HEALTHCARE ENVIRONMENTAL SERVICES AUTOMATION SOICETY

HESAS

Draft

ESM Maintenance Management

December 2020

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HESAS EMS Standards Document

Published by HESAS and ReXcels Press

Boston, MA, USA.

Initial draft publication, June 2014.

Final draft publication, December 2020.

Message from the chairman

It is vividly evident that the world witnessed the worst public health and economic crisis due to COVID-19 pandemic. This inevitably mobilized the international community to act seriously and swiftly. However, the mortalities and morbidities induced by healthcare-acquired infections (HAI) are equally fatal, but the international community did not act similarly. Consequently, we are continuously and chronically suffering from HAI.

The current intervention for HAI is merely based on passively-set standards and enforcing these standards via regulatory agencies such as the centre for disease control and prevention (CDC), joint commission international (JCI), ministries of health, and other regulatory agencies. To efficiently address HAI, we inevitably need to mobilize the international community because HAI traverses a multitude of epistemological dimensions, requiring multidisciplinary tacit knowledge, and mandates active international collaboration. Besides, we believe that we can efficiently traverse deeply into the root-causes and solution landscapes by automating the entire healthcare environmental services and infection control within healthcare institutions using the latest advancements in computational epistemology, computational infection control models, computational epidemiological models, artificial intelligence, machine learning, distributed ledger technology, collective intelligence, cognitive technologies, internet of things, ubiquitous technologies, intelligent micro-measurement frameworks, artificial life, evidence-based program implementation, patient-centric care, strategy anchored execution, and symbiotic healthcare ecosystem services. Consequently, we developed these open standards that were tailored from diverse international standards to promote the automation of healthcare environmental services and infection control processes and best practices.

The Healthcare Environmental Services Operational Map (HESOM) and other standards were developed to efficiently leverage multidisciplinary experts and practitioners to contribute towards the eradication of HAI-induced mortalities and morbidities. Using ReXcels research and innovation environment, we cultivate collective intelligence by bringing together these multidisciplinary experts to iteratively develop these standards and adaptively support the innovation of computational technology that automates the execution and enforcement of these standards. As such, we cordially invite you to use these documents and participate actively in the further development of these standards to significantly reduce HAI-induced mortalities, morbidities, and their enormous negative economic externalities.

Hamid Adem

Interim Chairman, and Chief R&D Officer

Change Control

Version	Date	Changes

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ESM Maintenance Management

Purpose

1 Purpose

1. PURPOSE

The purpose of this document is to establish a Maintenance Management process for Environmental Services department such that all aspects of Maintenance Management, are properly manage, furthermore to ensure that:

- MAINTENANCE COST IS MINIMIZED
- ASSET PERFORMANCE IS MAXIMIZED
- RISK OF FAILURE IS MINIMIZED.

This process would be based on international well acclaimed standards like:

- *NHS- National Health Services Standard*
- *OSHA- Occupational Safety and Health Administration standard*
- *CDC- Centers for Disease Control and Prevention standard*
- *Lean six sigma- Quality Standard*
- *JCI- Journal of Clinical Investigation standard*
- *JCAHO- Joint Commission on Accreditation of Healthcare Organizations (JCAHO)*
- *EPA- US Environmental Protection Agency*
- *HCAHPS - Hospital Consumer Assessment of Healthcare Providers and Systems*
- *HIPA- Health Information Privacy Act standard.*

*P.S: This process is a derivation from **ESM (Environmental Service Map),** which is a holistic and a comprehensive model for Environmental Services Management.*

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ESM Maintenance Management

Structure of the Document

2 Structure of the Document

2. STRUCTURE OF THE DOCUMENT

The Maintenance Management process document comprises the following chapters:

Chapter–3: *Scope*: This chapter describes the scope of the document and the Maintenance Management process.

Chapter–4: *General Assumptions*: This chapter describes the underlined assumptions made for both the document and Maintenance Management process.

Chapter–5: *Maintenance Management Framework*: This chapter exhibits the interaction of Maintenance Management process with other related processes and also describes the high level process sequence for Maintenance Management based on EMS framework.

Chapter–6: *Maintenance Management Process*: In this chapter Maintenance Management process and sub processes (if any) will be depicted and specified using rigorous BPMN and process specification templates.

Chapter–7: *References*: This chapter serves as a prime reference to Maintenance Management process and presents the details supporting it in tabular formats. The chapter describes relevant Business Rules, Risks, Quality Attributes, Data Quality Dimensions, Operation Policies, KPIs, CTQs, Abstract Time-scales and SLAs terms specific to Maintenance Management process.

The Maintenance Management process is supposed to be a living document and consists of various variable values which would frequently evolve or change as Maintenance Management process matures or changes

3 ESM Maintenance Management

Scope

3 Scope

3. SCOPE

This process is applicable to environmental services department's utilities, structures, protection systems and environmental control systems.

4 ESM Maintenance Management

General Assumptions

4 General Assumptions

4. GENERAL ASSUMPTIONS

The following are the general assumptions made:

- Physical resources are readily available to this process.
- Vendor and supplier support is readily available to this process.
- Senior management is committed to this process.
- This process used automated tools for its smooth operation.
- The roles defined in this document can be attached to the existing position
- Any process or sub process related assumptions are explicitly identified in related Process Specification table in Chapter 6.

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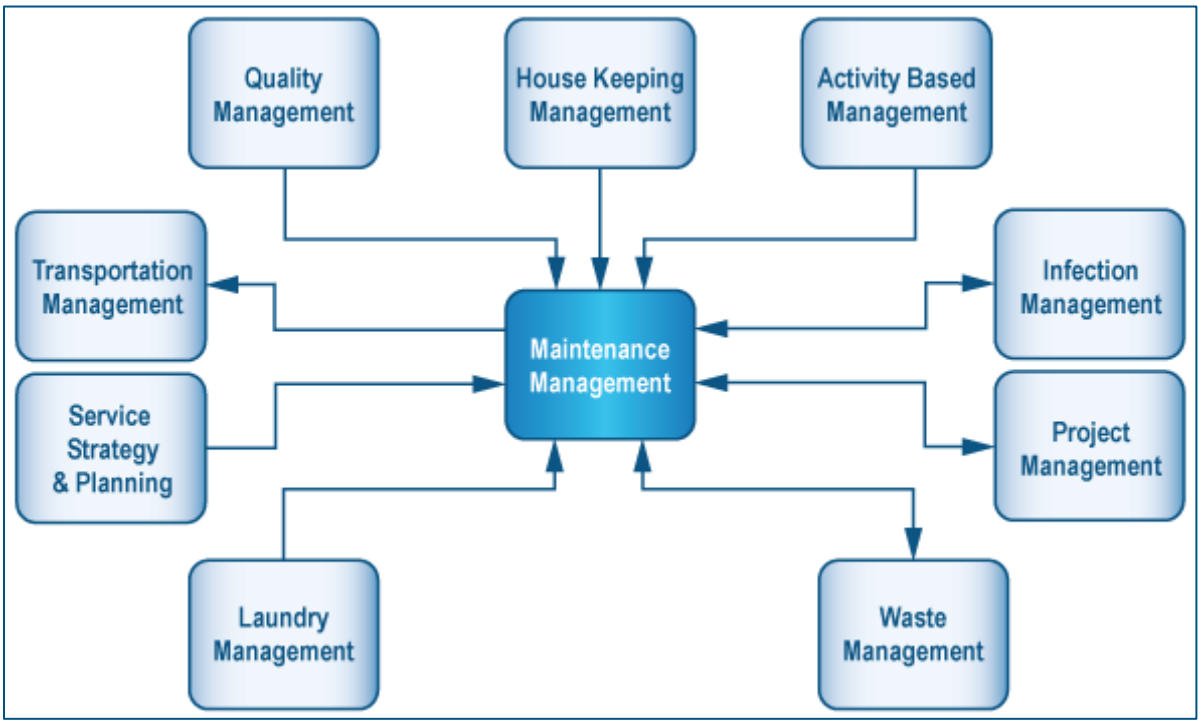
ESM Maintenance Management

Maintenance Management Framework

5 Maintenance Management Framework

5.1 Maintenance Management Interactions

The following depiction shows the points of interaction of Maintenance Management process with other related EMS processes. The arrows moving into Maintenance Management process signify the inputs from the other process to Maintenance Management process, and the arrows moving out of the Maintenance Management process signify the inputs from Maintenance Management process to other related EMS processes. All these processes depicted below are defined in their own respective dedicated documents.



5.2 Maintenance Management Process Sequence

The Maintenance Management process comprises of following high level sequence of activities:

1. **Establish Maintenance Management**
2. **Understanding RAM needs and constraints**
3. **RAM Design**

4. **Establish reliability & maintainability Systems**
5. **Establish Reliability Centric Maintenance Program**
6. **Establish MSD prevention program**
7. **Perform Maintenance**
8. **Monitor operational performance**

Section 5.2.1 -5.2.8 describes the high level process sequence for Maintenance Management process based on EMS framework. **Section 6.1** Process Model sheds more light on the flow of Maintenance Management process.

5.2.1 Establish Maintenance Management

This involves establishing:

- Establishing Maintenance Management policy
- Establishing Maintenance Management Goal and Objectives
- Establishing Maintenance Management team
- Establishing Maintenance Management roles and responsibilities
- Establishing Maintenance Budget.
- Establishing Performance measures.
- Identification of Legal/ Compliance requirements
- Training and awareness plan
- Resource Plan
- List of Contacts of maintenance suppliers and vendors

5.2.2 Understanding RAM needs and constraints

This involves thorough understanding of the current needs and expectation of the users. This involves following:

- **Determination of RAM goals.** This involves identification of RAM performance goals in terms of projected level of reliability, availability and maintainability.
- **Establish Metrics.** This involves establishing metrics such as:
  - **Reliability Metrics.**
    - **Failure rate.** The total expended number of failures within an item population, divided by the total time by that population, during a particular measurement interval under stated conditions
    - **Hazard rate.** Instantaneous failure rate. At any point in the life of an item, the incremental change in the number of failures per associated incremental change in time

    - **Mean time between Maintenance.** Average time between all system maintenance actions.
    - **Mean time between repairs.** The average time between all system maintenance actions requiring removal and replacement.
  - **Availability Metrics.**
    - **Inherent Availability.** Also known as mean time between failures. The average time during which all parts of the item perform within their specified limits, during a particular measurement period.
    - **Operational Availability.** Uptime divided by the total time.
  - **Maintainability Metrics.**
    - **Mean time to repair.** Average of the maintenance cycle times for the individual actions.
    - **Mean preventive maintenance.** value of maintenance downtime below which one can expect a specified percent of all corrective maintenance actions to be completed
    - **Mean time to restore system.** The mean or average time needed to restore a system
    - **Mean Downtime.** The mean or average time that a system is not operational due to repair or preventive maintenance
- **Identification of current RAM performance.** This involves identification of current RAM levels and its shortcomings.
- **Identification of requirements .**This involves establishing requirements to meet the RAM targets. This comprises of:
  - Logistics requirements
  - Technical Requirements.
  - Man Power requirements.
  - Financial Requirements.
- **Constraints identification.** This involves identification of various constraints for example budget, logistics footprint.
- **Establish Final requirement.** Translation of RAM terms into Requirement document.

5.2.3 RAM Design

This comprises of following**:**

- **Establish RAM Design Considerations.** This involves establishing RAM design considerations that would improve RAM performance**.** This comprises of following:
  - Simple design
  - Fault tolerance

- Elimination of failure modes
- Fail safe
- Redundancy

- **Perform RAM Design Review** This involves performing formal reviews for RAM. The reviews should be part of each system design activity in system development (or acquisition) process. Based on the type of system (in house) or acquisition following is undertaken:
  - **Establish Closed Lop design reviews process.** This involves using closed loop system for in house development to identify each design defect and rectify it immediately.
  - **Proper evaluation of COTS Equipment.** This involves evaluating thoroughly commercial off the shelf (COTS) software design to ensure that it can meet the RAM requirements accordingly. Factors to consider are as:
    - **Long term support**
    - **Warranty**
    - **Integrated diagnostics**
- **Perform Review**. This involves performing:
  - **System Functional Review**. SFR determines whether RAM functional performance requirements are fully defined and consistent with the performance specification.
  - **Preliminary Design review**. PDR assesses whether the preliminary RAM design will satisfy end user and maintainer requirements.
  - **Critical Design Review**. CDR assesses whether the final RAM design will satisfy user requirements
  - **Test Readiness Review**. TRR assesses the ability of tests to confirm RAM requirements
- **Ensure Mature Maintainability.** This involves ensuring that the systems and processes have been designed in a way to reduce maintenance time and increase system availability. This can be achieved by following Analysis:
  - Reliability Testing
  - Environmental Stress Screening
  - Maintainability fault insertion testing.
- **Manage failure Mode Mitigation process.** This involves managing the failure mode so that they are resolved as early as possible in design mode. following methodologies can be implemented:
  - **DCACAS.** Data Collection, Analysis, and corrective Action System (DCACAS) provides a good closed-loop system of data collection, analysis and dissemination to identify and correct failures of a product or process.

- **FMEA.** Identifies potential failure modes and their impact on the system as well as providing candidate failure modes for mitigation via corrective actions**.**
- **Fault tree Analysis.** Fault tree analysis (FTA) is a systematic, deductive methodology for defining a single specific undesirable event and determining all possible reasons (failures) that could cause the event to occur.
- **Ishikawa Diagram.** The Ishikawa Diagram, also called the cause-and-effect diagram or fish bone chart, relates causes to effects. It can be used to hypothesize the factors that resulted in an unwanted condition, such as defects in a product, or to identify factors essential for a desired result.

- **Managing trade off.** Operational performance is always at risk when RAM are traded off for cost or schedule. A risk assessment should be always carried out before making as such tradeoffs.
- **Establishing Modes of Maintenance.** This process comprises of following:
  - **Preventive Maintenance**. This involves performing pre-planned regular maintenance to ensure that the site infrastructure and utilities always remain operation and free from any breakdown. This also takes into consideration compliance related maintenance.
  - **Reactive Maintenance**. This refers to the maintenance activities which are associated with the repair and servicing of site infrastructure and utilities and which have become inoperable or unusable because of the failure of component parts.
  - **Emergency Maintenance**. Maintenance with regards to Maintenance staff responds to unexpected equipment breakdowns, building component failures, accidental or deliberate (vandalism) damage.

5.2.4 Establish reliability & maintainability Systems

The main aim of this phase is process control, quality assurance, and environmental stress screening.

- **Testing**. This involves performing thorough system tests like :
  - Reliability Assurance testing.
  - Continued Reliability Quality Testing
  - Reliability Growth testing Analysis
- **Technical Reviews**. Following technical reviews are undertaken:
  - System Verification Review. This comprises of assessing the final product to determine if it meets the functional requirements including RAM.
  - Production Readiness Review. This review ensures that designed in RAM levels are not degraded.
  - Operation Test Readiness Review. The operation test readiness review assesses the ability of operational tests to confirm RAM requirements.

- **Quality Assurance**. This process ensures to prevent degradation of reliability, availability and maintainability designed into the system. This ensures that all the parts of the system conform to ISO standard baseline.
- **Initial Operational Capability**. This involves ensuring that RAM related problems are addressed at this level. The problems like maintenance training, unanticipated failures.

5.2.5 Establish Reliability Centric Maintenance Program

This involves performing various failure analysis techniques to identify various failure causes or modes and identify failure effect. This provides opportunity to predict, prevent or detect failure and thus to minimize the failure consequence.

5.2.6 Establish MSD prevention program

MSD is a term for injuries and disorders that affect our musculoskeletal system (i.e. muscles, tendons, ligaments, nerves, discs, and blood vessels). Work-related MSDs are caused or aggravated by various hazards present in the workplace. Few examples of MSD are as follows:

- Sprains and strains of muscles, ligaments and tendons (eg shoulder muscle strain leading to rotator cuff tear)
- Back injuries, including damage to the muscles, tendons, ligaments, spinal discs (eg ruptured discs), nerves (eg sciatica), joints and bones
- Joint injuries or degeneration, including injuries to the shoulder, elbow, wrist, hip, knee, ankle, hands and feet
- Bone injuries (eg fractures)
- Nerve injuries (eg carpal tunnel syndrome of the wrist)
- Soft tissue hernias (eg abdominal hernias)
- Muscular and vascular disorders as a result of hand-arm vibration (HAV)

This comprises of following phases:

5.2.6.1 Establishing Strategic foundation

This comprise of following:

- **Set objectives.** This involves establishing broad objectives depending on the needs of organization. Objectives could relate to legislative compliance, reducing the costs, MSD incidents, improving productivity, operational efficiency or a combination of these and other factors.
- **Clear Commitment**: All levels of management need to clearly communicate that they are committed to preventing MSDs in the workplace.
- **Resources availability**: Supervisors and workers should know that real efforts are being made to reduce exposures to MSD hazards and that resources will be allocated to make any necessary changes.

5.2.6.2 Categorizing hazards

Typically the MSD hazard can be classified as following:

- **Force**
  When a task requires them to exert a level of force that is too high for any particular muscle, it can damage the muscle or the related tendons, joints and other soft tissue.
  This damage can occur from a single movement or action that requires the muscles to generate a very high level of force. However, more commonly, the damage results when muscles generate moderate to high levels of force repeatedly, for a long duration, and/or while the body is in an awkward posture. Some job tasks result in high force loads on different parts of the body. For example, lifting a heavy load that is far from the body increases the load on the lower back. This can potentially damage both the spinal discs and the vertebrae.
- **Fixed or Awkward Postures**
  The farther a joint moves towards either end of its range of motion, or the farther away from the neutral posture, the more awkward or poor the posture becomes and the more strain is put on the muscles, tendons and ligaments around the joint. For example, when arms are fully stretched out, the elbow and shoulder joints are at the end of their range of motion. If the worker pulls or lifts repeatedly in this position, there is a higher risk of injury.
- **Repetition**
  The risk of developing an MSD increases when the same parts of the body are used repeatedly, with few breaks or chances to rest. Highly repetitive tasks can lead to fatigue, tissue damage, and, eventually, pain and discomfort. This can occur even if the level of force is low and the work postures are not very awkward.

- **Other MSD Hazards and Workplace Factors**
  Other MSD hazards and workplace factors that should be considered include:
  - Contact stress
  - local or hand-arm vibration
  - Whole-body vibration
  - Cold temperatures
  - hot work environments
  - Repeated impacts
  - Work organization, and work methods

5.2.6.3 Performing Initial MSD assessment

This comprises of following:

- **Checklist.** Checking the current status of MSD prevention awareness and implementation in the maintenance management worker. This comprises of performing assessment via a set of question "initial assessment checklist". This idea behind this step is to see if there are missing basic elements and furthermore, to help identify opportunities to strengthen existing program.
  Appendix C provides a sample checklist.
- **Reviewing records.** This comprises of reviewing accident and injury record and performing verbal discussions with maintenance management workers, supervisors and managers. Common sources of such information include:
  - Injury records and trends
  - Incident and hazard reports
  - Issues raised by Check Inspectors, OHS committee members, deputies, employees, permanent and intermittent contractors

5.2.6.4 Conduct detailed MSD assessment

Based on the initial MSD assessment results, MSD detailed assessment might be conducted to identify MSD hazards. This comprises of following utilizing a general MSD hazard identification tool to identify which hazards are present, and take input from the maintenance management workers and staff with regards to the daily hazards that they encounter while performing their routine maintenance management job.

Appendix D provides a tool for General MSD hazard identification.

5.2.6.5 Establishing Priority

The next step is to prioritize their hazard identification findings to help determine the priority level for further action. This step can help workplaces determine which findings are of extremely high priority to address and which may require no further action except to continually monitor for any changes in status.

Appendix E shows a table for prioritizing hazard findings

5.2.6.6 MSD Hazard Root Cause

This involves using a fish bone structure for determining root cause of the hazards. This method can be useful in helping identify where something may be going wrong, or be improved. Such a diagram is typically the outcome of a brainstorming session where problem solvers can offer suggestions. The main goal is represented by the trunk of the diagram, and primary factors are represented as branches. Secondary factors are then added as stems, and so on. Creating the diagram stimulates discussion and often leads to increased understanding of a complex problem.

Causes are usually grouped into major categories to identify the sources of problem. The categories typically include:

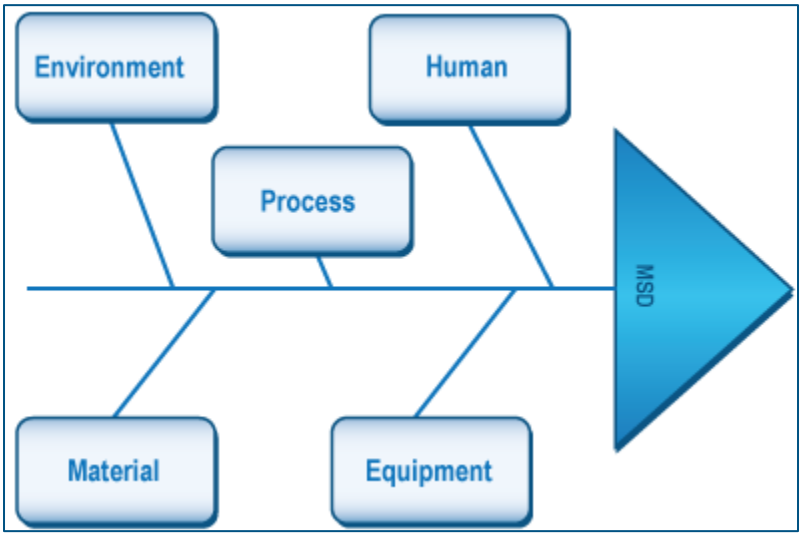
- **Human**: Anyone involved with the process
- **Process**: How the process is performed and the specific requirements for doing it, such as policies, procedures, rules, regulations and laws.
- **Equipment**: Any equipment, computers, tools etc. required to accomplish the job
- **Materials**: Raw materials, parts, pens, paper, etc. used to produce the final product
- **Environment**: The conditions, such as location, time, temperature, and culture in which the process operates.

Following points can be considered in each of the category:

- **Process**
  - Length of time allotted to tasks e.g., routine maintenance of air conditioning.
  - Machine paced tasks. E.g. cleaning of water tanks.
  - Duration of task e.g. time taken to fix electric wires
  - Variety of tasks
  - Production/quality standards
  - Communication between staff within the department
- **Equipment**
  - Working height e.g., how tall is the electric board.

- Location of controls and/or displays
- Operation of the controls e.g the machine controls are easy to operated
- Mobility of washing machine
- Location of the maintenance management units
- Association with other equipment
- Insufficient adjustability
- Maintenance requirements of the machines

- **Materials**
  - Packaging
  - Weight and dimensions of maintenance tools
  - Storage location
  - Quality
- **Environment**
  - Working space
  - Overcrowding
  - Temperature of the maintenance operation unit
  - Flooring
  - Housekeeping
- **Human**
  - Insufficient training on techniques/processes
  - Insufficient supervision /coaching
  - Production pressures and demands
  - Inappropriate response to reports of MSD related concerns
  - Differences in work methods/techniques
  - Inconsistent use of equipment/controls that help reduce MSD risk.



This comprises of following steps:

Step 1: Write down the specific MSD hazard you are concerned about to help focus the group.
Step 2: Ask why the MSD hazard exists – and identify the category on the worksheet
Step 3: For each answer, ask why again, and continue to do this until the group reaches consensus that the root cause has been identified.

5.2.6.7 Choose and implement MSD hazard controls

This phase comprises of choosing the hazard controls based on the brainstorming. Following are some solutions which can be undertaken for each category:

- **Process**: Following solution can be used to address process categories:
  - Job enlargement and/or task rotation between workers
  - Improve communication between workers performing task
  - Self-paced tasks, time allows for micro-breaks in between
  - Improved work/material flow by process redesigning

- Improve communication between departments
- Timely response to reported defects, equipment breakdown, product/tool/equipment damage
- Adequate staffing resources to handle workloads

- **Materials**: Following solution can be used to address materials categories:
  - Items weight should be taken into consideration for the organization of stock on shelves
  - Reduce use of sub-standard and poor quality materials
  - Lifting weight in manageable weights
  - Purchase materials in bulk containers
  - Redesign packaging to include handles and ease of lifting
  - Store materials in areas that are easy to access
- **Equipment**: Following solution can be used to address equipment categories:
  - Provide mechanical lifts, hoists, conveyors, motorized carts
  - Improved workstation design to facilitate its operation
  - Chair adjustability (sit/stand, height adjustable)
  - Perform preventative maintenance
  - Perform regular inspections
  - Provide space for workers to move
  - Allow unconstrained postures
  - Provide material handling equipment for moving materials
- **Environment**: Following solution can be used to address environment categories:
  - redesign layout to provide space for movement and required job tasks
  - improve housekeeping
  - Comfortable working temperature using coolers, air conditioning and warmers.
  - provide anti-fatigue matting
- **Human**: Following solution can be used to address Human categories:
  - Training maintenance management staff on :
    - Signs & symptoms of MSD
    - MSD hazard awareness
    - How to report msds/MSD hazards
    - Work techniques and processes to avoid MSD
  - Reinforce need for use of equipment/controls that help reduce MSD risk
  - Improved communication from supervisors

- Support for early reporting of concerns
- Personal protective equipment (in-soles, knee pads, anti-vibration gloves)
- Production pressures and demands

Appendix F provides tips that can be considered to remove various categories of MSD.

5.2.6.8 Follow up and evaluate success of MSD prevention program

This comprises of verifying whether the MSD hazards have been reduced or not. This comprises of:

- **Walk through surveys**. Making surveys and enquiring of the workers as to verify that the control is working (less pain, working as expected, no other hazards introduced)
- **Inspections**. This comprises of performing audits and inspections.
- **Record keeping**. Keep records of hazard identification, risk assessment and control processes to help meet regulatory requirements and ensure that MSD risks in performing manual task issues are being managed

Follow-up again after some time has passed to see if the control is still effective and to consider cost benefit issues.

5.2.6.9 Communicate results and acknowledge success.

This comprises of conveying the success of the program to all staff, and recognizing individual efforts undertaken to prevent MSD in the workplace

5.2.7 Perform Maintenance

This comprises of performing maintenance as per Maintenance policy to following:

- **Structural Maintenance.** This comprises of maintaining :
  - Building walls
  - Building Floors
  - Building Roofs
  - Furniture and fittings
- **Utility Maintenance.** This involves maintenance of:
  - Plumbing.
  - Electricity
  - Gas
  - Lifts and Escalators
- **Protection System Maintenance**. This involves:
  - Security Systems

- Fire suppression systems
- Water suspension systems

- **Environmental Control.** This involves:
  - Air Conditioning Systems.
  - Heating Systems.

5.2.8 Monitor operational performance.

This comprises of following:

- **Monitoring.** This comprises of :
  - **Sustaining RAM.** This involves identification of RAM problem as they emerge.
  - **Condition-Based Maintenance**. This involves defining optimal maintenance point that maximizes the expected results (in terms of increased product output, decreased maintenance costs, etc)
  - **Performing RGT.** Reliability growth testing monitors improvements in reliability while deficiencies are being identified and fixed.
  - **Repair Strategy Reviews.** Continually reviews maintenance and support concepts to ensure that repair strategy is not introducing defects into the deployed system that degrade its inherent RAM.
- **Audit Performance**

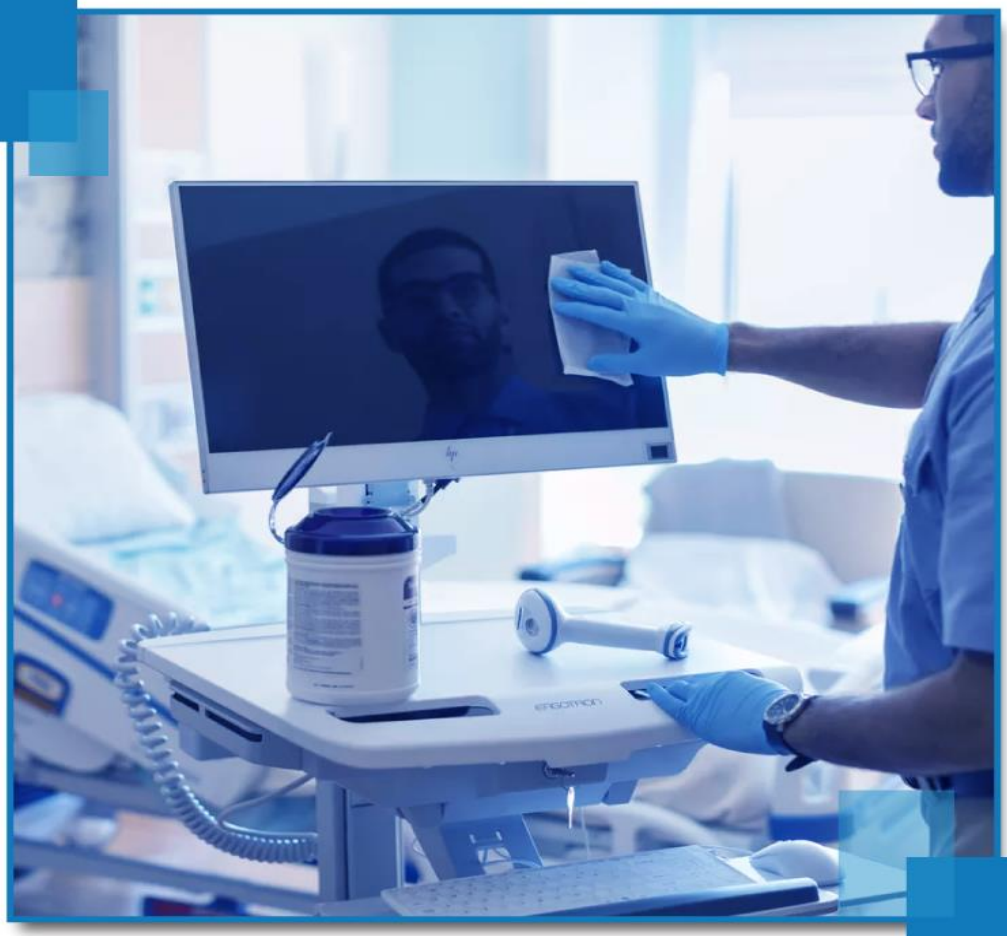
  This involves ensuring that the maintenance activities are performed as planned by performing regular audits. The audit comprises to general maintenance and also the regulatory maintenance as per Saudi government rules and regulations.

  Incase there are any deviations, the deviations are highlighted and action plan is formulated to rectify the deviation.

6

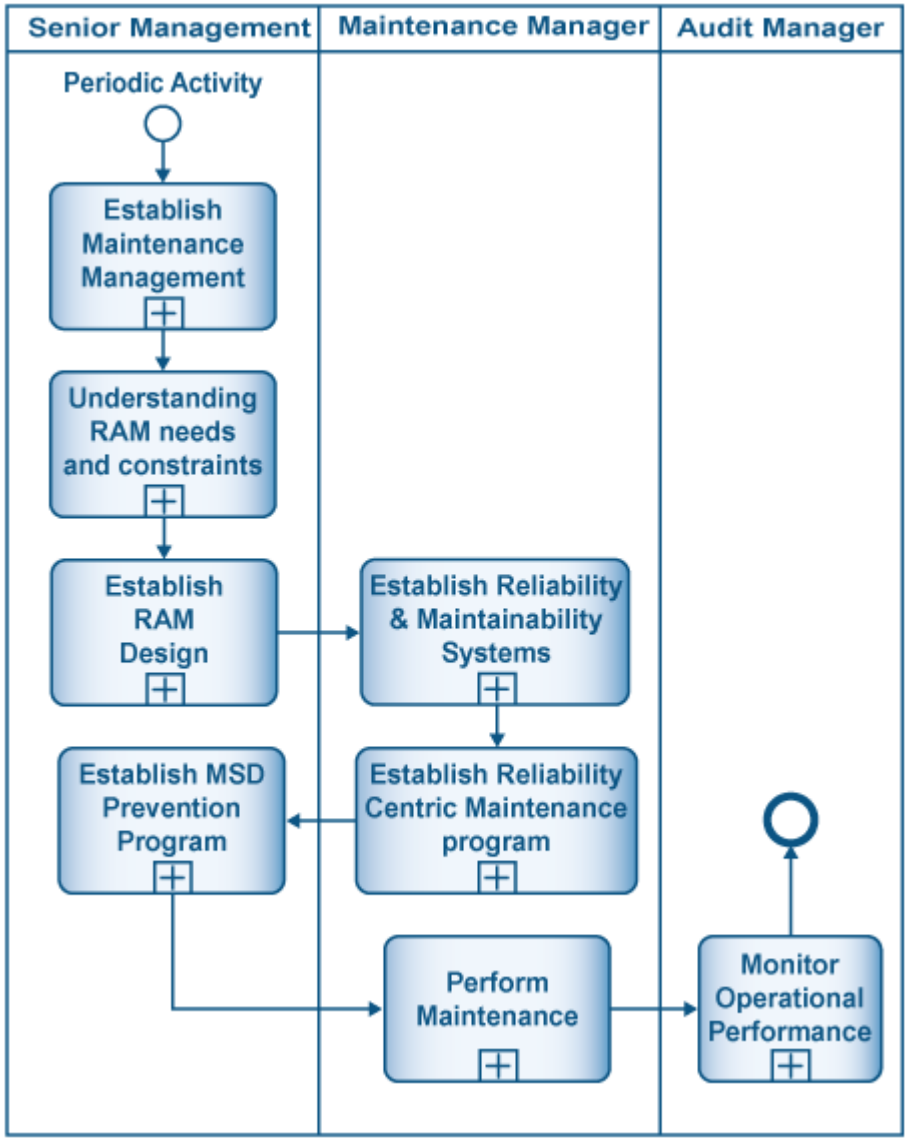
ESM Maintenance Management

Maintenance Management Process



6 Maintenance Management Process

6.1 Process Model



6 Maintenance Management Process

6.2 Process Specification

Specification	Description
Summary/Purpose	The purpose of this process is to create Maintenance Management process for environmental services department.
Scope	This is a Level 1 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Cost effective maintenance of premises.
Related Operational Policies	OP-001, OP-002, OP-003, OP-004, OP-005, OP-006, OP-007, OP-008 (Ref 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	Link 1, Link2, Link 4
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Periodic Activity</td></tr>
<tr><td>Basic Course of Event</td><td>Maintenance Management
1. Senior Management establishes Maintenance Management
2. Senior Management establishes understanding RAM needs and constraints
3. Senior Management establishes RAM design
4. Maintenance Manager establishes reliability and maintainability system
5. Maintenance manager reliability centric maintenance program
6. Senior management establishes MSD prevention program
7. Maintenance Manager performs maintenance
8. Auditor Manager monitors performance.
9. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Transportation Management, Quality Management, Waste Management, Infection Management, Activity based Management, House Keeping Management</td></tr>
</table>

6 Maintenance Management Process

Preconditions	Adequate resources are available to the process.
Post - conditions	Maintenance Management process is established.
Related Business Rules	BR-001, BR-002, BR-003, BR-004, BR-005, BR-006, BR-007, BR-008 (Ref 7.1)
Related Risks	RR-001, RR-002, RR-003, RR-004, RR-005, RR-006, RR-007, RR-008 (Ref. 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, Service reliability, confidentiality, authenticity, availability, non repudiation, testability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability, Reputation, Objectivity, Free-0f Error, Relevance, Completeness, Timeliness, Concise Representation (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	RNRR, RDRR, FCIR, MC, MCR, MCTR,MR, MDR, PRR, MRR, MHR, RCIR, MHPR (Ref 7.6)
Related CTQs	RNRRV, RDRRV, MRV, MDRV, PRRV, MRRV, MCV, MCRV, MCTRV, MOM, PWOM, CTQ, IOM, TOM, WRM, DRM, MHRV, RCIRV, MHPRV (Ref 7.7)
Actors/Agents	Senior Management, Maintenance Manager, Audit Manager.
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation

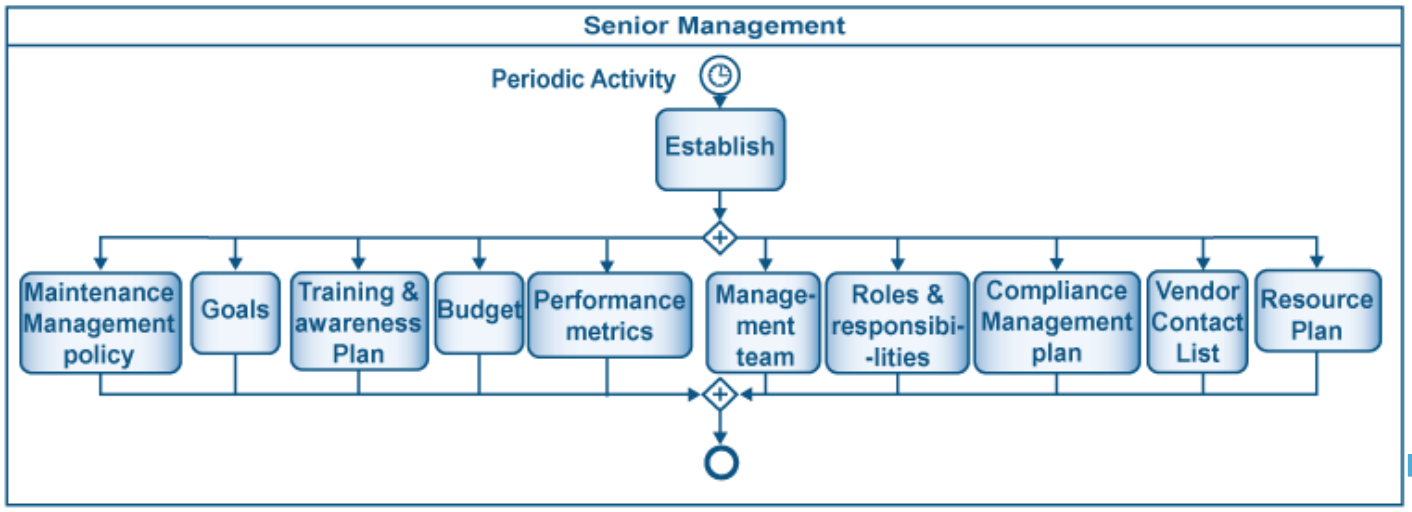
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1
Process Model	6.1
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection Appendix C: Sample Checklist Appendix D: General Hazard Identification Tool Appendix E: Hazard Priority Table Appendix F:Tips For Preventing MSD

6.3 Roles and Responsibilities

Roles	Responsibilities
Senior Management	• Senior Management establishes Maintenance Management framework • Senior Management establishes Maintenance Management • Senior management establishes MSD prevention program. • Senior Management establishes understanding RAM needs and constraints • Senior Management establishes RAM design
Maintenance Manager	• Maintenance Manager establishes reliability and maintainability system • Maintenance manager reliability centric maintenance program • Maintenance Manager performs maintenance
Audit Manager	• Auditor Manager monitors performance

6 Maintenance Management Process

6.4 Sub Process – Establish Maintenance Management



6 Maintenance Management Process

6.5 Sub Process – Establish Maintenance Management Specification

Specification	Description
Summary/Purpose	The purpose of this process is to establish Maintenance Management framework for environmental services department.
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Better and efficient management.
Related Operational Policies	OP-001 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Periodic Activity</td></tr>
<tr><td>Basic Course of Event</td><td>Maintenance Management Framework
1. Senior Management establishes Maintenance Management policy, training and awareness plan, goals and objectives, performance metrics, Maintenance Management team, roles & responsibilities, compliance management plan, vendor list.
2. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Establish Reliability Centric Maintenance program process</td></tr>
<tr><td>Preconditions</td><td>Adequate resources are available to the process.</td></tr>
<tr><td>Post - conditions</td><td>Maintenance Management policies, Team and strategies are formulated.</td></tr>
<tr><td>Related Business Rules</td><td>BR-002 (Ref 7.1)</td></tr>
</table>

6 Maintenance Management Process

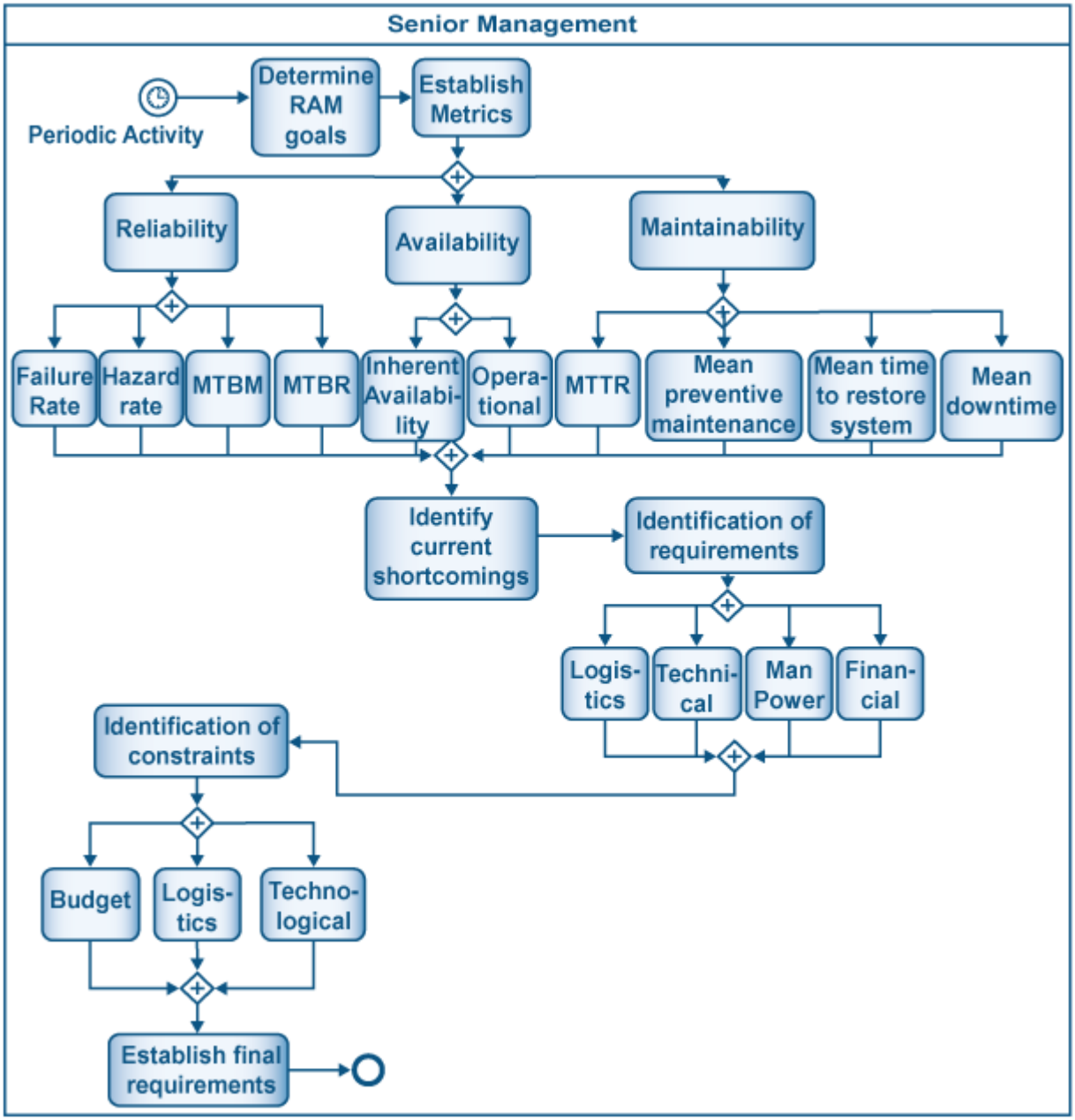
Related Risks	RR-004 (Ref 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	PRR(Ref 7.6)
Related CTQs	PRRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1
Process Model	6.4
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6 Maintenance Management Process

6.6 Sub Process – Establish Maintenance Management Roles and Responsibilities

Roles	Responsibilities
Senior Management	• Senior Management establishes Maintenance Management policy, training and awareness plan, goals and objectives, performance metrics, Maintenance Management team, roles & responsibilities, vendor list and compliance management plan.

6.7 Sub Process – Understanding RAM needs and Constraints



6.8 Sub Process – Understanding RAM needs and Constraints Specification

Specification	Description
Summary/Purpose	The purpose of this process is to ensure that RAM needs and constraints are well understood for environmental services.
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Better requirement understanding.
Related Operational Policies	OP-004 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None

6 Maintenance Management Process

<table>
<tr><td>Raw Materials</td><td>None</td></tr>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Establish Maintenance Management</td></tr>
<tr><td>Basic Course of Event</td><td>Understanding RAM needs and constraints
1. Senior Management determines RAM goals
2. Senior Management establishes Metrics for availability (inherent availability, operational Availability), reliability (failure rate, hazard rate, MTBM, MTBR) and maintainability (MTTR, mean preventive maintenance, mean time to restore system, mean downtime)
3. Senior Management identifies current shortcomings
4. Senior Management identifies requirements (logistics, technical, man power, financial)
5. Senior Management performs identification of the constraints (budget, logistics, technological)
6. Senior Management establishes final requirements.
7. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.</td></tr>
</table>

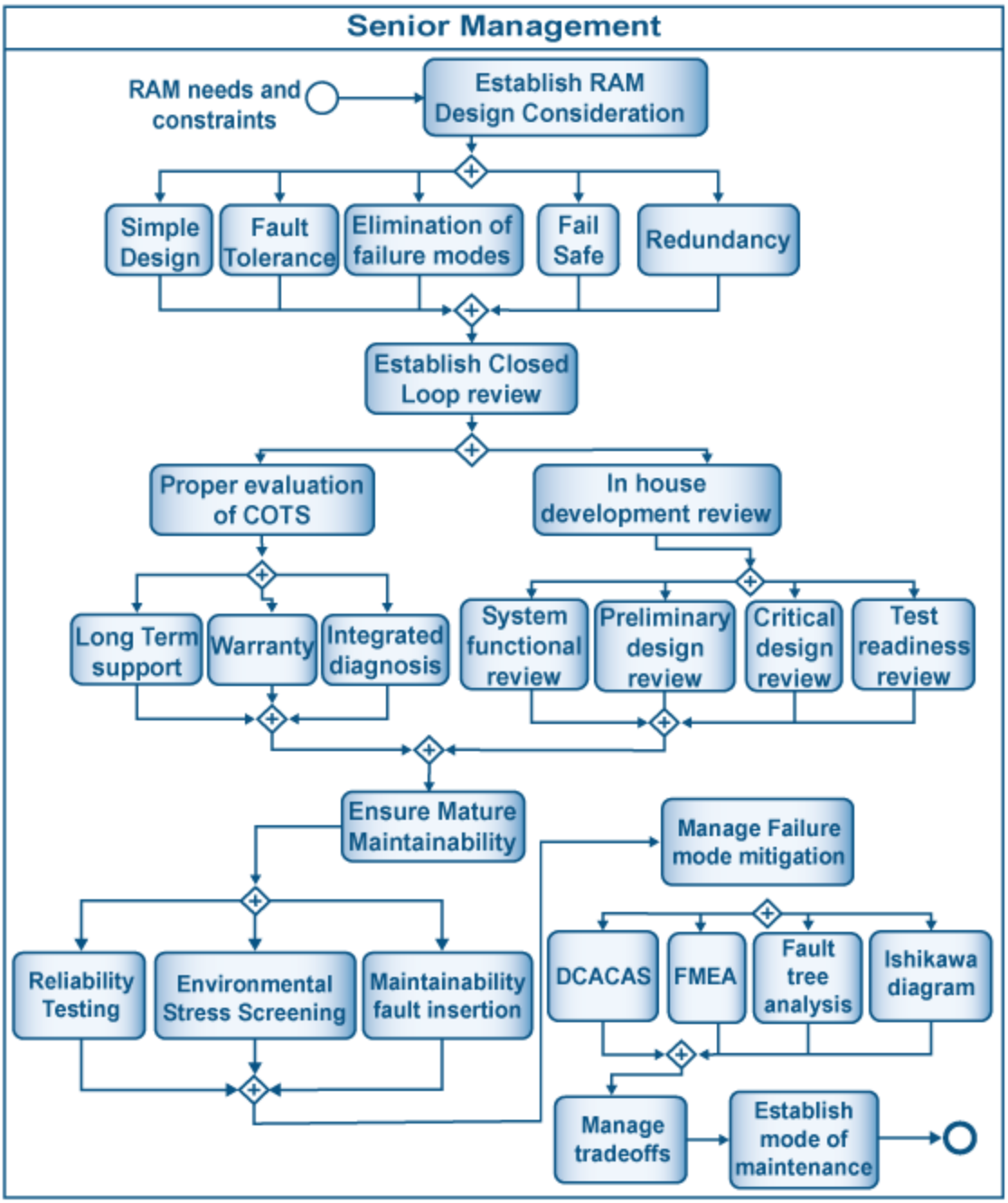
	3. End.
Extension points	Establish RAM design process
Preconditions	Adequate resources are available to the process.
Post -conditions	Maintenance Management need and constraints are formulated.
Related Business Rules	BR-005 (Ref 7.1)
Related Risks	RR-006 (Ref 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, Timeliness, Understandability, interpretability (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	RNRR(Ref 7.6)
Related CTQs	RNRRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head.

	2. Log Escalation
Process Map	5.1
Process Model	6.7
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.9 Sub Process – Understanding RAM needs and Constraints Roles and Responsibilities

Roles	Responsibilities
Senior Management	• Senior Management determines RAM goals • Senior Management establishes Metrics for availability (inherent availability, operational Availability), reliability (failure rate, hazard rate, MTBM, MTBR) and maintainability (MTTR, mean preventive maintenance, mean time to restore system, mean downtime) • Senior Management identifies current shortcomings • Senior Management identifies requirements (logistics, technical, man power, financial) • Senior Management performs identification of the constraints (budget, logistics, technological) • Senior Management establishes final requirements.

6.10 Sub Process – Establish RAM Design Management



6.11 Sub Process – Establish RAM Design Specification

Specification	Description
Summary/Purpose	The purpose of this process is to establish RAM design
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Better and efficient maintainability management.
Related Operational Policies	OP-005 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• RAM needs and constraints</td></tr>
<tr><td>Basic Course of Event</td><td>RAM Design
1. Senior Management establishes RAM design consideration (simple design, fault tolerance, elimination of failure modes, fail safe, redundancy)
2. Senior Manager establishes closed loop reviews for COTS (long term support, warranty, integrated diagnosis) and in house development review (system functional review, preliminary design review, critical design review, test readiness review)
3. Senior Management ensures mature maintainability (reliability testing, environmental stress screening, maintainability fault insertion)
4. Senior Management performs failure mode mitigation (DCACAS, FMEA, fault tree analysis, ishikawa diagrams)
5. Senior Management manages trade offs
6. Senior management establishes mode of maintenance.
7. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.</td></tr>
</table>

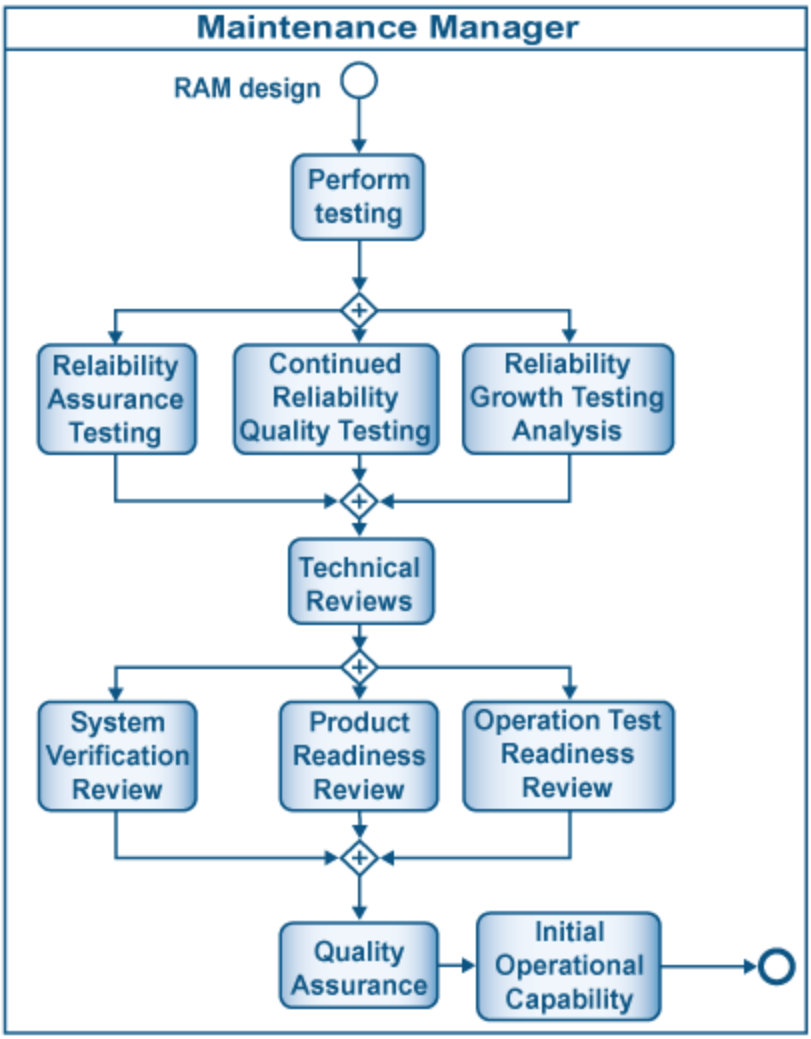
	3. End.
Extension points	Establish Reliability and maintainable systems
Preconditions	Adequate resources are available to the process.
Post -conditions	RAM design is formulated.
Related Business Rules	BR-005 (Ref 7.1)
Related Risks	RR-006(Ref 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, Timeliness, Understandability, interpretability (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	RDRR(Ref 7.6)
Related CTQs	RDRRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head.

	2. Log Escalation
Process Map	5.1
Process Model	6.10
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.12 Sub Process – Establish RAM Design Roles and Responsibilities

Roles	Responsibilities
Senior Management	• Senior Management establishes RAM design consideration (simple design, fault tolerance, elimination of failure modes, fail safe, redundancy) • Senior Manager establishes closed loop reviews for COTS (long term support, warranty, integrated diagnosis) and inhouse development review (system functional review, preliminary design review, critical design review, test readiness review) • Senior Management ensures mature maintainability (reliability testing, environmental stress screening, maintainability fault insertion) • Senior Management performs failure mode mitigation (DCACAS, FMEA, fault tree analysis, ishikawa diagrams) • Senior Management manages trade offs • Senior management establishes mode of maintenance.

6.13 Sub Process – Establish Reliability and Maintainability System



6.14 Sub Process Establish Reliability and Maintainability System Specification

Specification	Description
Summary/Purpose	The purpose of this process is to implement the RAM design
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Reliability of maintenance.
Related Operational Policies	OP-006 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>RAM design</td></tr>
<tr><td>Basic Course of Event</td><td>Establish reliability and maintainable Systems
1. Maintenance Manager performs testing Reliability assurance testing, continued reliability quality testing, reliability growth testing analysis
2. Maintenance Manager performs technical review (system verification review, product readiness review, operation test readiness review)
3. Maintenance manager performs quality assurance related activities.
4. Maintenance manager establishes initial operational capability.
5. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Establish Reliability Centric Maintenance program</td></tr>
<tr><td>Preconditions</td><td>Various maintenance related failures detection capability exists.</td></tr>
<tr><td>Post -conditions</td><td>Reliable systems are established.</td></tr>
</table>

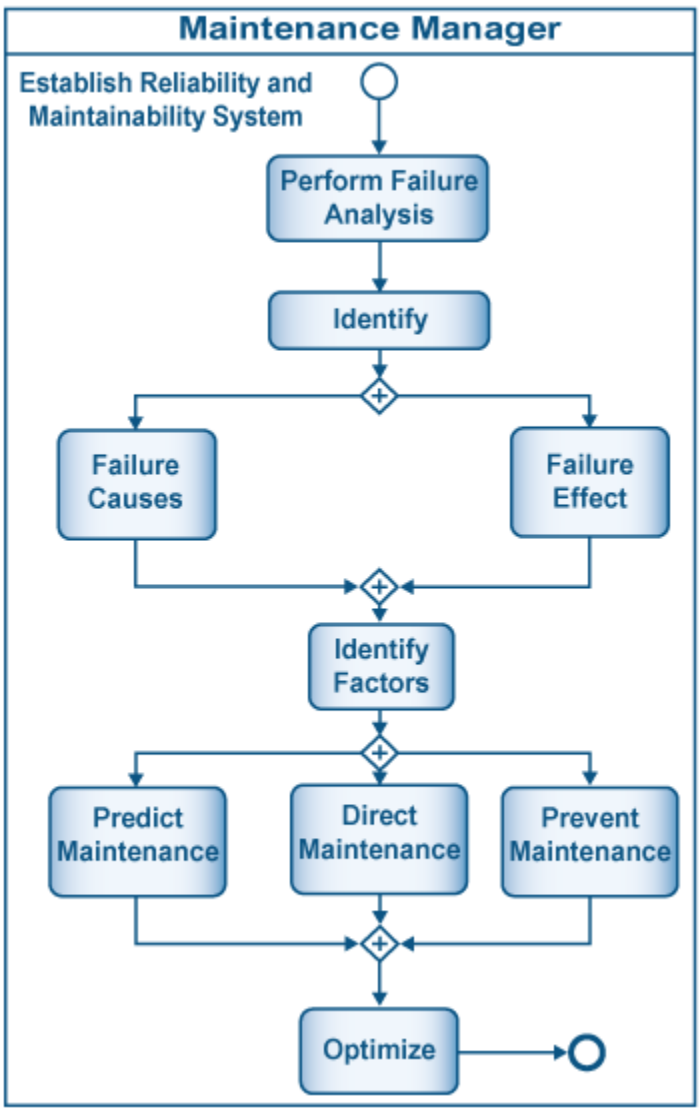
6 Maintenance Management Process

Related Business Rules	BR-006 (Ref 7.1)
Related Risks	RR-005 (Ref 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, confidentiality, (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, Timeliness, Understandability, interpretability, free of error, concise representation (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	FCIR(Ref 7.6)
Related CTQs	FCIRV(Ref 7.7)
Actors/Agents	Maintenance Manager.
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1
Process Model	6.13
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.15 Sub process – Establish Reliability and Maintainability System Roles and Responsibilities

Roles	Responsibilities
Maintenance Manager	1. Maintenance Manager performs testing Reliability assurance testing, continued reliability quality testing, reliability growth testing analysis 2. Maintenance Manager performs technical review (system verification review, product readiness review, operation test readiness review) 3. Maintenance manager performs quality assurance related activities. 4. Maintenance manager establishes initial operational capability

6.16 Sub Process – Establish Reliability Centric Maintenance program



6.17 Sub Process – Establish Reliability Centric Maintenance program Specification

Specification	Description
Summary/Purpose	The purpose of this process is to establish reliability centric maintenance program for environmental services department.
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Reliability of maintenance.
Related Operational Policies	OP-002 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None

6 Maintenance Management Process

<table>
<tr><td>Raw Materials</td><td>None</td></tr>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>Establish Reliability and Maintainability System</td></tr>
<tr><td>Basic Course of Event</td><td>Establish reliability centric maintenance program
1. Maintenance Manager performs failure Analysis.
2. Maintenance Manager identifies failure causes and failure effects.
3. Maintenance Manager identifies factors to predict, detect and prevent failures.
4. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>MSD prevention program</td></tr>
<tr><td>Preconditions</td><td>Various maintenance related failures detection capability exists.</td></tr>
<tr><td>Post -conditions</td><td>Reliability centric maintenance program gets established.</td></tr>
<tr><td>Related Business Rules</td><td>BR-003 (Ref 7.1)</td></tr>
</table>

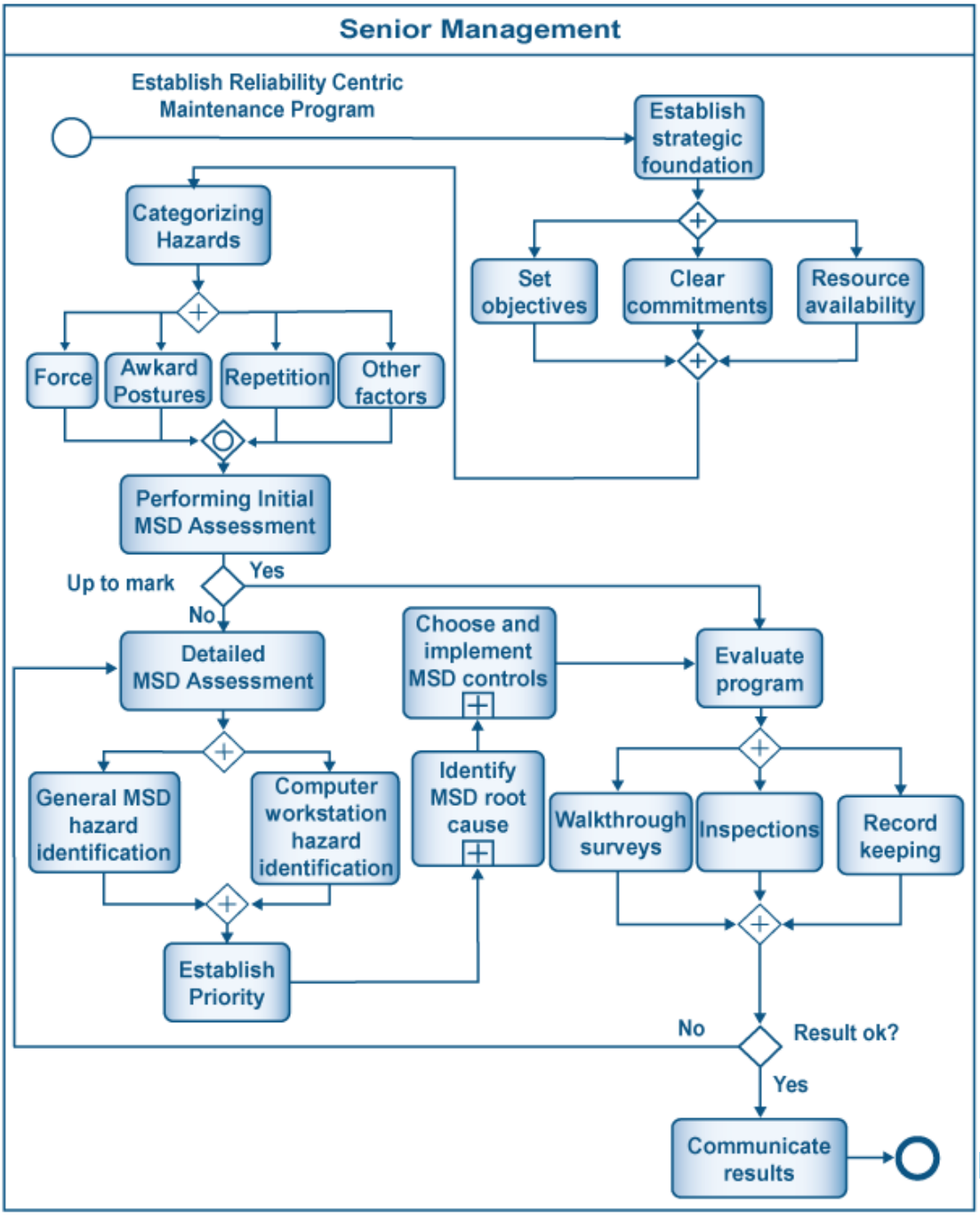
6 Maintenance Management Process

Related Risks	RR-005 (Ref 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, confidentiality, (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, Timeliness, Understandability, interpretability, free of error, concise representation (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	FCIR(Ref 7.6)
Related CTQs	FCIRV(Ref 7.7)
Actors/Agents	Maintenance Manager.
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1
Process Model	6.16
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.18 Sub process – Establish Reliability Centric Maintenance program Roles and Responsibilities

Roles	Responsibilities
Maintenance Manager	1. Maintenance Manager performs failure Analysis. 2. Maintenance Manager identifies failure causes and failure effects. 3. Maintenance Manager identifies factors to predict, detect and prevent failures.

6.19 Sub process – Establish MSD Prevention Program



6.20 Sub Process – Establish MSD Prevention Program Specification

Specification	Description
Summary/Purpose	The purpose of this process is to establish standard process for establishing MSD prevention program.
Scope	This is a level 1 Process Specification.
Primary Reference	• OSHA
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Ensure better safety of employees
Related Operational Policies	OP-007, OP-008,(Ref 7.5)
Assumptions	Senior Management Support exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None
Equipment & Accessories	Automated System for maintenance Management

6 Maintenance Management Process

<table>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimension</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Establish reliability centric maintenance program</td></tr>
<tr><td>Basic Course of Event</td><td>Establish MSD Program
1. Senior Management establishes strategic foundation which comprises of setting objectives, clear commitments and resource availabilities.
2. Senior Management categorizes MSD hazards into categories (force, awkward postures, repetition, and other factors)
3. Senior Management performs initial MSD assessment which comprises of checklist and records reviews.
4. Senior Management evaluates program which comprises of walkthrough surveys, inspections, record keeping.
5. Senior Management communicates results to the staff and management.
6. End</td></tr>
<tr><td>Alternative Path</td><td>Establish MSD Program (detailed MSD assessment)
1. Senior Management establishes strategic foundation which comprises of setting objectives, clear commitments and resource availabilities.
2. Senior Management categorizes MSD hazards into categories (force, awkward postures, repetition, and other factors)
3. Senior Management performs initial MSD assessment which comprises of checklist and records reviews.
4. Senior Management performs detailed MSD assessments
5. Senior Management establishes priority
6. Senior Management identifies MSD root cause</td></tr>
</table>

	7. Senior Management choose and implement MSD controls 8. Senior Management evaluates program which comprises of walkthrough surveys, inspections, record keeping. 9. Senior Management communicates results to the staff and management. 10. End **Establish MSD Program (result not okay)** 1. Senior Management performs detailed MSD assessments. 2. Senior Management establishes priority 3. Senior Management identifies MSD root cause 4. Senior Management choose and implement MSD controls 5. Senior Management evaluates program which comprises of walkthrough surveys, inspections, record keeping. 6. Senior Management communicates results to the staff and management. 7. End
Exception Path	**System Down** 1. Keep paper track until system is up and running 2. Update the System and clear all logs. 3. End.
Extension points	Perform maintenance
Preconditions	There exists a capability at environmental Services department to monitor the performance of OSH
Post -conditions	MSD hazards get reduced.
Related Business Rules	BR-007, BR-008 (Ref 7.1)
Related Risks	RR-007,RR-008(Ref. 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, Service reliability, confidentiality, authenticity, availability, non repudiation, testability (Ref 7.3)

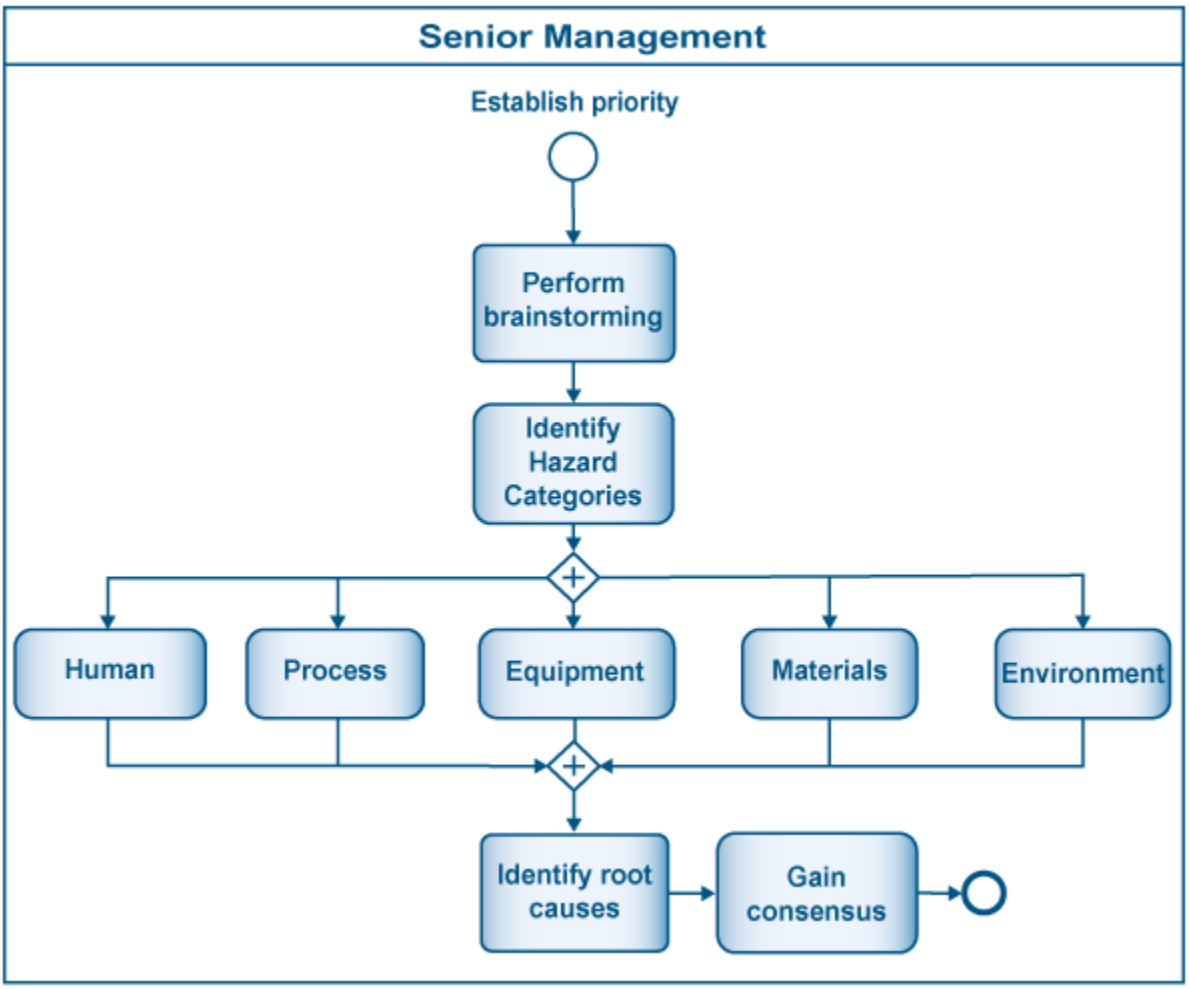
6 Maintenance Management Process

Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability, Reputation, Objectivity, Free-0f Error, Relevance, Completeness, Timeliness, Concise Representation (Ref 7.4)
Related Primary SLA Terms	TBD (Ref 7.9)
Related KPIs	MHR, RCIR, MHPR (Ref 7.6)
Related CTQs	MHRV, RCIRV, MHPRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Agent Not Available 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation Delegation Rule -2: Agent Overloaded 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation
Escalation	Rule 1: Performance or operational or legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	Section 5.1
Process Model	Section 6.19
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection Appendix C: Sample Checklist Appendix D: General Hazard Identification Tool Appendix E: Hazard Priority Table Appendix F:Tips For Preventing MSD

6.21 Sub Process – Establish MSD Prevention Program Roles and responsibilities

Roles	Responsibilities
Senior Management	• Senior Management establishes strategic foundation which comprises of setting objectives, clear commitments and resource availabilities. • Senior Management categorizes MSD hazards into categories (force, awkward postures, repetition, and other factors) • Senior Management performs initial MSD assessment which comprises of checklist and records reviews. • Senior Management performs detailed MSD assessments which comprises of general MSD hazard identification and computer workstation hazard identification. • Senior Management establishes priority • Senior Management identifies MSD root cause • Senior Management choose and implement MSD controls • Senior Management evaluates program which comprises of walkthrough surveys, inspections, record keeping. • Senior Management communicates results to the staff and management

6.22 Sub process – Identity MSD root cause



6.23 Sub Process – Identify MSD root cause Specification

Specification	Description
Summary/Purpose	The purpose of this process is identifying MSD root causes.
Scope	This is a level 2 Process Specification.
Primary Reference	• Lean waste minimization • Six sigma quality model • OSHA
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Service quality improvisation
Related Operational Policies	OP-007 (Ref 7.5)
Assumptions	Senior Management Support exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None
Equipment & Accessories	Automated System for maintenance management

6 Maintenance Management Process

<table>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimension</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Establish priority</td></tr>
<tr><td>Basic Course of Event</td><td>Identify MSD root cause
1. Senior Management performs brainstorming sessions
2. Senior Management identifies the hazard for categories (human, process, equipment, materials, environment)
3. Senior Management identifies the root cause for the hazards
4. Senior Management gains consensus.
5. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Choose and implement MSD control</td></tr>
<tr><td>Preconditions</td><td>There exists a capability at environmental Services department to monitor the performance of this process.</td></tr>
<tr><td>Post -conditions</td><td>Root cause of hazard is identified.</td></tr>
<tr><td>Related Business Rules</td><td>BR-007 (Ref 7.1)</td></tr>
<tr><td>Related Risks</td><td>RR-007 (Ref. 7.2)</td></tr>
</table>

6 Maintenance Management Process

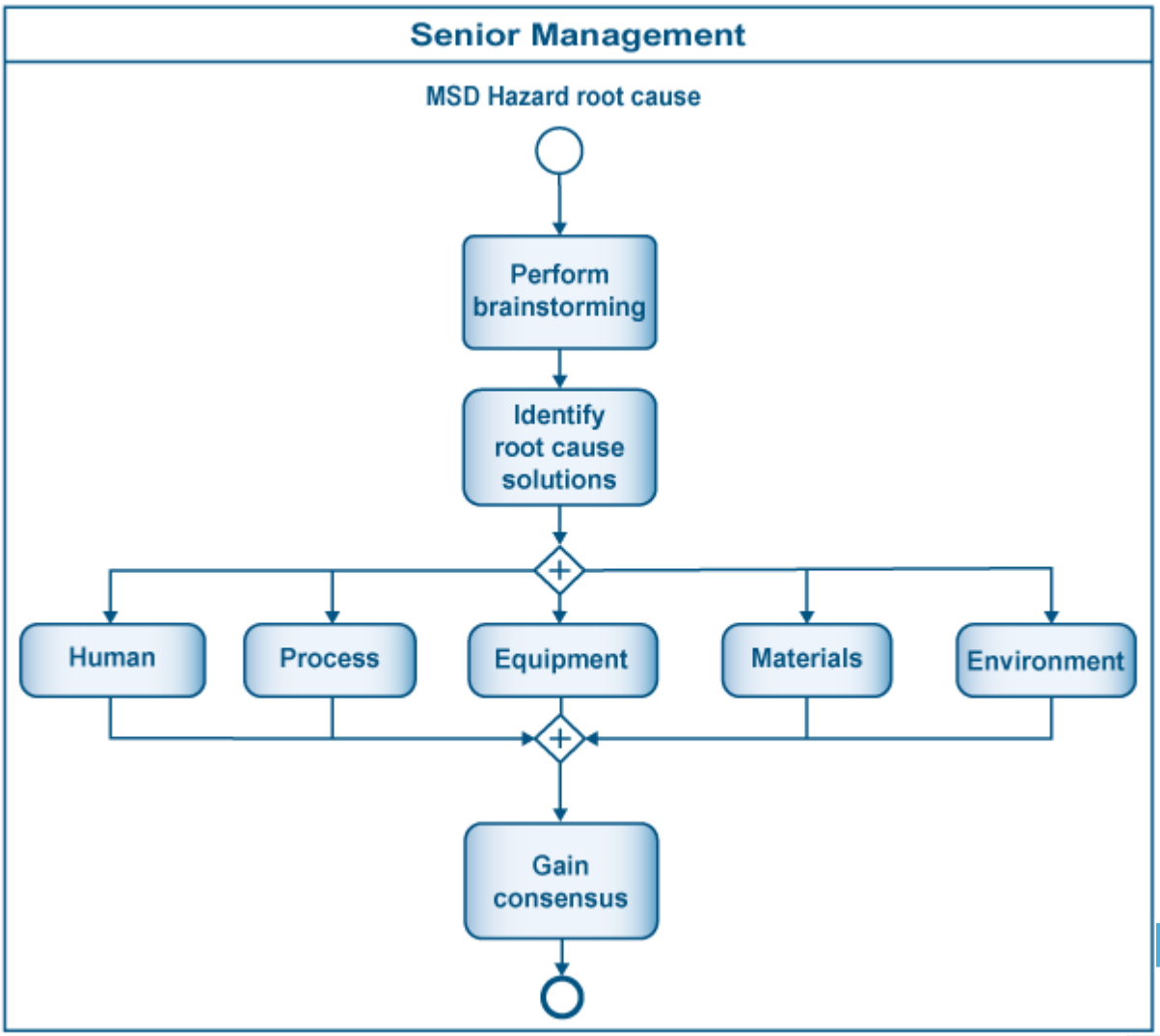
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, Service reliability, confidentiality, authenticity, availability, non repudiation, testability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability, Reputation, Objectivity, Free-0f Error, Relevance, Completeness, Timeliness, Concise Representation (Ref 7.4)
Related Primary SLA Terms	TBD (Ref 7.9)
Related KPIs	RCIR (Ref 7.6)
Related CTQs	RCIRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Agent Not Available 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation Delegation Rule -2: Agent Overloaded 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation
Escalation	Rule 1: Performance or operational or legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	Section 5.1
Process Model	Section 6.22

Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.24 Sub Process – Identify MSD root cause Roles and responsibilities

Roles	Responsibilities
Senior Management	• Senior Management performs brainstorming sessions • Senior Management identifies the hazard for categories (human, process, equipment, materials, environment) • Senior Management identifies the root cause for the hazards • Senior Management gains consensus.

6.25 Sub process – Choose and implement MSD controls



6.26 Sub Process – Choose and Implement MSD controls Specification

Specification	Description
Summary/Purpose	The purpose of this process is choose and implement MSD controls
Scope	This is a level 2 Process Specification.
Primary Reference	• Lean waste minimization • Six sigma quality model • OSHA
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, Maintenance Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Service quality improvisation and reduction of MSD hazards
Related Operational Policies	OP-008 (Ref 7.5)
Assumptions	Senior Management Support exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated System for maintenance management</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimension</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>• Identify MSD hazard root cause</td></tr>
<tr><td>Basic Course of Event</td><td>Choose and Implement MSD controls
1. Senior Management performs brainstorming sessions
2. Senior Management identifies root cause solutions for the hazard categories (human, process, equipment, materials, environment)
3. Senior Management gains consensus.
4. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Evaluate program</td></tr>
<tr><td>Preconditions</td><td>There exists a capability at environmental Services department to monitor the performance of this process.</td></tr>
<tr><td>Post -conditions</td><td>Root cause of hazard is implemented.</td></tr>
</table>

6 Maintenance Management Process

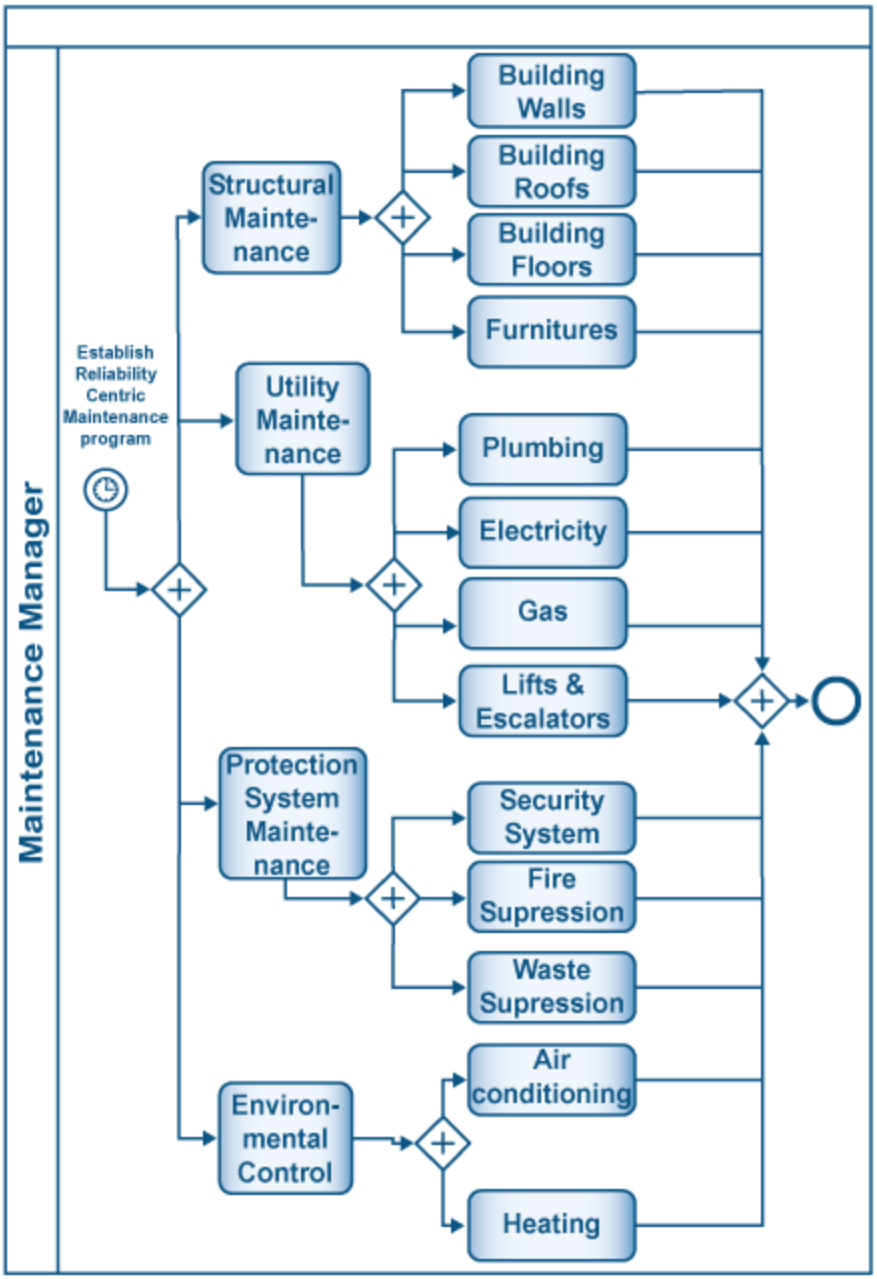
Related Business Rules	BR-008(Ref 7.1)
Related Risks	RR-008 (Ref. 7.2)
Related Quality Attributes	Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, Service reliability, confidentiality, authenticity, availability, non repudiation, testability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability, Reputation, Objectivity, Free-0f Error, Relevance, Completeness, Timeliness, Concise Representation (Ref 7.4)
Related Primary SLA Terms	TBD (Ref 7.9)
Related KPIs	MHPR (Ref 7.6)
Related CTQs	MHPRV (Ref 7.7)
Actors/Agents	Senior Management
Delegation	Delegation Rule -1: Agent Not Available 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation Delegation Rule -2: Agent Overloaded 1. Delegate the Issue to additional Agent with same Role 2. Update the Issue 3. Log the Delegation
Escalation	Rule 1: Performance or operational or legal Issues 1. Escalate to environmental services department head. 2. Log Escalation

Process Map	Section 5.1
Process Model	Section 6.25
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.27 Sub Process – Identify MSD root cause Roles and responsibilities

Roles	Responsibilities
Senior Management	• Senior Management performs brainstorming sessions • Senior Management identifies root cause solutions for the hazard categories (human, process, equipment, materials, environment) • Senior Management gains consensus.

6.28 Sub Process – Perform Maintenance



6 Maintenance Management Process

6.29 Sub Process – Perform Maintenance Specification

Specification	Description
Summary/Purpose	The purpose of this process is to establish perform maintenance process for environmental services department.
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Better and efficient maintenance management.
Related Operational Policies	OP-003 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	Link 1, Link2, Link 4
Raw Materials	Oil, gas, refills

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Plumbing tools, Maintenance tool kit, ladder</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>Establish Reliability Centric Maintenance program</td></tr>
<tr><td>Basic Course of Event</td><td>Perform Maintenance
1. Maintenance Manager performs Structural Maintenance (Building walls, Building Floors, Building Roofs, Furniture and fittings) and Utility Maintenance(Plumbing, Electricity, Gas, Lifts and Escalators) and Protection System Maintenance (Security Systems, Fire suppression systems, Water suspension systems) and Environmental Control(Air Conditioning Systems, Heating Systems)
2. End</td></tr>
<tr><td>Alternative Path</td><td>None</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Monitor Performance.</td></tr>
<tr><td>Preconditions</td><td>The maintenance is done per the maintenance plan and procedures.</td></tr>
<tr><td>Post -conditions</td><td>Maintenance of the premises happens.</td></tr>
</table>

6 Maintenance Management Process

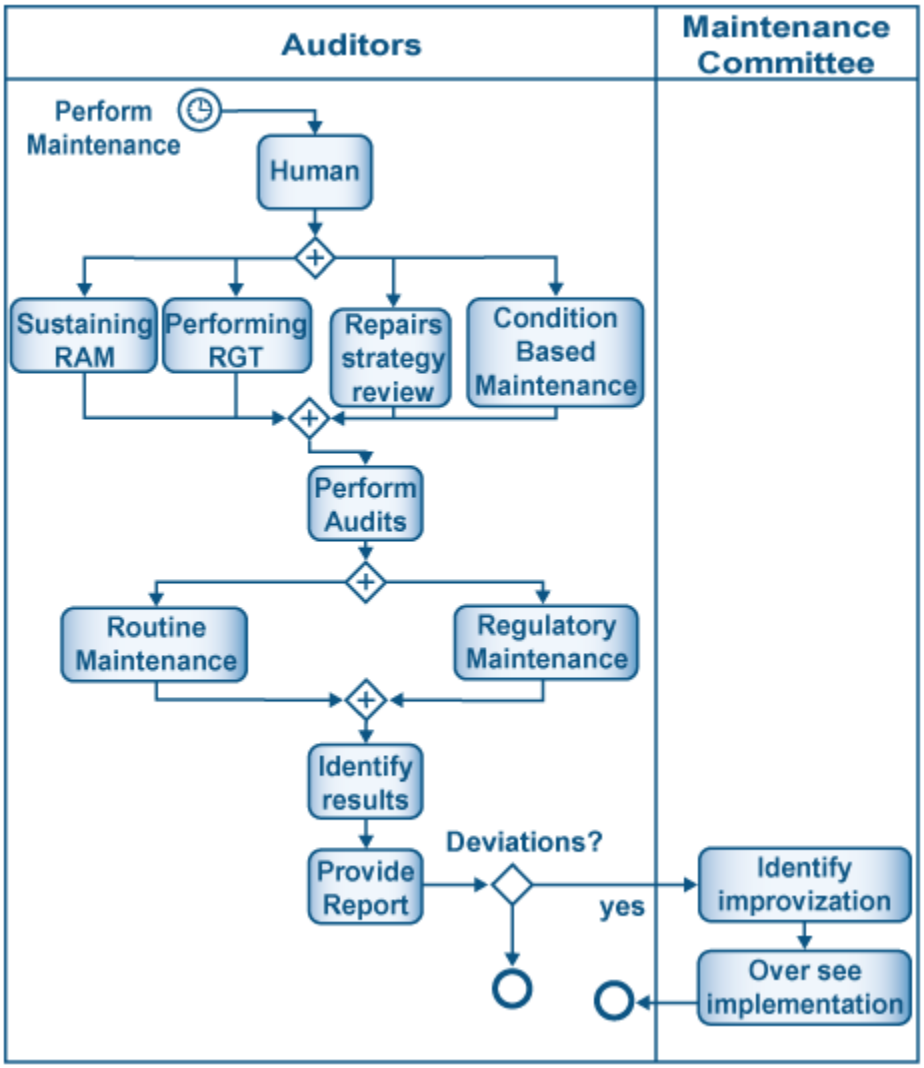
Related Business Rules	BR-001 (Ref 7.1)
Related Risks	RR-003(Ref. 7.2)
Related Quality Attributes	Service Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, Availability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, Timeliness, Understandability, interpretability, reputation, free of error (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	MR, MDR(Ref 7.6)
Related CTQs	MRV, MDRV(Ref 7.7)
Actors/Agents	Maintenance Manager.
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1
Process Model	6.28
Other References	Appendix A: Business Process Modeling Notation Reference

	Appendix B: Chain of Infection

6.30 Sub Process – Perform Maintenance Roles and Responsibilities

Roles	Responsibilities
Maintenance Manager	Maintenance Manager performs Structural Maintenance (Building walls, Building Floors, Building Roofs, Furniture and fittings) and Utility Maintenance(Plumbing, Electricity, Gas, Lifts and Escalators) and Protection System Maintenance (Security Systems, Fire suppression systems, Water suspension systems) and Environmental Control(Air Conditioning Systems, Heating Systems)

6.31 Sub Process – Monitor Performance



6.32 Sub Process – Monitor Performance Specification

Specification	Description
Summary/Purpose	The purpose of this process is to monitor the performance of the maintenance process.
Scope	This is a Level 2 Process Specification.
Primary Reference	• Code of Practice on Building Management & Maintenance- Hong Kong • NHS- National Health Services Standard • OSHA- Occupational Safety and Health Administration standard • Lean six sigma- Quality Standard
Related ESM Practices	Transportation Management, Quality Management, Service Strategy & planning, laundry Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management
Related Business Driver	Quality of service.
Related Operational Policies	OP-002 (Ref. 7.5)
Assumptions	1. Top level management commitment exists.
Voice of Customer	Hygiene, High and Consistent Quality of standards, Free of Infections, Timely Services, High Coordinating, Remove Waste, Excellent Ergonomic, Safety, Appearance, Excellent Worker Attitude. (Ref 7.10)
Customer Satisfaction Measure	Customer satisfaction index
COI Correlation	None
Raw Materials	None

6 Maintenance Management Process

<table>
<tr><td>Equipment & Accessories</td><td>Automated system for maintenance.</td></tr>
<tr><td>MSD Management</td><td>Lifting/carrying, Disability, Force, Loaded motion, Physical ergonomics, Posture change, Excessive force, Scarceness, Noise, Concentration, Floor hazards, Clothing, Psychosocial factors. (Ref 7.12)</td></tr>
<tr><td>EBC Procedures</td><td>None</td></tr>
<tr><td>Timing Dimensions</td><td><table><tr><th>Type</th><th>Normal</th></tr><tr><td>Average</td><td>30 min</td></tr><tr><td>Std</td><td>12 min</td></tr></table></td></tr>
<tr><td>Trigger</td><td>Periodic activity</td></tr>
<tr><td>Basic Course of Event</td><td>Monitor Performance
1. Auditors monitors sustaining RAM, performs RGT, performs repairs strategy review, performs condition based maintenance
2. Auditors perform routine and regulatory maintenance
3. Auditors identify the result
4. Auditors provides the report
5. End</td></tr>
<tr><td>Alternative Path</td><td>Monitor Performance (deviations)
1. Maintenance Committee identifies improvisations
2. Maintenance Committee oversees implementation
3. End</td></tr>
<tr><td>Exception Path</td><td>System Down
1. Keep paper track until system is up and running
2. Update the System and clear all logs.
3. End.</td></tr>
<tr><td>Extension points</td><td>Transportation Management, Quality Management, Waste Management, Project Management, Infection Management, Activity Based Management, House Keeping Management</td></tr>
</table>

6 Maintenance Management Process

Preconditions	All maintenance records are well maintained.
Post -conditions	Maintenance process get audited.
Related Business Rules	BR-004 (Ref 7.1)
Related Risks	RR-002(Ref. 7.2)
Related Quality Attributes	Service Reliability, Usability, Data Integrity, Non-repudiation, Accountability, Performance, Auditability, availability (Ref 7.3)
Related Data Quality Dimensions	Accuracy, Objectivity, Relevance, Completeness, timeliness, Understandability, interpretability, reputation, free of error (Ref 7.4)
Related Primary SLA Terms	(Ref 7.9)
Related KPIs	MRR(Ref 7.6)
Related CTQs	(Ref 7.7)
Actors/Agents	Auditor, Maintenance committee
Delegation	Delegation Rule -1: Maintenance Manager Not Available 1. Delegate the task to the agent with same role 2. Update the task 3. Log the delegation Delegation Rule -2: Maintenance Manager Overloaded 1. Delegate the task to the agent with same Role 2. Update the task 3. Log the delegation
Escalation	Rule 1: Performance, operational legal Issues 1. Escalate to environmental services department head. 2. Log Escalation
Process Map	5.1

Process Model	6.31
Other References	Appendix A: Business Process Modeling Notation Reference Appendix B: Chain of Infection

6.33 Sub Process – Monitor Performance Roles and Responsibilities

Roles	Responsibilities
Auditors	• Auditors perform routine and regulatory maintenance • Auditors identify the result • Auditors provides the report • Auditors monitors sustaining RAM, performs RGT, performs repairs strategy review, performs condition based maintenance
Maintenance Committee	• Maintenance Committee identifies improvisations • Maintenance Committee oversees implementation

Reference

7 Reference

7.1 Business Rules

BR ID	Description	Context	Rule	Source
BR-001	All routine maintenance activities would be performed in a manner such that it doesn't disturb the normal operations of the organization.	**TBD**	**TBD**	**TBD**
BR-002	All maintenance related requirements should be planning 6 month prior actual requirement.	**TBD**	**TBD**	**TBD**
BR-003	To ensure accuracy maintenance management would employ automated tools wherever necessary	**TBD**	**TBD**	**TBD**
BR-004	All maintenance outcomes should be monitored and reviewed	**TBD**	**TBD**	**TBD**
BR-005	A minimum of one metrics would be used in calculating RAM performance	**TBD**	**TBD**	**TBD**
BR-006	Technical reviews and performance testing would be done before implementation of the solution	**TBD**	**TBD**	**TBD**
BR-007	All MSD hazard should be identified and prioritized	Business	TBD	TBD
BR-008	All the root causes of MSD should be identified	Business	TBD	TBD

7 Reference

7.2 Risk

Risk ID	Description	Source	Severity Level	Status	Resolution
RR-001	Shortage of funds.	NA	High	NA	Senior management should plan the for finances well ahead so that there is never a shortage
RR-002	Poor monitoring of maintenance activities	NA	High	NA	Senior Management should monitor the efficiency of maintenance committee from time to time.
RR-003	Delay in Maintenance	NA	High	NA	Fines should be imposed on the supplier and contractors who fail to resolve issues within the time frame provided.
RR-004	Maintenance plan not up to date	NA	High	NA	The maintenance plan should be reviewed regularly and updated frequently.
RR-005	Failure causes not investigated	NA	High	NA	All failure causes should be investigated to eradicate the common and regular occurrence of problems
RR-006	Poor assessment of requirements	NA	High	NA	The assessment should be done by capable team members supported by frequent reviews and automated tools

RR-007	The MSD assessment results are not accurate	NA	High	TBD	Detailed assessment techniques should be undertaken. If needed MSD professional bodies should be contacted to perform assessment/
RR-008	Root cause for some MSD is not identified	NA	High	TBD	For those MSD for which root cause can't be identified there should be a work around solution identified until the cause is identified.

7.3 Quality Attribute

QA ID	Description	Threshold
QA-001	Interoperability	TBD
QA-002	Reliability	TBD
QA-003	Service Reliability	TBD
QA-004	Availability	TBD
QA-005	Usability	TBD
QA-006	Normal Usability Operations	TBD
QA-007	Confidentiality	TBD
QA-008	Authenticity	TBD

QA-009	Data Integrity	TBD
QA-010	Availability	TBD
QA-011	Non-repudiation	TBD
QA-012	Accountability	TBD
QA-013	Security Integration	TBD
QA-014	Performance	TBD
QA-015	Scalability	TBD
QA-016	Extensibility	TBD
QA-017	Adaptability	TBD
QA-018	Testability	TBD
QA-019	Auditability	TBD
QA-020	Operability and Deployability	TBD

7.4 Data Quality Dimension

DQ ID	Description	Threshold
DQ-001	Accuracy	TBD
DQ-002	Believability	TBD
DQ-003	Reputation	TBD

DQ-004	Objectivity	TBD
DQ-005	Free-of-Error	TBD
DQ-006	Value Added	TBD
DQ-007	Relevance	TBD
DQ-008	Completeness	TBD
DQ-009	Timeliness	TBD
DQ-010	Appropriate Amount	TBD
DQ-011	Understandability	TBD
DQ-012	Interpretability	TBD
DQ-013	Concise Representation	TBD

7.5 Operation Policy

Policy ID	Description	Context	Importance (1-5)
OP-001	All maintenance management related plans should be implemented only after approval from the senior management	TBD	TBD
OP-002	All maintenance failures would be investigated	TBD	TBD
OP-003	All routine maintenance activities would be planned	TBD	TBD

OP-004	MTTR, MTBR, and uptime would be used as metrics for reliability, maintainability and availability	TBD	TBD
OP-005	All design considerations would be documented and strictly followed.	TBD	TBD
OP-006	All test results would be validated before approval	TBD	TBD
OP-007	Advanced MSD assessment should be undertaken if the results from initial MSD assessment are not accurate	TBD	TBD
OP-008	Root cause identification and implementation would be done only when a consensus is reached by the brain storming team.	TBD	TBD

7.6 KPI

Name	Acronym	Description	Context	Importance	Soft Threshold	Hard threshold
RAM Needs review rate	**RNRR**	Number of reviews done to RAM requirements	NA	TBD	TBD	TBD
RAM design review rate	**RDRR**	Number of reviews done to RAM design	NA	TBD	TBD	TBD
Maintenance cost	**DC**	Maintenance cost per month	NA	TBD	TBD	TBD

7 Reference

Maintenance complaint rate	**DCTR**	Number of Maintenance complains per month	NA	TBD	TBD	TBD
Maintenance Compliance rate	**DCR**	Number of Maintenance targets achieved per month.	NA	TBD	TBD	TBD
Maintenance rate	**MR**	Maintenance done per month	NA	TBD	TBD	TBD
Maintenance Delay rate	**MDR**	Average delay in minutes per month	NA	TBD	TBD	TBD
Policy review rate	**PRR**	Number of policy reviews per month	NA	TBD	TBD	TBD
Maintenance resolution rate	**MRR**	Number of maintenance resolutions done per month	NA	TBD	TBD	TBD
Failure cause identification rate	**FCIR**	Number of failures causes identified per month	NA	TBD	TBD	TBD
MSD hazards rate	**MHR**	Number of MSD hazard in the organization	NA	TBD	TBD	TBD

		identified quarterly				
Root cause identification rate	**RCIR**	Number of hazards with root cause identified	NA	TBD	TBD	TBD
MSD hazard prevention rate	**MHPR**	Number of MSD hazard in the organization prevented quarterly	NA	TBD	TBD	TBD

7.7 CTQ

Name	Acronym	Description	Context	Importance	Soft Threshold	Hard Threshold
RAM Needs review rate variation	**RNRR**	Standard deviation of RNRR	NA	TBD	TBD	TBD
RAM design review rate variation	**RDRRV**	Standard deviation of RDRR	NA	TBD	TBD	TBD
Maintenance cost variation	**DCV**	Standard deviation of CC	NA	TBD	TBD	TBD
Maintenance complaint rate variation	**DCTRV**	Standard deviation of CCTR	NA	TBD	TBD	TBD

Maintenance Compliance rate variation	**DCRV**	Standard deviation of CCR	NA	TBD	TBD	TBD
Maintenance rate variation	**MRV**	Standard deviation of MR	NA	TBD	TBD	TBD
Maintenance Delay rate variation	**MDRV**	Standard deviation of MR	NA	TBD	TBD	TBD
Policy review rate variation	**PRRV**	Standard deviation of PRR	NA	TBD	TBD	TBD
Maintenance resolution rate variation	**MRRV**	Standard deviation of MRR	NA	TBD	TBD	TBD
Motion Optimization Measure	**MOM**	Management of motion optimization measure	NA	TBD	TBD	TBD
Paper work Optimization Measure	**PWOM**	Management of Paper work Optimization Measure	NA	TBD	TBD	TBD
Correction reduction measure	**CRM**	Management of Correction reduction measure	NA	TBD	TBD	TBD

7 Reference

Inventory Optimization Measure	**IOM**	Management of Inventory Optimization Measure	NA	TBD	TBD	TBD
Transportation Optimization Measure	**TOM**	Management of Transportation Optimization Measure	NA	TBD	TBD	TBD
Waiting Reduction Measure	**WRM**	Management of Waiting reduction Measure	NA	TBD	TBD	TBD
Delays reduction measure	**DRM**	Management of delays reduction measure	NA	TBD	TBD	TBD
Failure cause identification rate variation	**FCIRV**	Standard deviation of FCIR	NA	TBD	TBD	TBD
MSD hazards rate variation	**MHRV**	Standard deviation of MHR	NA	TBD	TBD	TBD
Root cause identification rate variation	**RCIRV**	Standard deviation of RCIR	NA	TBD	TBD	TBD
MSD hazard prevention rate variation	**MHPRV**	Standard deviation of MHPR	NA	TBD	TBD	TBD

7 Reference

7.8 Abstract Time – Scale

Name	Acronym	Description	Quantification
TBD	TBD	TBD	TBD

7.9 SLA Terms

SLA ID	Description	Context	KPI	CTQ
TBD	TBD	TBD	TBD	TBD

7.10 Voice of Customer

VOC	Customer	Description	Perceived Value
Hygiene	Doctors, Patients, Nurses, Housekeeping Supervisors, Housekeepers, Clerks, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker.	The environment should be attributing with great hygiene level.	• High quality healthcare services • Safe environment • Low infection rate • Low risk
High and Consistent	Doctors, Patients, Nurses, Housekeeping Supervisors, Clerks, Environmental Services Management, Laundry worker,	High and Consistent Quality of standards.	• Reputation of organization or hospital • Professionalism • Trust

7 Reference

Quality of standards	Transportation worker, Maintenance worker, Waste management worker, Housekeepers		• Positive psychological bias
Free of Infections	Doctors, Patients, Nurses, Housekeeping Supervisors, Clerks, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	Infections free and healthy environment.	• Safe environment • Reputation of hospital or organization • Trust • Quick healing • Positive psychological bias • Low risk
Timely Services	Doctors, Patients, Nurses, Housekeeping Supervisors, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	The response time for any request should be very short.	• Professionalism • Trust • Positive psychological bias • Reputation of hospital or organization • Safe environment
High Coordinating	Doctors, Patients, Nurses, Housekeeping Supervisors, Clerks, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	There should be high level of coordination between hospital employees and departments.	• Professionalism • Trust • Low risk • Excellent Ergonomic

7 Reference

Remove Waste	Patients, Nurses, Housekeeping Supervisors, Clerks, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	Wastes should be either removed or minimized.	• Safe environment • Low infection rate • Low risk • Reputation of hospital or organization • Low cost • Timely response • High quality
Excellent Ergonomic	Doctors, Patients, Nurses, Housekeeping Supervisors, Clerks, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	The hospital environment and policy should comply with physical, organization and cognitive ergonomics.	• Professionalism • Trust • Job accuracy • Excellent communication • Low risk • Reputation of hospital or organization
Safety	Doctors, Patients, Nurses, Housekeeping Supervisors, Clerks, Visitors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	Hospital environment should comply with occupational health and safety procedures.	• Safe environment • Professionalism • Low risk
Appearance	Housekeeping Supervisors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste	The appearance of the workers, supervisors and manager should induce positive biases.	• Professionalism • Reputation of hospital or organization • Trust • Positive psychological bias

	management worker, Housekeepers		
Excellent Worker Attitude	Housekeeping Supervisors, Environmental Services Management, Laundry worker, Transportation worker, Maintenance worker, Waste management worker, Housekeepers	The environment service employee should be free from negative attitudes.	• Professionalism • Reputation of hospital or organization • Trust • Positive psychological bias • Minimum disputes • Less employee turn over

7.11 Customer Context Matrix

Name of Customer	Acronym	Context of Customer	Coordination Process Area
Doctors	**DOC**	Direct	HIS Coordination
Patients	**PAT**	Direct	HIS Coordination
Nurses	**NUR**	Direct	HIS Coordination, Nurse Coordination
Housekeeping Supervisors	**HKS**	Direct	Quality Coordination, Nurse Coordination, infection control coordination
Clerks	**CLR**	Direct	HIS Coordination
Visitors	**VIS**	Indirect	HIS Coordination
Environmental Services Management	**ESM**	Direct	Nurse Coordination, infection control coordination
Other hospital workers	**OHW**	Indirect	Security coordination

Laundry worker	**LDW**	Direct	Nurse Coordination, HIS Coordination
Transportation worker	**TRW**	Direct	Quality Coordination, HIS Coordination
Maintenance worker	**MAW**	Direct	Quality Coordination, HIS Coordination
Waste management worker	**WMW**	Direct	Quality Coordination, HIS Coordination
Infection control professional	**ICP**	Indirect	infection control coordination
Housekeepers	**HK**	Direct	HIS Coordination, Nurse Coordination

7.12 MSD Attributes

MSD Attribute	Description
Lifting/carrying	Large vertical movements, long carry distances.
Disability	Pose a risk to those with a health problem or a physical or learning disability.
Force	High initial forces to get the load moving.
Loaded motion	High forces to keep the load in motion.
Physical ergonomics	Constraints on body posture/positioning, confined spaces/narrow doorways.
Posture change	Strong force and awkward movement/posture. E.g. bent wrists.
Excessive force	Excessive force to grip raw materials, product or tools
Scarceness	Inadequate tools for repetitive use screwdrivers, pliers, hammers.

7 Reference

Noise	Noise which cause stress and muscle tension.
Concentration	Tasks require high levels of attention/concentration especially where the worker has little control over allocation of effect to the task.
Floor hazards	Remove slip and trip hazards through provision of appropriate floor surfaces and good keeping.
Clothing	Clothing/PPE may prevent sufficient movement for the task or reduce capability. E.g. to grip consider handling needs when selecting work wear/gloves.
Psychosocial factors	Adverse psychosocial factors can increase the potential for manual handling injuries. A workers psychosocial response to work and the workplace conditions can affect their health in general and MSDs in particular. The factors include the content, design, organization and management of the work

Glossary / Acronyms

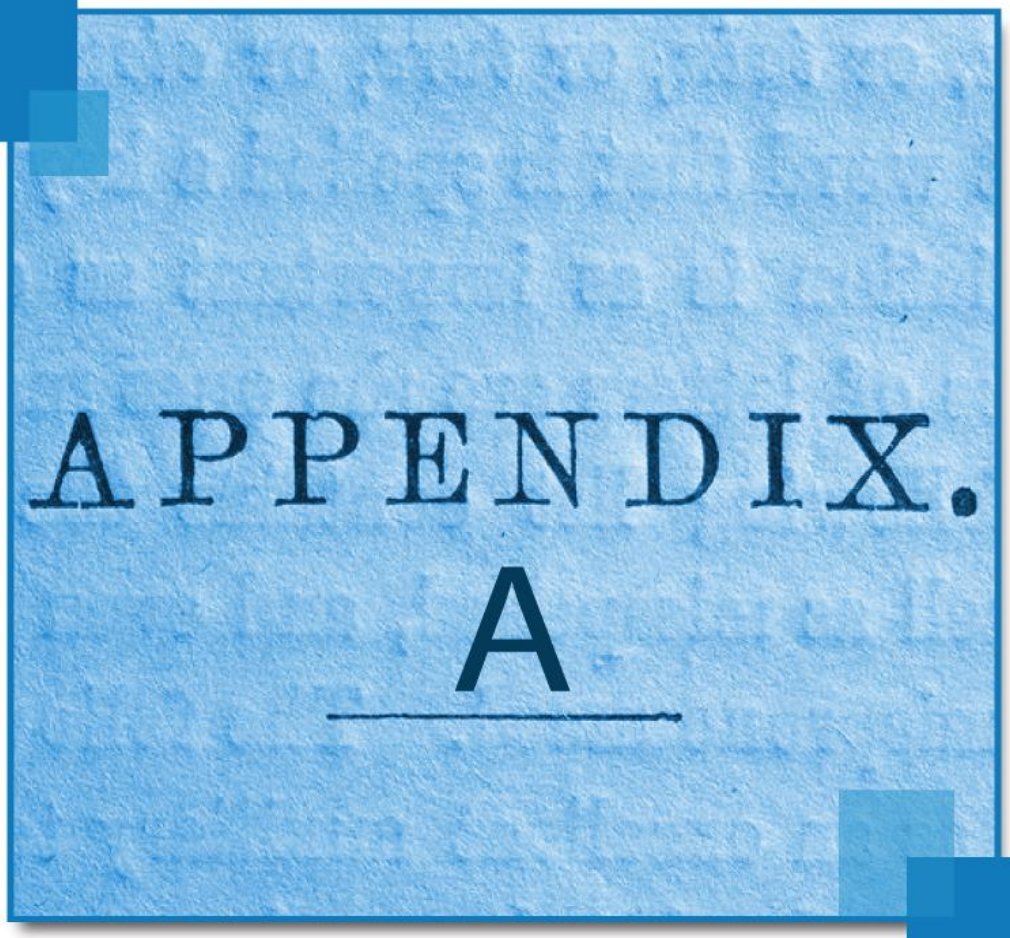
8 Glossary / Acronyms

Terminology	Description
Abstract Time Scale	Time Scale that will be quantified both during operations and continuous process improvement. These time identifiers are correlated with the soft thresholds that are dynamically specified during life span of the process.
BPMN	**Business Process Modelling Notation** Business Process Modelling Notation is the practice of documenting an organisation's key business processes in a graphical format.
Business Rules	Business Rules are intended to assert business structure or to control or influence the behaviour of the Business. Business rules describe the operations, definitions and constraints that apply to an organization
CRR	Contract Review Rate
CRRV	Contract Review rate Variation.
CTQ	**Critical to Quality** Critical To Quality (CTQ) is continuous measuring and monitoring tool agreed between the internal processes to achieve greater customer satisfaction.
Data Quality Dimensions	The totality of features and characteristics of data that bears on their ability to satisfy a given purpose
EBC	Evidence Based Cleaning
ESM	Environmental services Map
KPI	**Key Performance Indicator** A metric that is used to help manage a process, IT service or activity. Many metrics may be measured, but only the most important of these are defined as KPIs and used to actively manage and report on the process, IT service or activity. KPIs should be selected to ensure that efficiency, effectiveness, and cost effectiveness are all managed.
MSD	**Macro Skeleton Disorder**
OLA	**Organization level Agreement**

8 Glossary / Acronyms

	An Agreement between an IT Service Provider and another part of the same Organization
Operational Policy	Rules defined to operate the process.
PPE	Personal protection equipment.
Quality Attributes	Quality attributes are non-functional requirements used to evaluate the performance of a process.
RAM	Reliability Availability Maintainability
Risk	A possible event that could cause harm or loss, or affect the ability to achieve Objectives. A risk is measured by the probability of a threat, the vulnerability of the asset to that threat, and the impact it would have if it occurred.
SLA	**Service Level Agreement** An Agreement between an IT Service Provider and a Customer. The SLA describes the IT Service, documents Service Level Targets, and specifies the responsibilities of the IT Service Provider and the Customer
VOC	**Voice of Customer**

Appendix A: Business Process Modeling Notation Reference



9 Appendix A: Business Process Modeling Notation Reference

INTRODUCTION

Business Process Modelling ("BPM") is the practice of documenting an organisation's key business processes in a manner which:

- Is highly graphical
- Focuses on business terminology rather than technical
- Allows all business steps/tasks to be included, not just those which involve a computer system

Mentioned below are the various core concepts of BPMN with the relevant definition and graphic notation.

PROCESS START

All processes have to start somehow, general notation for a process models commence with the START event, is a circle.	
One can use simply the *basic unmarked* start event as above, or one of the different types of start event, to provide more detail as described below.	
If a process starts when some sort of message arrives, mail, email, text. Following notation can be used	**Message start** 
If a process starts by virtue of the passage of time – e.g. 1st Jan review or 4 days after the purchase order is sent, following notation can be used	**TIMER Start** 
If the process starts when a rule/condition is met – e.g. when Incident Impact is more than 100,000.	**RULE Start** 
If a process starts when another process finishes. Following notation can be used	**LINK Start** 
If there is more than one 'trigger' for a process to start. Following notation can be used	**MULTIPLE Start** 

9 Appendix A: Business Process Modeling Notation Reference

TASK AND SUB PROCESS

Task	Task is a lowest level activity in a process map. A task is used when the work is not broken down to a finer level of detail	
Sub Process	A Sub-process is a compound activity which can be broken down into finer details.	
Loops	Loops task or sub process continues to iterate until the loop condition is true.	

INTERMEDIATE EVENTS

Following notation can be used to display the intermediate event, similar to start and end events.						
	BASIC	**MESSAGE**	**TIMER**	**RULE**	**LINK**	**MULTIPLE**
						

PROCESS END

All processes have to end somehow, general notation for a process models end will be a circle with a solid line.	
One can use simply use the *basic* end event as above, or you can use one of the different types of end event, to provide more detail, as described below:	

9 Appendix A: Business Process Modeling Notation Reference

If a process ends by something being sent via a message of some sort e.g., mail, email, document, following notation can be used.	MESSAGE End 
If the end of this process causes the start of another, following notation can be used.	LINK End 
If more than one consequence of the process ending, following notation can be used.	MULTIPLE End 

SWIMLANES

Pool	A *Pool* represents a participant in a Process. It is also acts as a "swimlane" and a graphical container for partitioning a set of activities from other Pools	
Lane	A *Lane* is a sub-partition within a Pool and will extend the entire length of the Pool, either vertically or horizontally. Lanes are used to organize and categorize activities.	

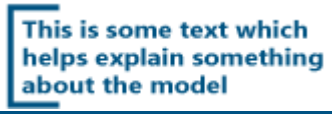
CONNECTORS

Sequence Flow	A *Sequence Flow* is represented by a solid line with a solid arrowhead (see the figure to the right) and is used to show the order (the sequence) that activities will be performed in a Process.	

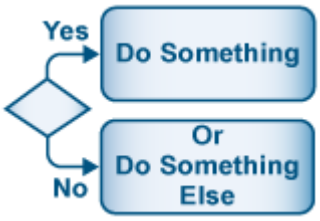
9 Appendix A: Business Process Modeling Notation Reference

Message Flow	A *Message Flow* is represented by a dashed line with an open arrowhead (see the figure to the right) and is used to show the flow of messages between two separate Process Participants. In BPMN, two separate Pools in the Diagram will represent the two Participants.	

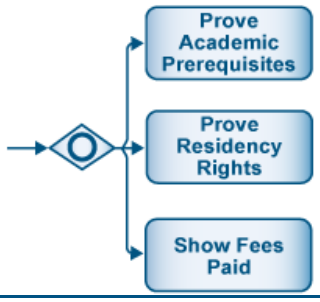
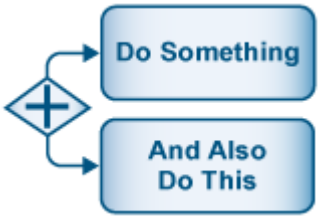
ARTIFACTS

Annotation	The ANNOTATION shape is used to add comments to a process model. It consists of text in a square left bracket	
Data Object	A data object represents a piece of data which is required or produced by the process eg. Customer details, output.	
Group	A grouping is purely for documentation or explanatory purposes. It has no impact on the model. It consists of a rectangle with dashed lines and rounded corners, usually enclosing other objects.	

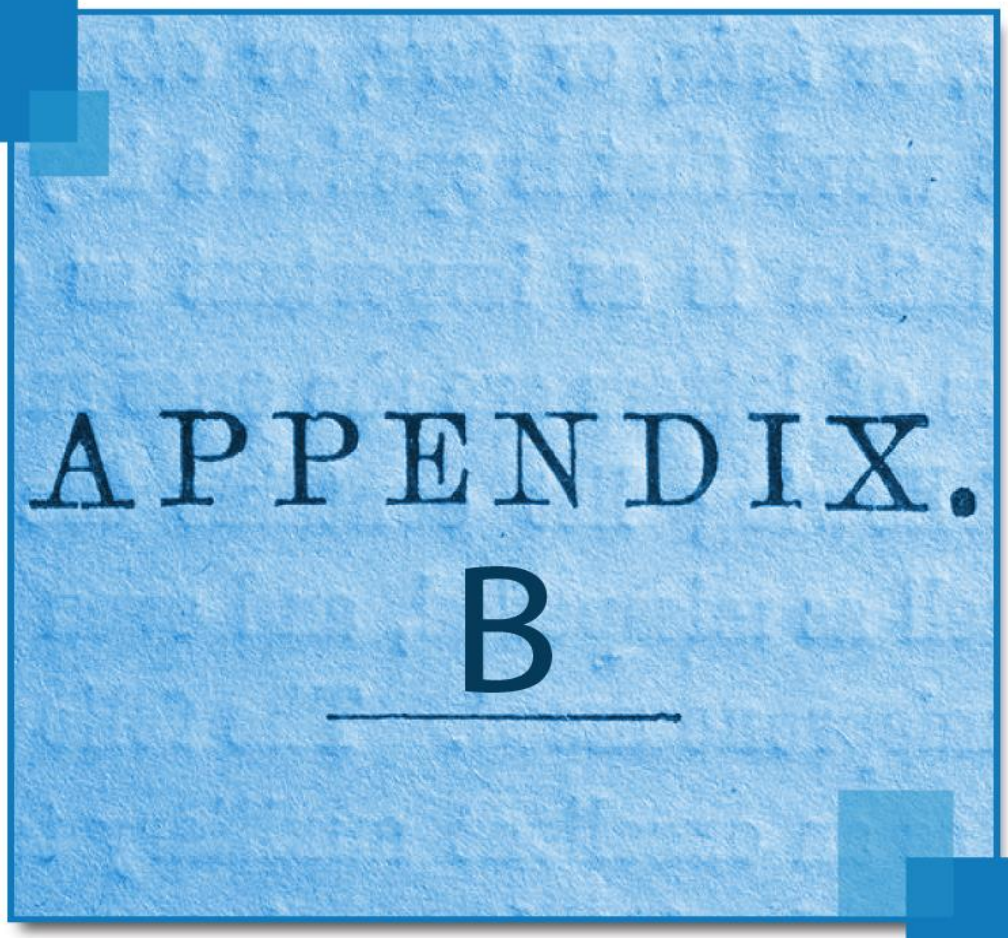
GATEWAYS

Exclusive	The values of the process are examined to determine which path to take	

9 Appendix A: Business Process Modeling Notation Reference

Inclusive	Each branch will be evaluated and will not stop when one branch condition becomes true.	
Parallel	Provides a mechanism to synchronise parallel flow and to create parallel flow.	

Appendix B: Chain of Infection



10 Appendix B: Chain of Infection

In order to control or prevent infection it is essential to understand that transmission stages of a pathogen resulting in infection requires the six vital links (Refer to the table below).

Each link mentioned below must be present for infection or colonization to proceed, and breaking any of the links can prevent the infection.

The section below details out the six stages:

Stage	Link	Description
1	Infectious Agent	Any disease-causing microorganism (pathogen)
2	The Reservoir Host	The organism in which the infectious microbes reside
3	The Portal of Exit	Route of escape of the pathogen from the reservoir.
4	The Route of Transmission	Method by which the pathogen gets from the reservoir to the new host
5	The Portal of Entry	Route through which the pathogen enters its new host
6	The Susceptible Host	The organism that accepts the pathogen

Link 1: Infectious Agent

The causative agent for infection is any microorganism capable of producing disease. Microorganisms responsible for infectious diseases include bacteria, viruses, rickettsiae, fungi, and protozoa. Sometimes, microorganisms are part of patient's own body flora and can cause infection in the immunocompromised host. These infections are called endogenous infections. Infections which are acquired from external sources are called exogenous infections.

Link 2: Reservoir Host

The second link in the chain of infection is the reservoir, i.e. the environment or object in or on which a microorganism can survive and, in some cases, multiply. Inanimate objects, human beings, and animals can all serve as reservoirs, providing the essential requirements for a microorganism to survive at specific stages in its life cycle.

Infectious reservoirs abound in health care settings, and may include everything from patients, visitors, and staff members to furniture, medical equipment, medications, food, water, and blood.

10 Appendix B: Chain of Infection

Link 3: Portal of Exit

The portal of exit is the path by which an infectious agent leaves its reservoir. Usually, this portal is the site where the microorganism grows. Common portals of exit associated with human reservoirs include the respiratory, genitourinary, and gastrointestinal tracts, the skin and mucous membranes and the placenta (transmission from mother to fetus)

Link 4: Route of Transmission

The microorganism can be acquired by inhalation (through respiratory tract), ingestion (through gastrointestinal tract), inoculation (through accidental sharp injury or bites), contact (during sexual intercourse) and transplacental transmission (microbes may cross placenta from the mother to fetus). It is important to remember that some microorganisms use more than one transmission route to get from the reservoir to a new host.

Of the six links in the chain of infection, the mode of transmission is the easiest link to break and is key to control of cross-infection in hospitals.

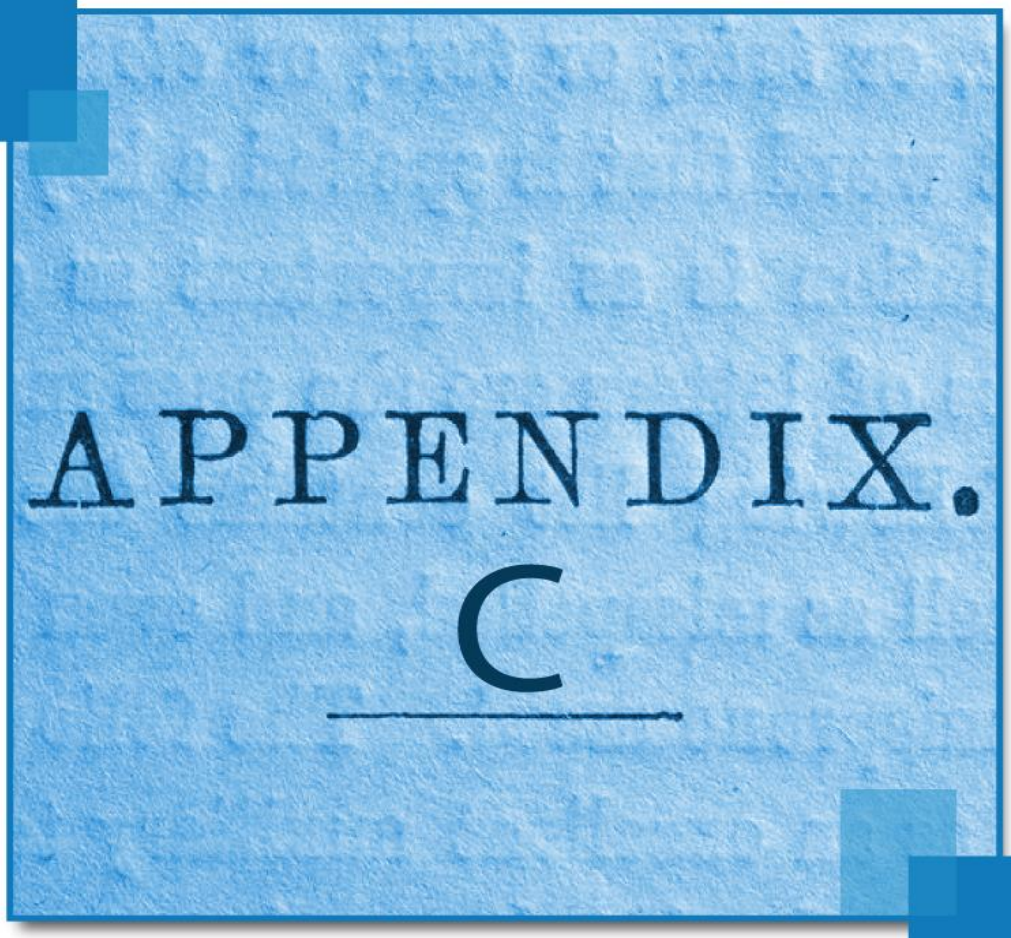
Link 5: The Portal of Entry

The portal of entry is the path by which an infectious agent invades a susceptible host. Usually, this path is the same as the portal of exit. For example, the portal of entry for tuberculosis and diphtheria is through the respiratory tract, hepatitis B and Human Immunodeficiency Virus enter through the bloodstream or body fluids and Salmonella enters through the gastrointestinal tract. In addition, each invasive device, e.g. intravenous line, creates an additional portal of entry into a patient's body thus increasing the chance of developing an infection.

Link 6: The Susceptible host

The final link in the chain of infection is the susceptible host. The human body has many defense mechanisms for resisting the entry and multiplication of pathogens. When these mechanisms function normally, infection does not occur. However, in immunocompromised patients, where the body defenses are weakened, infectious agents are more likely to invade the body and cause an infectious disease. In addition, the very young and the very old are at higher risk for infection because in the very young the immune system does not fully develop until about age 6 months, while old age is associated with declining immune system function as well as with chronic diseases that weaken host defenses.

Appendix C: Sample Checklist



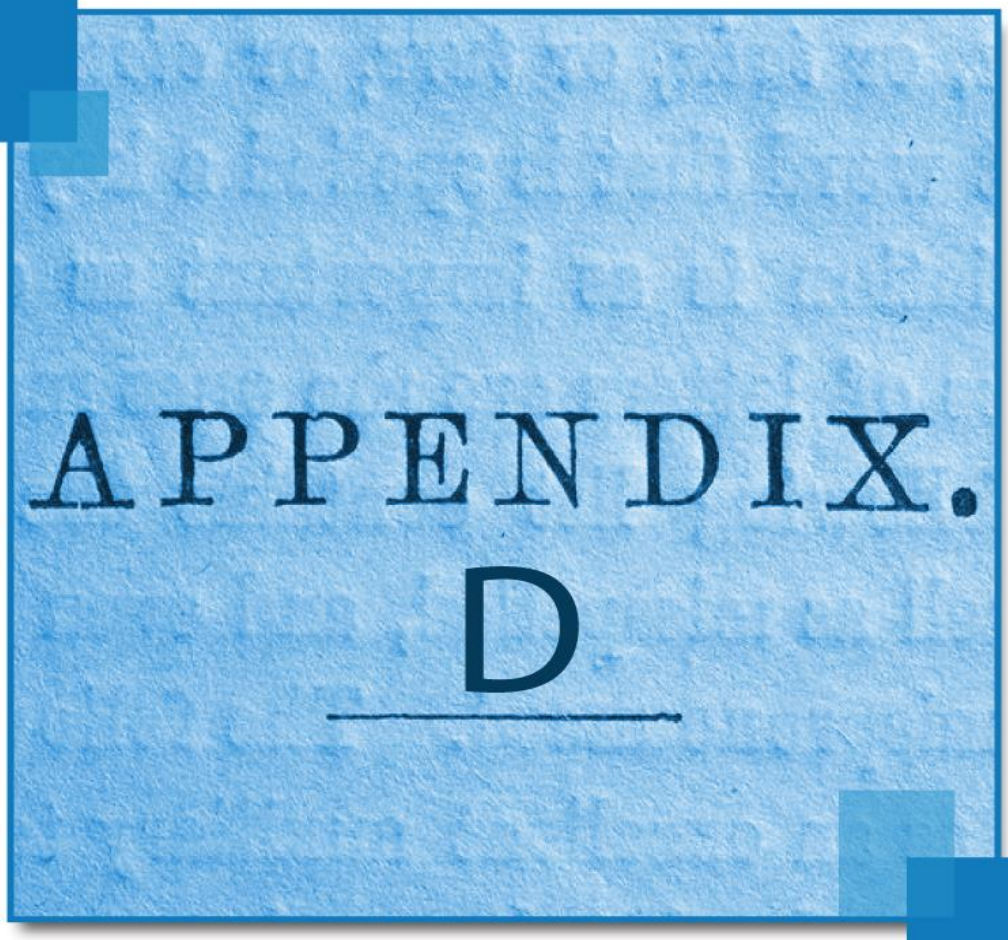
11 Appendix C: Sample Checklist

Establish a foundation for success	YES	NO
Managers, supervisors, and workers all know the workplace is serious about preventing MSDs	☐	☐
The workplace is ready to make changes to reduce the risk of MSDs	☐	☐
Resources are available to make any necessary changes	☐	☐
Understand MSDs and MSD hazards	**YES**	**NO**
Managers, supervisors, and workers know what MSDs are and what hazards can cause them	☐	☐
Recognize MSD hazards and related concerns	**YES**	**NO**
Incident/injury records are reviewed to find jobs/tasks where MSDs have been reported	☐	☐
Workers, supervisors and managers are asked about job/tasks that they believe contribute to any pain or discomfort	☐	☐
Problem jobs/tasks are observed and an MSD hazard identification tool is used, with full input and participation of workers who do the jobs/tasks	☐	☐
Conduct an MSD risk assessment	**YES**	**NO**
Problem jobs/tasks are prioritized for a simple risk assessment	☐	☐
Workers are asked to identify key concerns/activities/ task demands that are contributing to MSDs, pain or discomfort	☐	☐
Observations & MSD hazard identification tool results are compared to worker comments/concerns	☐	☐
Effort is made to agree on what issues/hazards should be addressed to help reduce the risk of MSDs (agreement between observations, hazard identification tool(s), and worker comments)	☐	☐
Effort is made to agree on why these hazards exist for this job/task	☐	☐
Choose and implement MSD hazard controls	**YES**	**NO**

11 Appendix C: Sample Checklist

When MSD hazard controls are needed, workers, supervisors, maintenance, and safety personnel discuss/brainstorm ideas and options to control identified MSD hazard(s)	☐	☐
Possible controls for MSD hazards are selected and reviewed	☐	☐
Preferred control ideas are identified and action plans are developed for implementation	☐	☐
Follow up on and evaluate success of MSD hazard controls	**YES**	**NO**
Workers are asked for their feedback on/opinions about MSD hazard controls	☐	☐
Workers receive training on how to use MSD controls and are using them	☐	☐
Observations and the MSD hazard identification tool results are used to help confirm that the exposure to the MSD hazard has been reduced	☐	☐
Reviews are done to ensure that no new hazards/concerns result from the MSD hazard control(s)	☐	☐
Communicate results and acknowledge success	**YES**	**NO**
Those involved in the process are acknowledged and the workplace is told about new MSD hazard control(s)	☐	☐

Appendix D: General Hazard Identification Tool



12 Appendix D: General Hazard Identification Tool

Job Title or Task: _____ **Date:** _____

Completed By: _____

General Observations/Notes:

	MSD HAZARDS GRIPPING	Tick if present
Pinching gripping	Unsupported heavy object(s)	
	Difficult/tiring holding or manipulating	
	Difficult/tiring squeezing to open/close	
Power gripping	Unsupported heavy object(s)	
	Difficult/tiring holding or manipulating	
	Difficult/tiring squeezing to open/close	
	MSD HAZARDS FORCE	**Tick if present**
Lifting and Lowering	Object is heavy/difficult to lift/lower	
	Object is lifted/lowered repeatedly	
	Hands are above the shoulders when lifting/lowering object	
	Hands are below the knees when lifting/lowering object	
	Object is far away from the belly button	
	Loads are unstable, unbalanced, uncooperative, or unpredictable	
	Awkward lifting/lowering postures (bend, twist, kneel, reach, sit)	
Pushing pulling	Object is hard/difficult to push/pull	
	Object is pushed/pulled repeatedly	
	Object is pushed with hands above the shoulders	
	Object is pushed with hands below the waist	
	Awkward pushing/pulling postures (bend, twist, kneel, reach, sit)	
	MSD HAZARDS AWKWARD POSTURE	**Tick if present**

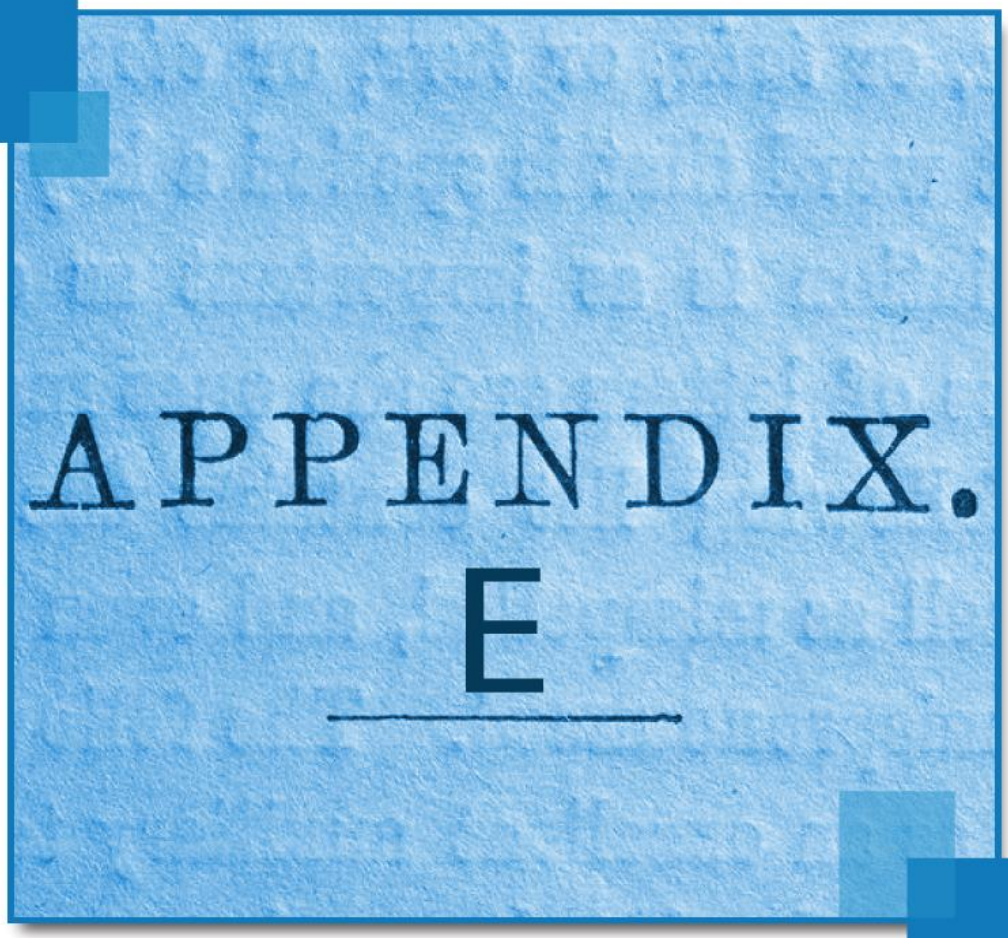
12 Appendix D: General Hazard Identification Tool

Awkward Position	Neck visibly bent forward (chin close to chest)	
	Neck visibly bent to one side (ear close to shoulder)	
	Neck twisted to either side/chin close to the shoulder	
	Neck noticeably bent back	
	Neck bent forward and chin out (head forward)	
	Hand(s) at or above the head	
	Elbow(s) at/or above the shoulder	
	Elbows/hands behind the body	
	Sitting or standing with the back noticeably bent forward,	
	Sideways, or twisted	
	Back noticeably bent backward with no support for the back	
	Squatting/kneeling while working	
	Wrist noticeably bent down or up	
	Wrist noticeably bent to the side (toward thumb/little finger)	
	Hand turned so palm faces fully up or down	
Fixed position	Sitting for long periods without standing (office work, driving)	
	Standing still on a hard surface for a long period of time	
	MSD HAZARD -REPITITION	**Tick if present**
Repetition	Performing the same neck motions repeatedly	
	Performing the same shoulder motions repeatedly	
	Performing the same elbow motions repeatedly	
	Performing the same wrist motions repeatedly	
	Performing the same hand/finger motions repeatedly	
	Performing intensive keyboarding	
	Performing intensive mousing	

12 Appendix D: General Hazard Identification Tool

	MSD HAZARDS -OTHERS	Tick if present
Repeated impacts	Using the hand or knee as a hammer	
Contact stress	Tool handles dig into hand/palm	
	Workstation/equipment edges/products dig into body (hands,	
Hand arm vibration	Forearms, trunk, thighs)	
	Using vibrating tools (impact wrenches, carpet strippers, chain saws, jackhammers, scalers, riveting hammers, grinders, sanders, jig saws, jack-leg drills)	
Whole body vibration	Operating mobile equipment/vehicles on rough, uneven surfaces	
Cold hot temperature	Work environment is cold, hand/arms are exposed to cold air	
	Work environment is hot/humid	

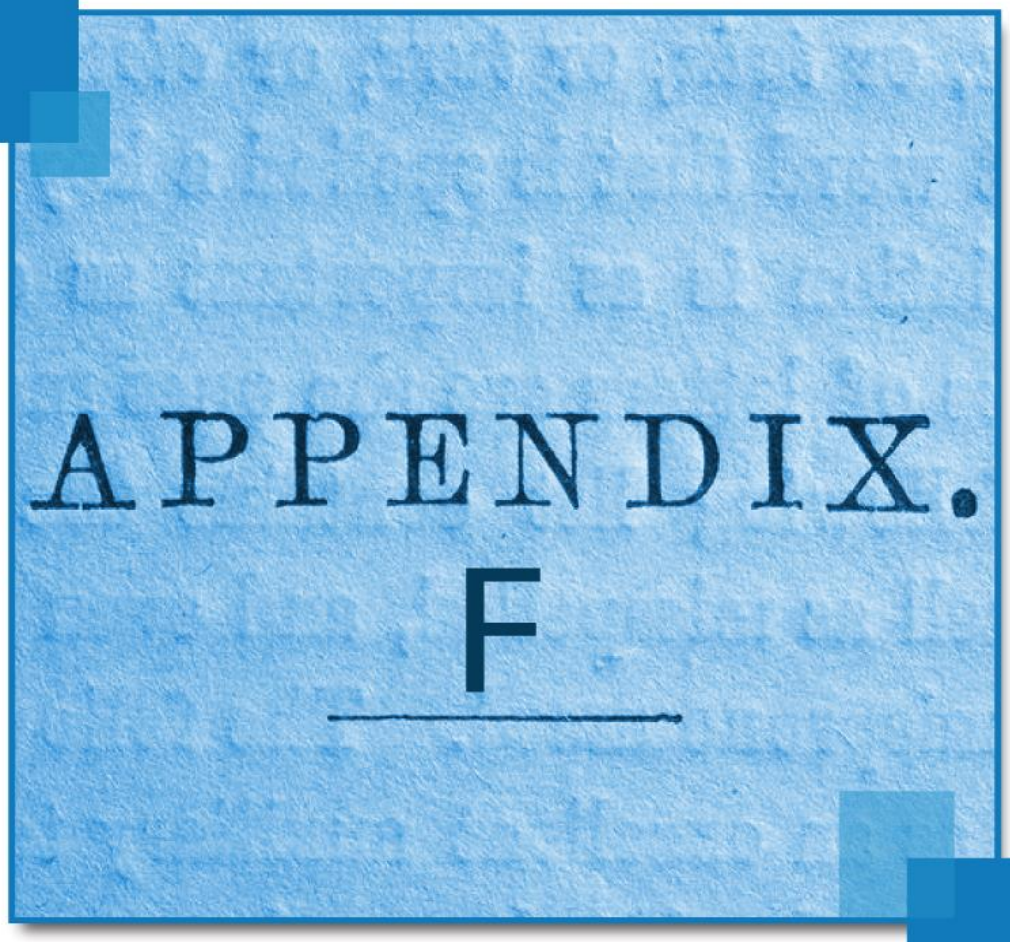
Appendix E: Hazard Priority Table



13 Appendix E: Hazard Priority Table

PRIORITY LEVEL	MSD REPORTED		WORKER DISCOMFORT		MSD HAZARD IDENTIFIED	
	YES	NO	YES	NO	YES	NO
VERY HIGH	√		√		√	
	√			√	√	
	√		√			√
HIGH	√			√		√
		√	√		√	
MEDIUM		√	√			√
LOW		√		√	√	
No Risk assessment needed		√		√		√

Appendix F: Tips for Preventing MSD



14 Appendix F: Tips for Preventing MSD

Force

- **Gripping tools/equipment**
  - Provide tools that allow workers to grip the tool using a power grip.
  - Eliminate the use of pinch or key grips as much as possible.
  - Choose tools that have triggers that allow for the use of multiple fingers rather than one finger or a thumb.
  - Choose tools that can be used with the wrist straight.
  - Choose tools with vibration reducing features.
  - Choose tools that are lighter and designed to reduce hand torque and kickback.
  - Ensure the tool is balanced and does not require extra muscular effort to hold it in position.
  - Ensure the handle of a tool does not create pressure points in the palm of the hand.
  - Use tools with handles that fit the hand, for example use a smooth, cushioned hand grip rather than one with hard ridges that space the fingers.
  - Provide rubber or sponge-type grips on tool handles.
  - Provide tools than be safely used by either left handed or right handed workers
  - Maintain tools regularly.
  - Inspect tools regularly. Ensure worn or damaged tools are fixed or replaced.
- **Pushing and pulling**
  - Provide carts that have vertical or height adjustable handles to enable different-sized workers to position their hands between waist and shoulder height.
  - Use larger wheels on carts and bins as this reduces push and pull forces and they are easier to roll over cracks or holes.
  - Ensure that wheels/casters that are suitable for the load being transported and are compatible with the type of flooring.
  - Determine the most suitable swivel arrangement of casters – two or four, front or back.
  - Ensure there is enough space so the worker does not have to use awkward postures to move the cart.
  - Design/change the layout of the work area to eliminate the need to push wheeled objects upslopes or over uneven surfaces.
  - Ensure the flooring is level, smooth and in good condition.
  - Ensure workers can see over the top of the cart.
  - Push rather than pull carts.

- Maintain carts, especially wheels and wheel bearings.
- Provide brakes on carts where practical.

- **Heavy, frequent or awkward lifting**
  - Use mechanical assists to lift/lower loads - such as hoists, pallet trucks, pump trucks ladder hoists, gin poles, daisy chains, cranes, or chain falls.
  - Use lifting devices designed for specific tasks, e.g. lifting / moving people, lifting / moving animals
  - Move objects as close to the body as possible before lifting them – use turntables to bring loads close.
  - Ensure there are no obstacles between the worker and the load being lifted.
  - Provide height adjustable pallet trucks/scissor lifts to keep loads off the floor and so that loads can be handled with the hands above knee height.
  - Organize the starting and ending location of the lifts to limit the overall vertical travel distance a load has to be lifted.
  - Avoid lifts below knuckle level and above shoulder level – limit use of high and low shelves.
  - Avoid lifting loads that are heavier than four kg when seated – stand and use larger, stronger muscles.
  - Improve grips/handles on objects being lifted.
  - Split the overall weight of a load into smaller loads.
  - Avoid uneven, unbalanced loads.
  - Use gravity as an assist whenever possible (lower rather than lift).
  - Use carts, motorized buggies, conveyors, gravity feed rollers to transport loads rather than carrying them.
  - Provide tools/devices to help with carrying tasks - carrying handles, extension handles.
  - Train workers to assess all material handling tasks and to ensure that the path is clear of obstructions/trip hazards when carrying items.
  - Do not carry objects up and down stairs if two hands are needed to hold objects. Keep one hand free to hold hand rail.
  - Improve housekeeping to prevent slips, trips and falls.
  - Require suppliers to include the weight on all objects/packages that are manually handled
  - Use shoulder pads when carrying loads on shoulders.

14 Appendix F: Tips for Preventing MSD

Fixed or awkward postures

- Provide height adjustability in a standing workstation.
- Establish a suitable working height depending on the type of work being done (i.e. precision, light or heavy work).
- Provide sit/stand stools at standing workstations and for tasks with prolonged standing.
- Provide height adjustable chairs.
- Utilize lift tables to keep the position the objects close to the worker.
- Utilize tilt tables to angle objects close to workers.
- Utilize rotating platforms to minimize reaching for objects.
- Provide self-elevating platforms in deep bins to keep items easily accessible and near the top of the bin.
- Provide false bottoms in deep sinks or containers.
- Limit shelf heights to between knee and shoulder height.
- Provide foot rests at standing workstations.
- Ensure the type of flooring will minimize shock absorption to the worker's body.
- Provide anti-fatigue matting for standing work areas with hard floor surfaces.
- Use devices such as lifts, duct jacks, scissor lifts, and extension poles or stands for operating tools overhead.
- Use adjustable scaffolds, aerial and other work platforms to raise the whole body closer to work.
- Place materials used often at appropriate height and less frequently used materials in less desirable locations.
- Use tables, benches, or stands to bring work to waist height

Repetition

- Implement well-designed job rotation.
- Add different tasks to the job to increase the variety of activities.
- Include flexibility in the job so the worker can control pace of work.
- Use a work/rest schedule that allows for frequent changes of activity.
- Encourage employees to take micro-breaks.
- Mechanize the task where necessary.

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Repeated impacts

- Look for tools/equipment that will eliminate the need for repeated impacts:
  - Use rubber mallets/other tools instead of the hand, and
  - Use power stretchers for carpet installations.
- Provide workers with well-designed padded gloves/knee pads.
- Change fittings/parts/equipment to minimize the forces used with repeated impacts.
- Limit the time duration required for repeated impacts.

Contact stress

- Change or modify equipment (e.g. use a long-handled screwdriver to prevent the butt from digging into the palm).
- Change or modify work area to prevent sharp edges from digging into skin (e.g. cover sharp or metal edges with padding).
- Use personal protective equipment (e.g. use knee pads while kneeling; use padded gloves when lifting heavy objects by narrow plastic strapping).
- Improve or change work practice to reduce resting or leaning against sharp edges.

Local or hand-arm Vibration

- Use vibration-absorbing padding on grips or handles.
- Provide employees with anti-vibration gloves.
- Keep tools well maintained/sharp to reduce vibration.
- Source various suppliers who can supply tools with lower levels of vibration.
- Reduce total exposure to vibration by alternating between tasks that use vibrating tools and tasks with non-powered tools or by incorporating job rotation between tasks.
- Use cutting or powerhead vibration dampening devices.
- Use equipment that includes vibration-dampening rubber grommets on controls and control box.

Whole-body vibration

- Avoid sitting or standing for prolonged periods on vibrating surface if practicable (e.g. avoid working on catwalks attached to vibrating machinery).

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- Isolate the source of vibration from the rest of the work space to prevent transmission of vibration to the sitting or standing area (e.g. isolation of truck cabs from diesel engine vibration).
- Train and instruct operators and drivers to:
  - Adjust the driver weight setting on suspension seats,
  - Adjust the seat position and controls correctly to provide good lines of sight and
  - Support,
  - Adjust the vehicle speed to suit the ground conditions to avoid excessive bumping and jolting,
  - Steer, brake, accelerate, shift gears and operate attached equipment smoothly, and
  - Follow worksite routes to avoid traveling over rough, uneven or poor surfaces.
- Choose machinery suitable for the job:
  - Select vehicles and machines with the appropriate size, power and capacity for the work and the ground conditions.
- Maintain machinery and roadways:
  - Make sure that paved surfaces or site roadways are well maintained (e.g. Potholes filled in, ridges leveled, rubble removed),
  - Maintain vehicle suspension systems correctly (e.g. Cab, tire pressures, seat
  - Suspension),
  - Replace solid tires on machines such as fork-lift trucks, sweepers and floor scrubbers before they reach their wear limits, and
  - Obtain appropriate advice (from seat manufacturers, machine manufacturers and/or vibration specialists) when replacing a vehicle seat. Seats need to be carefully matched to the vehicle to avoid making vibration exposure worse.
- Other measures
  - Introduce work schedules to avoid long periods of exposure in a single day and allow for breaks where possible.
  - Avoid high levels of vibration and/or prolonged exposure for older employees, people with back problems, young people and pregnant women.

Cold temperatures

- Ensure workers wear high-friction, well-fitting gloves.
- Ensure that workers wear clothing that keeps them warm without adding a lot of bulk
- Ensure hand tools are stored in a warm place prior to use.

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- Provide alternating periods of cold and warm work (worker rotation) and allow workers to take rest breaks in warm areas.
- Avoid having workers use tools that discharge cold gases over the hand.
- Provide local source heating (portable heaters) for workers.
- Educate workers about the adverse effects of cold and its influence on MSDs.
- Encourage workers to stay well hydrated

Hot work environments

- Provide alternating periods of cool/shaded and warm work (worker rotation) and allow workers to take rest breaks in cool areas.
- Provide local source cooling (portable spot chillers) for workers.
- Educate workers about the adverse effects of heat and its influence on MSDs.
- Encourage workers to stay well hydrated.

Work organization

- Ensure that repetitive or demanding tasks incorporate opportunities for rest or recovery (e.g. allow brief pauses to relax muscles; change work tasks; change postures or techniques).
- Incorporate task variability so that the worker does not have to perform similar repetitious tasks throughout the full shift. Provide the worker with the opportunity to vary work tasks by rotating jobs or increasing the scope of the job.
- Ensure that work demands and work pace are appropriate.

Work methods

- Evaluate jobs to determine whether work methods are compatible with worker capabilities.
- Analyze the differences in work methods between individuals to find the best work methods.
- Ensure that the official work method is the best work method and corresponds with what workers are actually doing.