipment are processed and managed. As such, camera-equipped devices are not allowed in these zones.

BIOGRAPHY

CHEN Cien Sheng Gordan is a Manager (Building and Infrastructure) who is currently overseeing the transformation of facilities management (FM) with IT. He is experienced in the implementation of enterprise resource planning system, project portfolio management system, maintenance management systems and mobility solutions. Gordan graduated with a Bachelor of Engineering (Computer Engineering) degree from Nanyang Technological University (NTU) in 2005.

SEAH Lye Kang is an Assistant Director (Building and Infrastructure) for FM and is the Operations Manager for the IT-enabled Facilities Management (ITeFM) project. He has more than 20 years of experience in project management, defence procurement, FM and systems management. Lye Kang graduated with a Bachelor of Engineering (Electrical Engineering) degree with First Class Honours from NTU in 1996. He further obtained a Master of Science (Power Engineering) degree with Distinction from the University of Manchester Institute of Science and Technology, UK, in 2000.

SIA Kok Huat is a Programme Manager (Enterprise IT) leading the implementation of mobile applications and web portals for the ITeFM project. He has implemented various IT systems across business domains such as ammunition, supply, maintenance, finance and National Service management. He is a certified Project Management Professional and Certified IT Project Manager (CITPM) certified by Singapore Computer Society. Kok Huat graduated with a Bachelor of Science (Computer Science and Information Systems) degree with Honours from the National University of Singapore in 1996.