SPECIFICATION AND MANUAL FOR THE ESTABLISHMENT OF A PUBLIC TRANSPORT CONTROL AND CALL CENTRE

KEITH MITCHELL and **LEE VAN DEN BERG***

Nelson Mandela Bay Municipality, P O Box 116, Port Elizabeth, 6000
Khuthele Projects, First Floor, Walmer Office Park, 13-17 Heugh Road, Port Elizabeth*

ABSTRACT

An integral part of the success of the proposed transformed public transport system in Nelson Mandela Bay Municipality (NMBM) is the establishment and effective operating of a passenger orientated control and guidance system for its entire public transport system - providing real time information to users, but also enabling better timetable synchronisation and centralised fleet control operations for the NMBM Transit Administration Agency (TAA).

BACKGROUND

Public transport in NMBM is faced with the enormous challenge to accommodate the growing volume of passengers and to provide attractive timetables and services at the same time. More up to date passenger information, improved passenger safety, better bus and train (in future) tracking, monitoring and automated control are only some factors which are crucial for the success of transformed public transport system.

Thus, an integral part of the success of the proposed transformed public transport system in NMBM is the establishment and effective running of a passenger orientated control and guidance system for its entire public transport system - providing real time information to users, but also enabling better timetable synchronisation and centralised fleet control operations for the Nelson Mandela Bay Transit Administration Agency.

The Nelson Mandela Bay Municipality Transit Administration Agency operations control system will ensure that the data from terminal devices at all bus (train in future) stations and stops flow together at the control level. Installations that should be connected to this system include ticket vending machines, as well as train (in future) and bus destination displays, public address systems, emergency call points, CCTV cameras and many more.

Operation and call centre staff are thus constantly kept informed about the current operational situation by various, problem-oriented, graphic overviews. This automation of routine processes relieves the burden on staff. Irregularities are automatically reported by integrated alarm functions enabling operators to concentrate fully on conflict solution and optimising operations. By means of a sophisticated event control function, the system analyses and filters out the data which is relevant for further processing. Failures can be handled manually or automatically. Thus, via the intuitive and convenient user interface any necessary manual input can be performed swiftly and accurately.

The operational control centre systems can be used to control origin, destination and information displays as well as trigger announcements over the public address system fully automatically. In special situations, e.g. additional buses, quick and easy manual triggering is possible via the operating interface. This enhances the quality of passenger information.

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The corner stone of the system is the location of the bus. It is determined in three steps:

1. GPS-satellite navigation plots the bus roughly on the right bus stop window (a section of the route before and after the bus stop)

2. Bus door opening at the bus stop locates the bus exactly on the right position along the route.

3. The bus location along the route is based on the odometer measuring the accurate distance of the bus from the preceding bus stop

Co-ordinated connections, including those with other modes of transport, increase convenience for travellers. The system monitors bus movements to make sure that connections can take place and give staff (train and bus drivers, interlocking staff, train and bus dispatchers) the appropriate instructions. Fully integrated CCTV monitoring ensures problem-free surveillance of passenger traffic by control centres. Especially during the evening and night this provides a significant improvement in passenger security without necessitating additional staff.

Control centre operators can communicate with stations and stops via the integrated audio installations, and passengers can speak to the call or control centre at all times via emergency call points. The integrated emergency stop device is a further important element in increased safety for passengers. Buses can be stopped by the control centre in the event that passengers are in danger, e.g. when boarding or leaving a bus.

WHAT ARE CALL, CONTACT AND CONTROL CENTRES?

A **call centre** is a centralised office used for the purpose of receiving and transmitting a large volume of requests by telephone. In general, one can say that a call centre is a group of people providing service at a distance using information and communication technology.

A call centre is often operated through an extensive open workspace for call centre agents, with work stations that include a computer for each agent, a telephone set/headset connected to a telecom switch, and one or more supervisor stations. It can be independently operated or networked with additional centre's, often linked to a corporate computer network, including mainframes, microcomputers and LANs. Increasingly, the voice and data pathways into the centre are linked through a set of new technologies called computer telephony integration (CTI).

In addition to a call centre, collective handling of letters, faxes, live chat, and e-mails at one location is known as a **contact centre**. Non-telephone interactions (e-mail, web, letter, and fax) account for less than 9% of a typical call centre's activities; the main skills required are still focused on listening and communicating through the telephone.

A **contact centre**, also known as customer interaction centre, is a central point of any organisation from which all customer contacts are managed. Through contact centres, valuable information about the company are routed to appropriate people, contacts to be tracked and data to be gathered. It is generally a part of company's customer relationship management (CRM). Today, customers contact companies by calling, emailing, chatting online, visiting websites, faxing and even instant messaging and vice versa.

DESIGN OF CONTROL AND CALL CENTRE

Ergonomics plays a very important role in the layout and design of the control suite. For this purpose reference is made to the ISO 11064 Standard for the ergonomic design of control centres. This Standard is divided in 7 parts, which each deal with a particular element with regard to the design of the control centre. Due to the similar nature in the control and call centre the same design standard must apply.

The 7 parts are as follows:

ISO 11064-1: 2000 – Principles for the design of control centres
ISO 11064-2: 2000 – Principles for the arrangement of control suites
ISO 11064-3: 1999 – Control Room layout
ISO 11064-4: 2004 – Layout and dimensions of workstations
ISO 11064-5: 2008 – Displays and controls
ISO 11064-6: 2005 – Environmental requirements for control centres
ISO 11064-7: 2006 – Principles for the evaluation of control centres

The first part is further broken down into 9 principles with parts 2 – 7 broken down into 5 phases and 11 steps to follow in order to design a control centre. The 9 broad principles that one must adhere to is as follows:

Principle 1: Application of human centred design approach with the objective to design adequate working conditions with regard to human safety, health and well being whilst taking into account technological and economic efficiency.

Principle 2: Integrate ergonomics in engineering practice. Ergonomics and its associated tools should be integrated into the projects management guidelines in order for the role of ergonomics to be taken into account by all designers and engineers involved in the planning, design, implementation and operational audit of the control and call centre. Integration of technical and ergonomic expertise is paramount.

Principle 3: **Improve design through iteration.** Evaluation to be repeated until the interactions between operators and designed objects achieve their functional requirements and objectives. A formal process to define and controls mechanisms and procedures for scope changes in the design of all aspects of the control centre.

Principle 4: **Conduct a situational analysis of existing or similar situations.**

Principle 5: A task analysis shall be conducted to fully understand the tasks delegated to individual control room and call centre operators and must consider all modes of system operation such as start up, normal operation, shut-down, anticipated emergency scenarios, periods of partial shut down for maintenance, the results used in the design process and development of staffing plans.

Principle 6: Design error-tolerant systems by way of a risk assessment for obtaining information on human error.

Principle 7: Ensure user participation in a structured approach where future users are involved in the design of the control centre in order to optimize long-term human-machine interaction by instilling a sense of ownership in the design.

Principle 8: Form and interdisciplinary design team to oversee and influence all phases of the design. The team must include system and process engineers, ergonomists, architects and industrial designers. The design team and users to be available at the appropriate time throughout the control and call centre design and implementation.

Principle 9: Document ergonomic design basis that reflect the ergonomic design basis for the control and call centre.

The Framework for the design process is a methodical sequence of procedures that focus attention on particular topics, design activities and iterative reviews and must involve the following phases:

Phase A: Clarification of the purpose, context resources and constraints of the control and call centre.

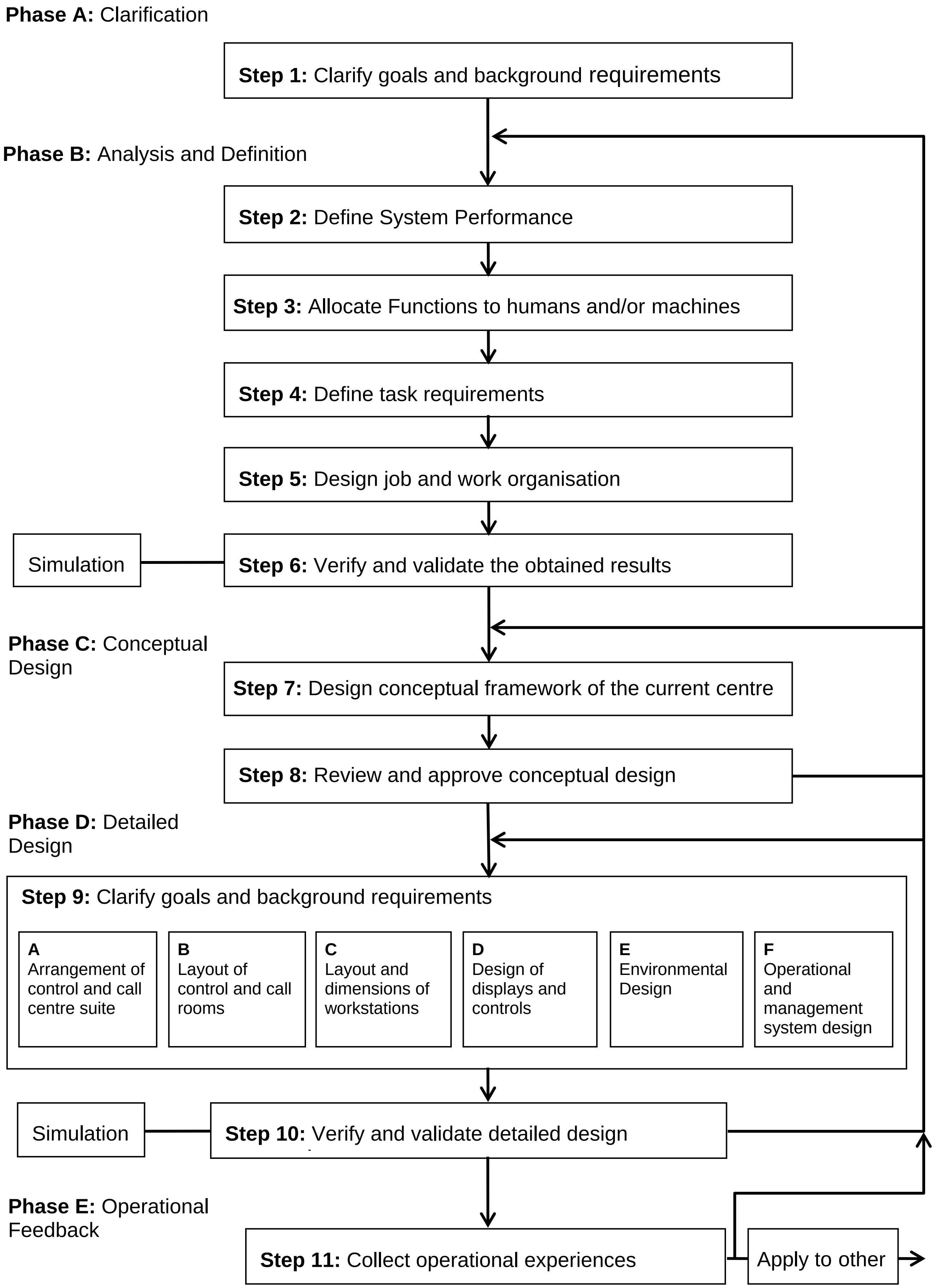
Phase B: Analysis and definition of the control and call centre's functional and performance requirements culminating in a preliminary functions allocation and job design.

Phase C: Develop a conceptual design of initial room layout, furnishing designs, displays and controls, and communication interfaces necessary to satisfy the needs identified in Phase B.

Phase D: Develop detail design specifications necessary for the construction and/or procurement of the control and call centre, its content, operational interfaces and environmental facilities.

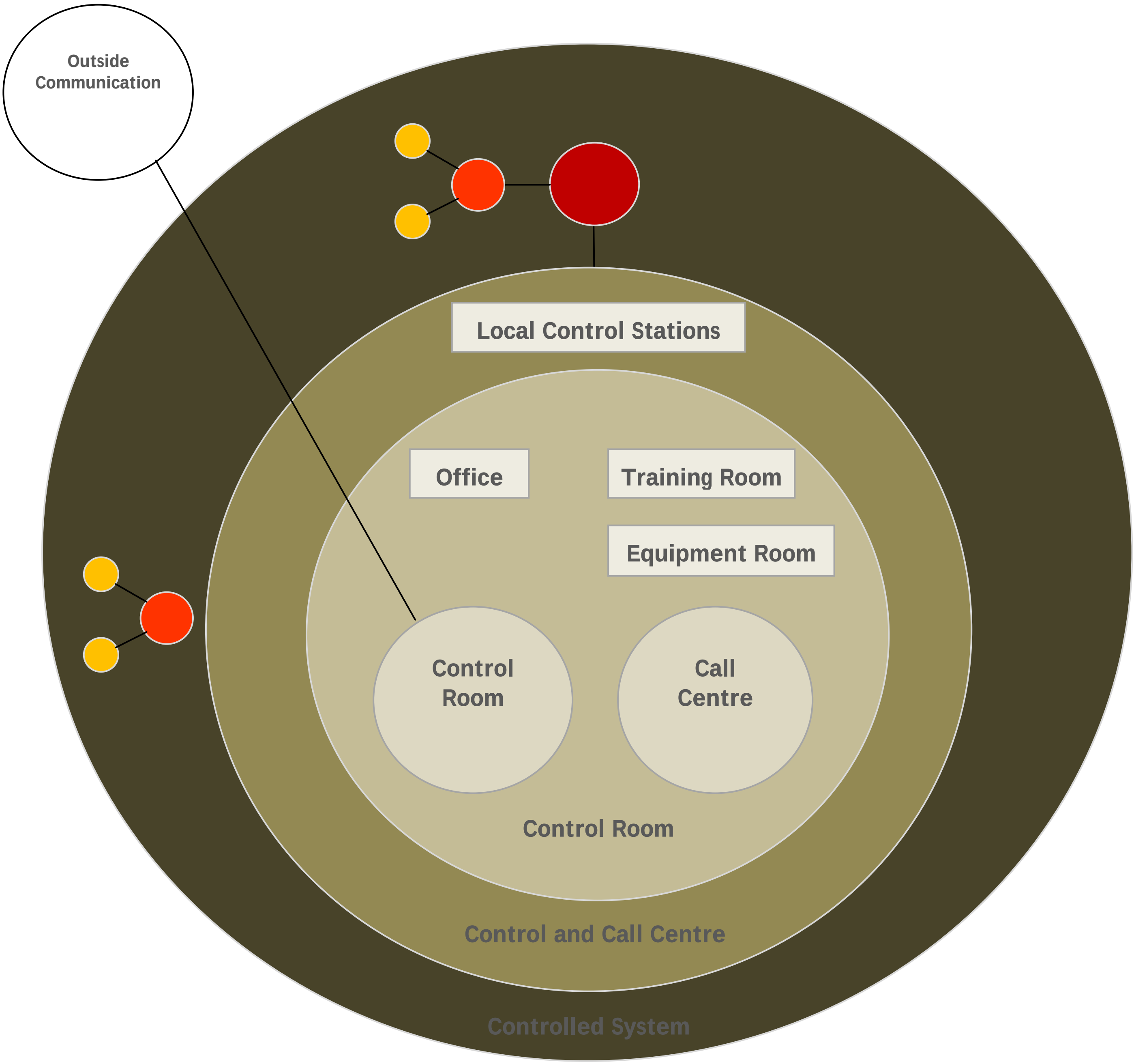
Phase E: Operational feedback by conducting a post commissioning review to identify successes and shortcomings in the design.

These phases are further broken down into 11 steps as shown in the diagram below.


Phase A: Clarification
Step 1: Clarify goals and background requirements
Phase B: Analysis and Definition
Step 2: Define System Performance
Step 3: Allocate Functions to humans and/or machines
Step 4: Define task requirements
Step 5: Design job and work organisation
Simulation
Step 6: Verify and validate the obtained results
Phase C: Conceptual Design
Step 7: Design conceptual framework of the current centre
Step 8: Review and approve conceptual design
Phase D: Detailed Design
Step 9: Clarify goals and background requirements
A Arrangement of control and call centre suite
B Layout of control and call rooms
C Layout and dimensions of workstations
D Design of displays and controls
E Environmental Design
F Operational and management system design
Simulation
Step 10: Verify and validate detailed design
Phase E: Operational Feedback
Step 11: Collect operational experiences
Apply to other

PHASE A: Clarification

The purpose of this phase is to clarify the operational goals, relevant requirements and constraints with the design of the control and call centre. The role of the control and call centre and its relationships with other relevant sub-systems are illustrated in the figure below:



The first and only step in this phase is to **clarify the goals and background** requirements for the control and call centre. The requirements to establish this is described in detail in Annexure B of ISO 11064-1:2000 and need to be followed meticulously.

PHASE B: Analysis and definition

Based on the findings in Step 1 a functional analysis must be carried out in **Step 2: Define system Performance** in order to identify the ergonomic needs required to achieve the objectives defined in Phase A. The functional analysis could be done by way of functional breakdown (IEC 60964), flow charts, simulations and operational walk-throughs. It must consider steady state operation, normal transient operation, emergency/abnormal operation and scheduled and unscheduled maintenance.

The performance requirements and functions identified in Step 2 must now be allocated to humans and/or machines in **Step 3: Allocate Functions to Humans and/or machines**. The allocation process must take into account the strengths and shortcomings of contemporary machine designs, of humans and past design experiences and performances and the consequences for safety, productivity and well being. Table 1 – Basic Procedures for the allocation of functions/tasks to humans and/or machines in ISO 11064 – 1:2000 must guide this step.

Step 4: Define Task Requirements requires a task analysis to be conducted to determine the fundamental elements of the tasks allocated to humans in Step 3. A record must then be drawn up of the task elements based on a systematic breakdown of tasks. Studies, walk throughs and surveys must be considered as a means to identify and qualify principal tasks and associated constraints, timing, and frequency requirements, potential control and call interactions, prerequisites, safety issues and anticipated environmental conditions. The task analysis must include preliminary engineering solutions based on opportunities for innovation and invention that may be identified.

Job design and work organisation must then be carried out in **Step 5: Design Job and Work Organisation**. The job designs must match operator's physical characteristics, cognitive and analytical abilities, organisational and leadership skills and social-system factors. It must not only consider the formal tasks allocated to humans but also the social aspects of work organisations and the individual's need for job satisfaction, measurable goals and rewarding growth opportunities.

Before commencing with Phase C: Conceptual Design, an intermediate verification and validation of the function/task allocations, task requirements, job assignments and work organisations developed in Steps 3, 4 and 5 must be performed as Step 6: Verify and validate the obtained results. All conflicts must me identified **and resolved** before proceeding with Phase C.

PHASE C: Conceptual Design

The purpose of this phase is to develop a comprehensive design of a control and call centre that satisfies the allocated functional and task requirements, job descriptions and organisational plans established in Phase B. The conceptual design must include the physical attributes of the control and call centre, its furnishings and any special amenities such as rest rooms, libraries, meeting rooms, etc.

The conceptual design must also include the proposed operator interface such as displays, controls, communications and multimedia applications. This activity must establish the context, target specifications and any constraints necessary to proceed with the detailed design in the consequent steps.

The results of the previous steps shall now be restructured systematically from integrated system performance viewpoint into a series of design concepts and preliminary specifications encompassing all intended aspects of the control and call centre's physical and functional characteristics in **Step 7: Design Conceptual Framework of the Control Centre.**

Governing design policies such as pre-chosen equipment vendors, system designs, etc must be clearly stated and documented. In addition all applicable user and regulatory guidelines, standards and building and other related regulations must be considered and included in the preliminary specifications.

This step and process must result in several design ideas that can be individually appraised and potentially combined to form an enhanced conceptual design

The next critical step is Step 8: Review and Approval of Concept Design by the client/owners, users and maintainers of the proposed control and call centre. This step provides a final opportunity to review and verify that the functional requirements have been accommodated by design ideas and technologies that are feasible, acceptable and in compliance with all applicable guidelines, standards, policies and good practice.

Step 8 enables the subsequent detailed design to proceed with a minimum risk of major functional revisions and physical changes.

PHASE D: Detailed Design following the previous step is:

Step 9A: Control Suite Arrangement – Earlier task requirements and job design process (steps 4 and 5) that influenced the conceptual design must form the basis of this step. The design specifications must facilitate the smooth transition between all the activities to be conducted in the control and call suite. Area requirements for other supporting functions such as equipment room, administrative office, meeting and crises rooms must be specified.

Step 9B: Control and Call Room Layout – The room layouts must be based on the task requirements and job designs defined in earlier steps as well as on the population characteristics. The proposed layout must support the operating links previously determined, including face-to-face communication, equipment sharing and team work.

Step 9C: Workstation Layout and Dimensions – All workstations must offer elements of adjustability if used by operators of different sizes.

Step 9D: Design of displays and controls – Display and control design specifications for the control and call rooms must be developed in this step. The design specifications must satisfy the functional specifications and task allocations done in step 3. Special attention need to be given to cognitive characteristics of the users. The density, contents and quality of information and its timely presentation are critical to consider and the device best suited for the control and call actions must be selected.

Step 9E: Environmental Design – The design specifications must meet ergonomic criteria in particular with regard to safe and comfortable working environments.

and

Step 9F Operational Management Systems Design – The operational and management requirements solutions must be developed in detail during this step.

The last step during Phase D is Step 10: Verify and validate Detailed Design Proposal. The detail design developed in steps 9A-F must formally be verified to ensure conformation to the design specification and must the formally be validated to ensure it conforms to the user needs. Verification and validation must pay special attention to operational safety, human error reduction, ergonomic design, environmental factors and job satisfaction and for this purpose a specific document describing the criteria and methods used in the validation and verification must be developed. Compromises taken during the design process must thus be well documented due to their importance for validation

PHASE E: Operational Feedback

Once the control and call centre has been completed and commissioned, operational feedback must be used to continue checking on the validity of the design of the control and call centre design during its lifespan. This must be achieved by collecting and examining operational feedback information after the start of the systems operation.

A post commissioning audit with the primary goal of recording both the design successes and shortcomings must be performed.

The final step in the specification and design of the control and call centre is Step 11: Collect Operational Experience and any identified ergonomic or other deficiencies should be collected during this step. Field observations, interviewing or any other systematic method could be used for this purpose. Use task analysis techniques to analyse the operational feedback information. Task analysis results must then be used when upgrading existing installations.

CONCLUSION

The Nelson Mandela Bay Municipality Transit Administration Agency Concept of Operations report, which will include amongst other the NMBM Public Transport Operation Plan, Advanced Public Transport Management System and Automated Fare Collection System Operators Framework, Proposed Organisational and Post Establishment for the Transit Administrative Agency (TAA) of NMBM, NMBM FIFA 2010 Transportation Operations Centre, User Requirements Specification reports, will address Phase A and B of the process and once finalised and accepted will form the basis on which the conceptual, detail and operational phases will be approached.

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