
INTERNATIONAL CENTRE FOR FACILITIES

A not-for-profit, non-governmental scientific and educational organization

440 Laurier Avenue West, #200 / Ottawa, ON, Canada K1R 7X6
Phone=613 727-1788 Fax=613 723-9167
www.icf-cebe.com

The “ST&M” approach: Functionality and Serviceability in the Life Cycle of Facilities

by Françoise Szigeti and Gerald Davis, ASTM fellow, IFMA fellow, CFM, AIA

DRAFT of 2002-03-04, prepared for presentation at meeting of CIB W060 Performance Concept in Building, at Hong Kong, May, 2002

To the reader:

The audience for this paper

- Business, institutional and government managers, who need facilities that best support operations.
- Owners, managers and occupiers of facilities, for specifying what functionality is needed and measuring whether it is provided.
- Financial managers and asset managers, for prioritizing spending on new construction, repair and rehabilitation.
- Building occupants, for communicating what they need to be able to do, or see, or hear, or experience, or not experience, in a place they use for work or other activities.
- Project managers for buildings and infrastructure, to enable numeric measurement, and therefore better control, of the qualitative aspects of a project.
- Architects, engineers and space planners, to measure and demonstrate the levels of functionality for the occupants and other stakeholders that is achieved in a design.
- Realty specialists and landlords, to find the best match between occupants and available properties, or between properties and market demand.
- Software managers, to help set the framework for information exchanges across all phases of the life cycle of a facility, from finance, through design and construction, use, operation and maintenance, and disposition.

What this paper is about

- What the “ST&M” approach is.
- How it helps communication among stakeholders in buildings and infrastructure.
- How it is used for planning and control in portfolio and asset management and during projects.
- How it is applied through the life cycle of a facilities, for operation, maintenance and evaluation.
- Its usefulness in projects, operation and maintenance.

Table of Contents

To the reader.....	1
1. Overview of the ST&M approach.....	3
<i>Figure 1. Core elements of the Serviceability Tools & Methods® approach.....</i>	<i>3</i>
The two kinds of scales.....	4
Combination of required functions to match with a combination of physical features.....	5
<i>Figure 2. Topics of the Serviceability Scales (ST&M).....</i>	<i>6</i>
The scales are calibrated to the building stock.....	7
<i>Figure 3. Example of a pair of scales:.....</i>	<i>8</i>
<i>Figure 4. Explaining the parts of Serviceability Scales.....</i>	<i>9</i>
<i>Figure 5. Excerpts from a functionality requirement profile.....</i>	<i>10</i>
<i>Figure 6. Guideline for Levels for Scales for Offices.....</i>	<i>12</i>
<i>Figure 7. Guideline for Levels for Scales for Health Care Facilities.....</i>	<i>13</i>
<i>Figure 8. Guideline for Levels for Scales for the Service Life of Facilities.....</i>	<i>14</i>
Other types of assets.....	15
Use outside North America.....	15
Comparing demand and supply.....	15
<i>Figure 9. Comparison of functionality requirement profile with two properties on offer.....</i>	<i>16</i>
2. Functionality and Serviceability in the Life Cycle.....	18
<i>Figure 10. Phases in the Life Cycle when ST&M data is used.....</i>	<i>18</i>
<i>Figure 11. Level changes during the service life of a facility.....</i>	<i>25</i>
<i>Figure 12. Requirement levels change during the service life of a facility.....</i>	<i>25</i>
Totals and averages for a portfolio of buildings.....	26
<i>Figure 13. Example: select design-build proposal.....</i>	<i>27</i>
Selection of topics important for a "Lite" profile.....	27
<i>Figure 14. Different Occupant Groups Need Different Topics for "Lite".....</i>	<i>28</i>
3. Measuring Quality and Compliance for Performance-Based Building.....	29
Three Domains of Performance-Based Building.....	29
Figure 15. Domains of Performance-Based Building.....	30
From user language to codes and specifications.....	30
<i>Figure 16. ST&M as a performance-based component of the building process.....</i>	<i>32</i>
Models of Performance Systems.....	33
<i>Figure 17. Systems for specifying and measuring performance.....</i>	<i>34</i>
Quality Management and ISO 9000.....	34
ST&M answers questions.....	35
Appendix.....	36
Terminology.....	36
Index.....	38

1. Overview of the ST&M approach

The ST&M approach includes a method plus a tool (calibrated scales) for ensuring a good match between needs of owners, users and operators, and the facilities provided.

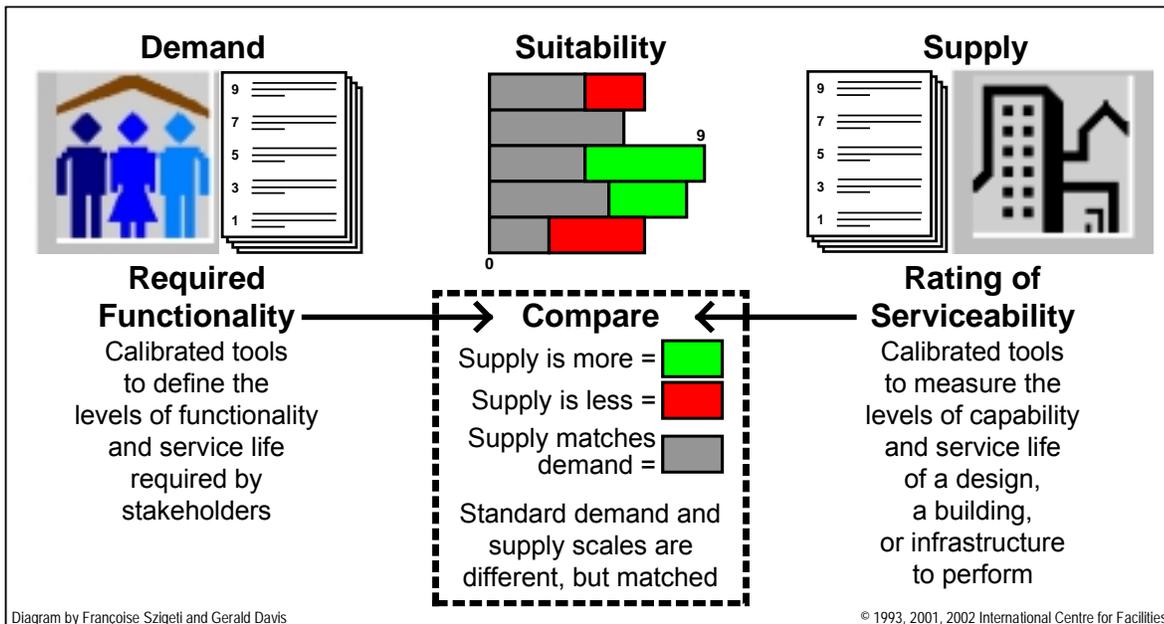
The ST&M approach supports performance-based building.

The Serviceability Tools & Methods® (ST&M)® approach ensures a good match between the needs of building owners, users and operators, and the capabilities of the facilities provided.

The ST&M approach uses a set of standard tools for measuring in broad terms what is needed and what is provided. It compares what functionality the occupant groups require and how well assets support those needs. It specifies requirements – of occupants, managers and owners – and measures how well a facility meets those requirements. The ST&M approach eases communication among stakeholders, and encourages collaboration. It provides essential content for Statements of Requirements.

The ST&M approach was standardized by ASTM and in 1996 became a set of American National Standards. It supports performance-based building by explicitly separating requirements of stakeholders from prescriptive measurement of compliance.

Figure 1. Core elements of the Serviceability Tools & Methods® approach



Summary of the Serviceability Tools & Methods approach.

- As diagrammed in Figure 1, the ST&M approach deals with:
- **Demand**, that is the levels of functionality and remaining service life required by occupant, owner, manager and other stakeholders.
 - **Supply**, that is the measured levels of serviceability, or capability to perform of a design, a building or infrastructure to perform.
 - **Comparison** between the two, to find the most suitable match.

Throughout the full life cycle of a facility, ST&M can be used for strategic and overall decision-making, and portfolio management, as well as for the management of individual assets.

ST&M considers a wide range of topics.

The ST&M approach examines more than 100 topics of functionality and serviceability, listed in Figure 2. The topics address a wide range of subjects, such as support for office work, amenities to attract and retain staff, support for information technology, security for staff and protection of assets, temperature and indoor air, and operating the building.

Results are transparent, replicable and auditable, and the process is fast.

Organizations with multiple facilities that share similar functions use the ST&M approach to create an accurate and consistent record. The results are transparent, replicable and auditable. ST&M speeds up the functional programming process and provides comprehensive, systematic and objective requirements.

The ST&M approach also includes formats to describe the organization and function-based tools to estimate the amount of floor space an organization needs. For more information, refer to *Serviceability Tools*, Volumes 1 and 2, published by the International Centre for Facilities, available through www.icf-cebe.com.

The two kinds of scales

In the ST&M approach, scales are used, giving a range of standard levels, so that stakeholders can choose how much of each attribute (topic) is needed, and then compare with the requirement levels that others have set, and with facilities they occupy, or might occupy in the future.

Two matched sets of scales.

For each topic, there are two scales. The first is a functionality requirement scale giving several levels of functionality. The second is a serviceability rating scale, which matches the levels of the functionality requirement scale, and describes features indicating levels of serviceability. Both scales are a special kind of multiple choice questionnaire. Each is calibrated so that levels of functionality and serviceability range from 0 (least) to 9 (most).

Example in Figures 3 and 4.

In Figures 3 and 4, a single topic is used to illustrate and explain these principles. In Figure 3, a set of matching scales is presented at full size. In Figure 4, it is annotated to explain how its parts comply with the principles outlined below.

Functionality requirement scales describe customer needs.

Each functionality requirement scale describes customer needs – demand – in non-technical, everyday language, that occupants and asset managers can understand. The multiple choice questionnaires allow them to select which statements best describe what levels of workplace functionality the occupants need so that their workplaces will support workers and enhance their effectiveness.

Thus the ST&M approach involves occupants and values their input. This increases the probability that results will be acceptable to all concerned.

Functionality requirement profile is the core of front-

The set of functionality requirement levels for a particular organization is called a functionality requirement profile. (Figure 5) It is the core of front-

end planning.

end planning, because it is independent of the facilities the organization now occupies, or other facilities they might possibly occupy in the future. Furthermore, because it is so acceptable to all concerned, it is a particularly valuable component of the Statement of Requirements for a facility.

In addition, the ST&M approach enables an organization to compare its functionality requirements and its facilities with other organizations in a broad range of industries, regions and cultures.

Serviceability rating scales measure the capability of a facility to meet a range of needs.

The second set of scales, at the right in Figure 1, and also at the right in Figures 3 and 4, is used to assess the capabilities and remaining service life of a facility. These serviceability scales describe features of facilities – supply – in performance language. The person who rates a facility is asked only to identify which level has the closest description to what is physically present, or is designed to be built. The set of levels of capability and service life selected from these scales constitute the serviceability rating profile of the facility. It is independent of any present or potential user group.

The serviceability rating profile can then be compared with the levels of required functionality or remaining service life, to test whether a particular facility or design proposal is suitable.

A facility is good or not good relative to a requirement profile.

Whether the serviceability and remaining service life of a facility is good, bad, or middling is not absolute. It depends on what is required. If the levels of capability of the facility are close to the levels of requirement, then it may be a good fit, such as the bar-chart comparison at left in Figure 9. Change the requirement levels, and the same facility might then become not so good.

Combination of required functions to match with a combination of physical features

At each level, the functionality requirement scales specify a bundle of required functions which should be taken together.

The topic titles in Figure 2 are broad subject categories that describe what people may need to be able to do, or see, or hear, experience, or not have to see or hear or experience, in or about a facility. To state functional needs precisely enough that facilities can be evaluated for compliance, each topic is subdivided into what are called *required functions*. Taken together, each bundle of required functions specifies what functionality is required at each level, for each topic.

For example, in Figure 5A, the topic A.2.1. Meeting and Conference Rooms, bundles the required functions for meeting and conference rooms: quantity and size of rooms; location in office; frequency of meetings; privacy and freedom from distraction; and audio-visual aids. (Figure 5B shows the levels in graphic format.)

In the serviceability rating scales, physical features are considered in combination, rather than separately.

On each topic, more than one building feature normally contributes to the capability to meet the requirement. Traditionally, however, building elements and systems have been tested and assessed separately from each other. Yet, for example, the performance of the lighting system will depend, in part, on the color of the paint on the walls and the light absorbency of the carpet and furniture.

Figure 2. Topics of the Serviceability Scales (ST&M)

A. GROUP AND INDIVIDUAL EFFECTIVENESS

A.1 Support for Office Work (E 1660)

- A.1.1 Photocopying and office printers
- A.1.2 Training rooms, general
- A.1.3 Training rooms for computer skills
- A.1.4 Interview rooms
- A.1.5 Storage and floor loading
- A.1.6 Shipping and receiving

A.2 Meetings and Group Effectiveness (E1661)

- A.2.1 Meeting and conference rooms
- A.2.2 Informal meetings and interaction
- A.2.3 Group layout and territory
- A.2.4 Group workrooms

A.3 Sound and Visual Environment (E1662)

- A.3.1 Privacy and speech intelligibility
- A.3.2 Distraction and disturbance
- A.3.3 Vibration
- A.3.4 Lighting and glare
- A.3.5 Adjustment of lighting by occupants
- A.3.6 Distant and outside views

A.4 Thermal Environment and Indoor Air

- A.4.1 Temperature and humidity
- A.4.2 Indoor air quality
- A.4.3 Ventilation air (supply)
- A.4.4 Local adjustment by occupants
- A.4.5 Ventilation with openable windows

A.5 Typical Office Information Technology (E1663)

- A.5.1 Office computers and related equipment
- A.5.2 Power at workplace
- A.5.3 Building power
- A.5.4 Telecommunications core
- A.5.5 Cable plant
- A.5.6 Cooling

A.6 Change and Churn by Occupants (E1692)

- A.6.1 Disruption due to physical change
- A.6.2 Illumination, HVAC and sprinklers
- A.6.3 Minor changes to layout
- A.6.4 Partition wall relocations
- A.6.5 Lead time for facilities group

A.7 Layout and Building Features (E1664)

- A.7.1 Influence of HVAC on layout
- A.7.2 Influence of sound and visual features on layout
- A.7.3 Influence of building loss features on space needs

A.8 Protection of Occupant Assets (E 1693)

- A.8.1 Control of access from building public zone to occupant reception zone
- A.8.2 Interior zones of security
- A.8.3 Vaults and secure rooms
- A.8.4 Security of cleaning service systems
- A.8.5 Security of maintenance service systems
- A.8.6 Security of renovations outside active hours
- A.8.7 Systems for secure garbage
- A.8.8 Security of key and card control systems

A.9 Facility Protection (E 1665)

- A.9.1 Protection around building
- A.9.2 Protection from unauthorized access to site and parking
- A.9.3 Protective surveillance of site
- A.9.4 Perimeter of building
- A.9.5 Public zone of building
- A.9.6 Facility protection services

A.10 Work Outside Normal Hours or Conditions (E 1666)

- A.10.1 Operation outside normal hours
- A.10.2 Support after-hours
- A.10.3 Temporary loss of external services
- A.10.4 Continuity of work (during breakdowns)

A.11 Image to Public and Occupants (E 1667)

- A.11.1 Exterior appearance
- A.11.2 Public lobby of building
- A.11.3 Public spaces within building
- A.11.4 Appearance and spaciousness of office spaces
- A.11.5 Finishes and materials in office spaces
- A.11.6 Identity outside building
- A.11.7 Neighborhood and site
- A.11.8 Historic significance

A.12 Amenities to Attract and Retain Staff (E 1668)

- A.12.1 Food
- A.12.2 Shops
- A.12.3 Day care
- A.12.4 Exercise room
- A.12.5 Bicycle racks for staff
- A.12.6 Seating away from work areas

A.13 Special Facilities and Technologies (E 1694)

- A.13.1 Group or shared conference centre
- A.13.2 Video teleconference facilities
- A.13.3 Simultaneous translation
- A.13.4 Satellite and microwave links
- A.13.5 Mainframe computer centre
- A.13.6 Telecommunications centre

A.14 Location, Access and Wayfinding (E 1669)

- A.14.1 Public transportation (urban sites)
- A.14.2 Staff visits to other offices
- A.14.3 Vehicular entry and parking
- A.14.4 Wayfinding to building and lobby
- A.14.5 Capacity of internal movement systems
- A.14.6 Public circulation and wayfinding in building

B. THE PROPERTY AND ITS MANAGEMENT

B.1 Structure, Envelope and Grounds (E 1700)

- B.1.1 Typical office floors
- B.1.2 External walls and projections
- B.1.3 External windows and doors
- B.1.4 Roof
- B.1.5 Basement
- B.1.6 Grounds

B.2 Manageability (E 1701)

- B.2.1 Reliability of external supply
- B.2.2 Anticipated remaining service life
- B.2.3 Ease of operation
- B.2.4 Ease of maintenance
- B.2.5 Ease of cleaning
- B.2.6 Janitors' facilities
- B.2.7 Energy consumption
- B.2.8 Energy management and controls

B.3 Management of Operations and Maintenance (E 1670)

- B.3.1 Strategy and program for operations and maintenance
- B.3.2 Competences of in-house staff
- B.3.3 Occupant satisfaction
- B.3.4 Information on unit costs and consumption

B.4 Cleanliness (E 1671)

- B.4.1 Exterior and public areas
- B.4.2 Office areas (interior)
- B.4.3 Toilets and washrooms
- B.4.4 Special cleaning
- B.4.5 Waste disposal for building

Therefore, each level of the serviceability rating scale contains the description of a combination of features that, acting together, indicate that the facility is likely to have the capability to meet the requirement that is stated in the corresponding level of the requirement scale. For instance, the topic A.2.1. Meeting and Conference Rooms, includes the features: mix and quantity; floor-plate configuration and access; acoustic control; indoor environment including air, illumination, temperature and visual access to the outside; and fixtures and fixed equipment, including sufficient ceiling height for a projection screen.

The serviceability rating scales give indicators of capability at each level, and not a complete specification.

The descriptions in the serviceability rating scale are classified to match the corresponding descriptions in the requirement scale, again, for example from level 1 to level 9. In many instances, the indicators are a more precise expression of the level required than the wording in a typical Solicitation for Offers (SFO).

Even so, the serviceability rating scales do not describe or identify *all* the features of a facility which, at a specific level, are likely to contribute to meeting that level of requirement. That would result in an unmanageably long list of features for each topic, and for most topics that would include some features that the person conducting the serviceability rating typically cannot easily observe directly, nor ascertain from documents.

Levels 9 to 1 signify most to least, not better to worse.

A level 9 in the scales indicates the “most” demand for a requirement or the highest capability and level 1 indicates the “least”. These levels do not indicate which level is better or worse for a particular occupant, user, or owner. For instance, a retail outlet and a corporate headquarters might each have a commercial need to be highly visible in their town. They might require a level 9 on the topic, “Identity outside building”. (Figure 3.) On the other hand, a country’s secret service might require a level 0 for its covert operations, signifying a need to be invisible, or at least as unobtrusive as practicable.

Level 0 is being added in current revisions.

When the scales were created and standardised, the range was from 1 to 9, as in Figures 3 and 4. During the process of revision and update, a level 0 is now being added. See Figures 6, 7 and 8.

The scales are calibrated to the building stock

Examples of guidelines for calibration of scales are given Figure 6 – *Guideline for Levels for Scales for Offices*, Figure 7 – *Guideline for Levels for Scales for Health Care Facilities* and in Figure 8 – *Guideline for Levels for Scales for the Service Life of Facilities*.

The scales are calibrated to the building stock, at levels 5, 9 and 1.

The scales are calibrated to the building stock in North America, which is a relatively stable base that evolves slowly over decades. The guideline for calibration of scales for offices is given in Figure 6. A level 5 on the serviceability rating scales describes what one would expect to find, for each topic, in a town of about 50,000 population, in a commercial building at least ten years old, that would be classified as Class B according to the scale of the Building Owners and Managers Association, International (BOMA).

“Class B: Buildings competing for a wide range of users with rents in the average range for the area. Building finishes are fair to good for

Figure 3. Example of a pair of scales:

A.11 Image to Public and Occupants

Topic A.11.6. Identity outside building

User Requirement Scale	Facility Rating Scale
<p><input type="checkbox"/> 9 ○ <u>Public exposure</u>: Operations require maximum exposure to the public. ○ <u>Ease of locating and identifying building</u>: The address, building and signage must be very easy for pedestrians or motorists to find and recognize, even for those unfamiliar with the locality.</p> <p><input type="checkbox"/> 7 ○ <u>Public exposure</u>: Operations require above average exposure to the public. ○ <u>Ease of locating and identifying building</u>: The address, building and signage must be easy to find and recognize, even for those not very familiar with the locality.</p> <p><input type="checkbox"/> 5 ○ <u>Public exposure</u>: Operations require average exposure to the public. ○ <u>Ease of locating and identifying building</u>: The address, building and signage must be easy to find and recognize, for those familiar with the locality.</p> <p><input type="checkbox"/> 3 ○ <u>Public exposure</u>: Operations do not require much exposure to the public. ○ <u>Ease of locating and identifying building</u>: Most visitors are regulars. Corporate image is not a high priority.</p> <p><input type="checkbox"/> 1 ○ <u>Public exposure</u>: Operations require that the office is obscure to the public, e.g. for security reasons. ○ <u>Ease of locating and identifying building</u>: There is no requirement at this level.</p>	<p><input type="checkbox"/> 9 ○ <u>Identity of building</u>: The building is a well known landmark. The building and entrance are clearly visible and recognizable. ○ <u>Corporate identity and signage</u>: The organization's identity is clearly recognizable, and readily visible from all directions. Direction signs are placed at main nearby transit stops. ○ <u>Quality of external signs</u>: The building has special custom signage, e.g. stand-alone elements, special lighting, and full information. All signs are in as-new condition.</p> <p><input type="checkbox"/> 7 ○ <u>Identity of building</u>: The building and building entry are clearly visible to passing motorists and pedestrians, and recognizable. ○ <u>Corporate identity and signage</u>: The organization is well identified from all directions.; Signage is adequate, and clearly visible on every approach to passing motorists and pedestrians. ○ <u>Quality of external signs</u>: Building signage is appropriate and typical, e.g. street address, building name, principal occupant group(s). Signs have no visible deterioration.</p> <p><input type="checkbox"/> 5 ○ <u>Identity of building</u>: The building and building entry are visible to passing motorists. The building is identifiable, and not easily confused with its neighbors. ○ <u>Corporate identity and signage</u>: The organization is identified to a minimum level. Signage is generally visible to passing motorists and pedestrians. ○ <u>Quality of external signs</u>: Building signage is appropriate and typical, e.g. street address, building name and, if appropriate, principal occupant group(s). Signs have no damage or major deterioration.</p> <p><input type="checkbox"/> 3 ○ <u>Identity of building</u>: The building is obscured by other buildings from some directions, and from people approaching along the street from one direction. The building is very similar and hardly distinguishable from adjacent buildings. ○ <u>Corporate identity and signage</u>: The organization is not clearly identified. Signs are obscured from some directions, or are in poor light. ○ <u>Quality of external signs</u>: Signage is minimal or impaired, e.g. minimal information, weathered surfaces, partly damaged.</p> <p><input type="checkbox"/> 1 ○ <u>Identity of building</u>: The building is obscured by other buildings until viewed from directly in front, or, the building is not distinguishable from adjacent buildings, e.g. facades are almost the same. ○ <u>Corporate identity and signage</u>: There is no evidence of the organization's identity on the exterior of the building. Signs are obscured, e.g. by vehicles or other buildings. Signs are very poorly located or hard to read, e.g. signs are too high on the building, too small, the lettering is too small or low in contrast, or signs are in shadow. ○ <u>Quality of external signs</u>: Signage is minimal or badly damaged, with incomplete information, e.g. no street number or building name.</p>

<input type="checkbox"/> Exceptionally important.	<input type="checkbox"/> Important.	<input type="checkbox"/> Minor importance.
<input type="checkbox"/> Minimum threshold level =		<input type="checkbox"/> NA <input type="checkbox"/> NR <input type="checkbox"/> DP <input type="checkbox"/> LI

NOTES *Space for handwritten notes on Requirements or Ratings*

Figure 4. Explaining the parts of Serviceability Scales

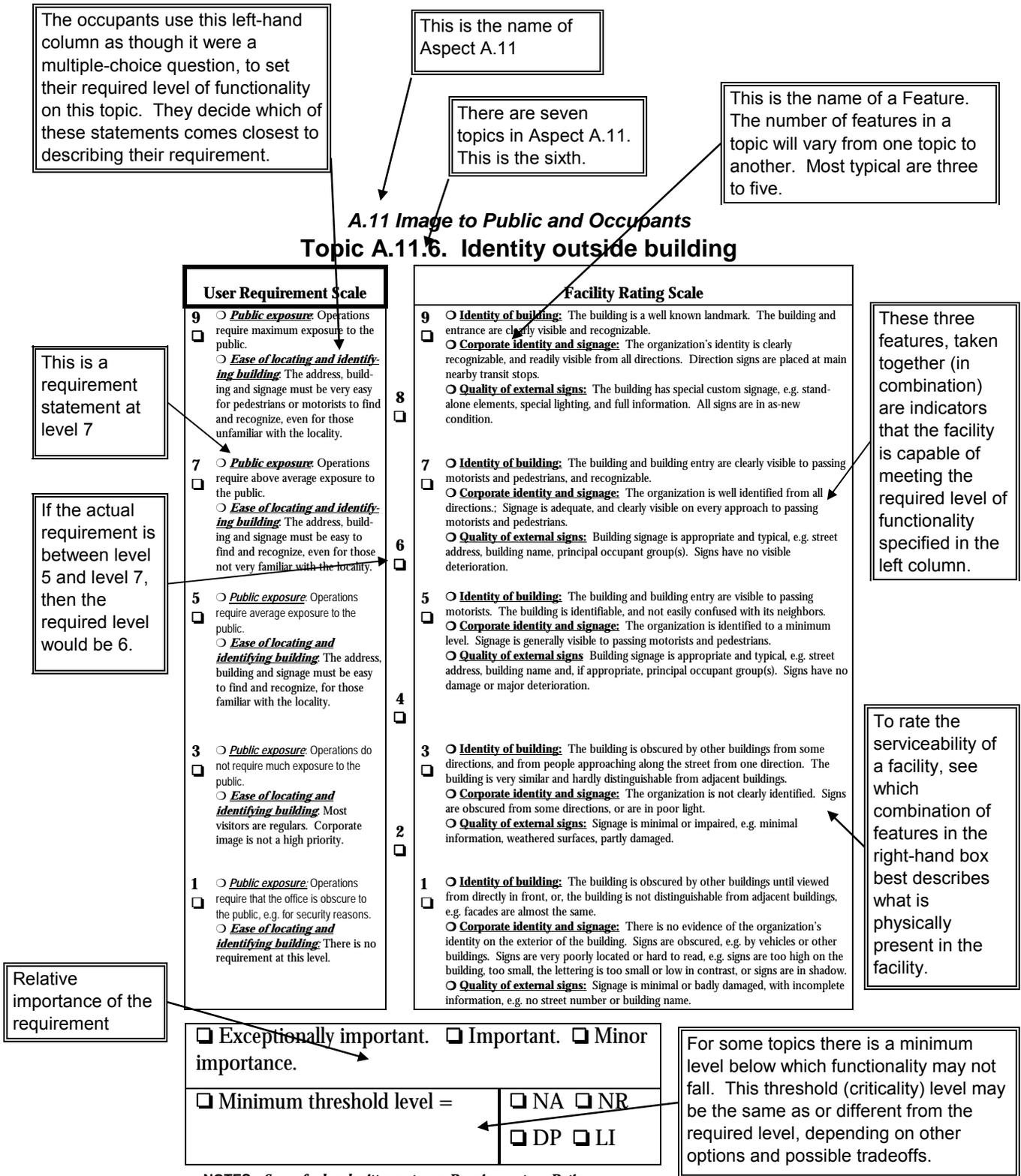


Figure 5. Excerpts from a functionality requirement profile

Figure 5A. Part of the text of a functionality requirement profile

Below is an excerpt from the text profile of a high-tech organization with a slow rate of change. This is the text from the requirement scales, at the levels selected for this organization. The wording of several topics has been fine-tuned to state more precisely the functionality that is required.

A.1.5. Storage and floor loading = 6

Important

Threshold = 0

OFFICE FLOOR STORAGE = 6

Operations require above-average areas of heavy storage ON office floors, e.g. 1% to 5% of floor area. Limited anticipated need for very heavy loads, such as compact rolling shelving, flat plan-files or a heavy safe, and these can be in areas designated as having extra structural capacity.

OFFICE FLOOR GOODS MOVEMENT = 7

Can be located in designated areas provided there is good access to an elevator. Hand trolley or battery-operated transporter with pallet is sufficient to move goods ON office floor. Hallways must accommodate heavy loads.

OFF THE FLOOR STORAGE = 6

Storage OFF the office floor is needed for between 3% and 5% of office floor area, with good environmental conditions, e.g. not high humidity, clean, ventilated. Includes requirement for storage of several workstations of office furniture for shipment off-site.

OFF THE FLOOR GOODS MOVEMENT = 5

Require secure access by elevator to this storage. Hand trolley or transporter (not battery driven) for cartons or lightly-loaded pallets is sufficient to move goods in elevators, storage and loading areas.

A.1.6. Shipping and receiving = 7

Threshold = 0

Exceptionally important

DOCK CAPACITY = 7

Loading dock capacity needs to be adequate most of the time, and able to accommodate all types of vehicles, with infrequent delays.

GOODS MOVEMENT = 7

Require shipping, receiving and elevator facilities that will provide for efficient handling of a substantial volume of movement of goods in and out of the office, including 45 ft semi-trailer rigs at least several times per week, and daily during some periods. Dock height must be suitable for large trucks.

PROTECTION OF GOODS = 7

Good security is required in holding area and storage area, e.g. secured storage and supervision of all movements. Must have protection from weather damage to goods.

COURIER PARKING = 6

Need parking for courier vehicles. Many organizations have frequent UPS and FEDX deliveries.

A.2.1. Meeting and conference rooms = 8

Threshold = 7

Important

QUANTITY AND SIZE OF ROOMS = 9

Operations require many types and sizes of meetings, including conferences of about 25 plus observers. During special operations, meeting rooms for up to 100 people are needed. An auditorium size space is occasionally needed.

LOCATION IN OFFICE = 9

On large floors, the meeting rooms need to be distributed throughout the office, and only a few of the largest rooms may be in a group at one location.

FREQUENCY OF MEETINGS = 7

Some meetings last for several hours or all day, but most are 2 hours or less. The frequency of meetings requires that some rooms be used almost continuously by successive groups. Meetings often involve visitors from other organizations.

PRIVACY AND FREEDOM FROM DISTRACTION = 7

The work requires good concentration, and above average privacy and freedom from distraction.

AUDIO VISUAL AIDS = 9

Audio-visual presentations are used extensively, e.g. video, overhead transparency, 35 mm slides, and display of computer information on large monitor or projection display, connected to local area network.

A.2.2. Informal meetings and interaction = 8

Threshold = 0

Important

VALUE TO ORGANIZATION = 8

To a significant degree, the success of the organization is dependent on the creative thinking, innovation and collaboration of its people.

PURPOSE OF MEETING AND INTERACTION = 8

It is very important that staff be aware of what people in other parts of the organization are doing, and how it might affect or be supported by their own work and ideas.

PARTICIPANTS IN MEETINGS AND INTERACTION = 7

Informal interactions and dialogue among staff with diverse roles and interests are to be encouraged, explicitly and implicitly. Interactions are to be encouraged among people from different branches, divisions and projects whose interests and objectives may compete or diverge.

A.2.3. Group layout and territory = 7

Threshold = 0

Minor importance

WORKGROUP PARTICIPATION = 8

Workgroups and project teams are or will be a very important part of operations, with between 10 % and 20% of the office staff participating at any one time.

FORMATION AND DURATION OF GROUPS = 7

Need to be able to set up workgroups with a few weeks advance notice. Most last for several months, but some last longer.

WORKGROUP SIZE = 7

Size of a typical workgroup varies over time, usually in a range from 3 to 12 people.

CONFIGURATION OF WORKSPACES = 5

All individual and group spaces of a workgroup must be in a single cluster. Workplaces of individual members must be close to or within the group's main workroom.

SEPARATION OF WORKGROUPS = 7

For protection of information or valuable assets, some workgroups require a wall around their cluster of individual and group spaces, with locked-door control of access. Each project team needs its

own group workroom. Several sub-groups may meet separately at | the same time.

Figure 5. Excerpts from a functionality requirement profile (continued)

Figure 5B. Graphic representation of the part of the functionality requirement profile from Figure 5A. Below is an excerpt from the full barchart of the functionality requirement levels for that organization.

GROUP AND INDIVIDUAL EFFECTIVENESS										
		A.1 Support for Office Work								
		1	2	3	4	5	6	7	8	9
6	- I									
	A.1.5 Storage and floor loading									
7	- E									
	A.1.6 Shipping and receiving									
		A.2 Meetings and Group Effectiveness								
		1	2	3	4	5	6	7	8	9
8	7 I							T		
	A.2.1 Meeting and conference rooms									
8	- I									
	A.2.2 Informal meetings and interaction									
7	- M									
	A.2.3 Group layout and territory									

“the area and systems are adequate, but the building does not compete with Class A at the same price.”

The calibration is being updated.

As the building stock evolves, the scales will need to be re-calibrated, some of them likely each decade. During 2001-2002, that re-calibration is under way. For instance, in response to changes in how typical buildings are wired to accommodate computers and telecommunications, the scales for cable plant have been updated and approved in ASTM.

Level 9 is the most required or found in the building stock.

A level 9 is calibrated to the most that one would generally expect to require, or to find for that topic for the type of facility listed in the scope for these standards. Other types of facilities may require or have more or less capabilities than that described in these scales. For instance, the most impressive image in a building lobby might be found in the corporate headquarters of a corporation of high prestige and national scope. The most security might be found at a facility where highly valued proprietary information is worked on, and the best access to public transportation might be in a government office with very high visitor traffic. On the other hand, these scales would not include enough security for a jail or for the core zone of an embassy, so neither of these facility types is included in the scope section of these standard classifications.

Level 1 is the least.

Similarly, a level 1 was calibrated to the least that one would expect to find for that topic. For instance, an organization with no public visitor traffic, and a high need for information security, might require a level 1 for identity outside the building, and for access to public transportation.

A requirement for all level 5 is never the best fit.

After individual and group interviews with thousands of users, owners and facility professionals, a level 5 on all topics has *never* been the optimum requirement profile: it is not the most functional; not the most effective for the organization; not the cheapest. In the few instances where senior management has directed that requirement level 5 be used across the board, the results were counter productive, and the directive was eventually abandoned. That is because level 5 is not calibrated to what is best or average for occupants;

Figure 6. Guideline for Levels for Scales for Offices

(Note: a similar set should be prepared for each type of facility for which scales are prepared)

Requirement levels for a topic Functional capability that Programs, Services or Activities may require of their facilities	Serviceability rating levels for a topic
<p>9 = Most technically demanding functional requirement Functional requirement that is the most technically demanding for this topic.</p> <p>8 = (Some of 9 and some of 7)</p> <p>7 = Special functional requirement Functional requirement that is clearly more than typically demanding, but not the most demanding.</p> <p>6 = (Some of 7 and some of 5)</p> <p>5 = Typical mid-range functional requirement Functional requirement that is taken as typically mid-range and normal.</p> <p>4 = (Some of 5 and some of 3)</p> <p>3 = Less demanding requirement in an office function, program, or service Requirement that is clearly less demanding than a mid-range program.</p> <p>2 = (Some of 3 and some of 1)</p> <p>1= Requirement for the least practicable functionality Requirement that is appropriate in special situations, but is clearly exceptional.</p> <p>0 = Never acceptable in an office, "must not have"</p>	<p>Indicators of the set of physical features which, acting in combination, provide the required functionality. The scales do not <i>specify</i> the full set of required features at each level of serviceability. Instead, at each level they list <i>indicators</i> of whether the required features are present. If the indicators for a particular level are present, then it is probable that the full set of features for that level are also present.</p>
<p><input type="radio"/> Exceptionally important <input type="radio"/> Important</p> <p><input type="radio"/> Minor importance</p> <p>Minimum threshold level; or, level of criticality (if any) = 9 8 7 6 5 4 3 2 1 0</p>	<p>9 = Indicators of the combination of features that would meet a level 9 requirement The highest level of functional capability for this topic that is likely to be found in a facility to house office-type functions.</p> <p>8 = (Some of 9 and some of 7)</p> <p>7 = Indicators of the combination of features that would meet a level 7 requirement. Functional capability that is clearly more than level 5, but not the most capable found in office facilities.</p> <p>6 = (Some of 7 and some of 5)</p> <p>5 = Typical mid-range capability Functional capability that is taken as typical of a mid-range office facility, e.g. in a BOMA class B building in a town of 50,000.</p> <p>4 = (Some of 5 and some of 3)</p> <p>3 = Indicators of the combination of features that would meet a level 3 requirement. Functional capability that is clearly less than a level 5.</p> <p>2 = (Some of 3 and some of 1)</p> <p>1= Indicators of the least capable combination of features that is feasible or practicable. Least feasible functional capability or performance.</p> <p>0 = Not present, or do not have</p>
<p><input type="radio"/> NA = Not Applicable <input type="radio"/> DP = Decision Postponed</p> <p><input type="radio"/> LI = Lack Information <input type="radio"/> NR = Not Required</p>	

Figure 7. Guideline for Levels for Scales for Health Care Facilities

(Note: a similar set should be prepared for each type of facility for which scales are prepared)

Requirement levels for a topic

Functional capability that Programs, Services or Activities may require of their facilities

9 = Most technically demanding functional requirement

Functional requirement that is the most technically demanding for this topic within the field of health care, e.g. of a program or service at the fore-front for research or treatment for infectious diseases.

8 = (Some of 9 and some of 7)

7 = Special functional requirement

Functional requirement of a health care program or service that is clearly more than typically demanding, but not the most demanding.

6 = (Some of 7 and some of 5)

5 = Typical mid-range functional requirement

Functional requirement that is taken as typically mid-range and normal for treatment or care functions, e.g. in ambulatory care, outpatient diagnostic, or many recovery wards, in a municipal acute care hospital.

4 = (Some of 5 and some of 3)

3 = Requirement clearly less than level 5

Health care function, program, or service that is clearly less demanding than a mid-range program.

2 = (Some of 3 and some of 1)

1= Requirement for the least practicable functionality

In practice, this level of requirement would be tolerated only temporarily in any setting where health care or related functions occur - e.g. for emergency triage in a temporary disaster setting.

0 = Never acceptable in a health care facility, "must not have"

Exceptionally important Important

Minor importance

Minimum threshold level; or, level of criticality (if any)

= 9 8 7 6 5 4 3 2 1 0

NA = Not Applicable

DP = Decision Postponed

LI = Lack Information

NR = Not Required

Serviceability rating levels for a topic

Indicators of the set of physical features which, acting in combination, provide the required functionality.

The scales do not *specify* the full set of required features at each level of serviceability. Instead, at each level they list *indicators* of whether the required features are present. If the indicators for a particular level are present, then it is probable that the full set of features for that level are also present.

9 = Indicators of the combination of features that would meet a level 9 requirement

The highest level of functional capability for this topic that is likely to be found in a health care institution, e.g. in a university teaching hospital.

8 = (Some of 9 and some of 7)

7 = Indicators of the combination of features that would meet a level 7 requirement.

Functional capability that is clearly more than level 5, but not the most capable found in health care facilities.

6 = (Some of 7 and some of 5)

5 = Typical mid-range capability

Functional capability that is taken as typically mid-range or normal for treatment or care functions, e.g. likely to be found in ambulatory care, outpatient diagnostic, or many recovery wards, in a municipal acute care hospital.

4 = (Some of 5 and some of 3)

3 = Indicators of the combination of features that would meet a level 3 requirement.

Functional capability that is clearly less than a level 5, but that in practice may be tolerated within a treatment or care facility.

2 = (Some of 3 and some of 1)

1= Indicators of a the least capable combination of features that is feasible or practicable

In practice, this level of functional capability or performance would be tolerated only temporarily in any setting for health care or related function, e.g. emergency triage at a disaster setting.

0 = Not present, or do not have

Figure 8. Guideline for Levels for Scales for the Service Life of Facilities
Scales for the condition of a whole facility, and its main systems, components and materials

Requirement levels

For requirements set by Portfolio Manager, Asset or Property Manager, User, Investor, Owner, Lender or Insurer.

- 9 = Require full forecast service life of new materials, components or whole facility**
Full functionality for users or operators for next few years. No expenditures for R&A required.
- 8 = (Some of 9 and some of 7)**
- 7 = Require forecast service life at least two thirds that of new, and low risk of problems.**
Condition may have only minor effect on functionality. No major R&A expenditures required.
- 6 = (Some of 7 and some of 5)**
- 5 = Require forecast service life in range of one third to two thirds of new.**
Required to be fully functional, but accept problems typical for a facility of its age in that locality. No major R&A expenditures required, but some minor R&A.
- 4 = (Some of 5 and some of 3)**
- 3 = Keep in inventory. May be at or close to end of service life, but require functional condition.**
Require sufficient functionality that users can work, but facility operator may need special skills or support. Budget for major repair or rehabilitation.
- 2 = Likely to dispose of facility. Required only to be marginally or partly functional.**
Required to be at least partly or temporarily accessible, for service or to remove property. Not required for normal functions.
- 1= Will dispose of facility, or salvage value only**
No requirement for functionality. Facility not needed. May want to salvage some components or systems.
- 0 = Must not have this building, system, component or material;**
or: Not applicable in this context; or: Decision postponed, e.g. because lack information, or: Decision to not set a requirement level.

○ Exceptionally important ○ Important
○ Minor importance
Minimum threshold level; or, level of criticality (if any) = 9
8 7 6 5 4 3 2 1 0

○ NA = Not Applicable ○ DP = Decision Postponed
○ LI = Lack Information ○ NR = Not Required

Service life rating levels

The set of physical features and conditions which would *indicate* condition and forecast service life:

- (a) materials and workmanship,
- (b) relevant condition and design details, and
- (c) expected maintenance.

The scales do not *specify* the full set of required features at each level. Instead, at each level they list *indicators* of the condition and forecast service life. If the indicators for a particular level are present, then it is probable that the full set of features for that level are also present.

- 9 = Indicators of new or like new.**
Suitable for the full service life of a new construction or installation. Currently trouble-free.
- 8 = (Some of 9 and some of 7)**
- 7 = Indicators that forecast service life at least two thirds that of new, and low risk of problems.**
Only normal operating and maintenance in next few years. Little or no loss of functional capability.
- 6 = (Some of 7 and some of 5)**
- 5 = Indicators of forecast service life in range of one third to two thirds of new.**
Some normal repair or renewal projects forecast in next few years. Only minor effects on functional capability, typical for its age in that locality.
- 4 = (Some of 5 and some of 3)**
- 3 = Indicators of minimal level of functionality.**
Repair, renewal or other corrective action needed within the current budget cycle, or in the near future. Functional capability that is taken as typical of a minimally acceptable facility.
- 2 = Indicators of the end of normal service life. Marginally or partly functional.**
Not habitable, or system not functioning. Not OK for normal work or living., e.g. HVAC or plumbing or electric power not operating. Limited access permitted, e.g. only to repair or shore up, or to remove property.
- 1 = Failed but still in place.**
Facility not OK to work in or live in. Parts of a facility or system may be hazardous or have failed, e.g. only trained persons may enter facility or operate a system or component, and then only to reduce hazards, conduct repairs, or remove essential property.
- 0= Failed. Not functional, or hazardous.**
System, or whole facility, has failed, or is hazardous, or violates regulation. When applied to whole building, then entry prohibited under any circumstances.

instead it represents what commercial developers expected would be best for them in their particular circumstances at time of construction, two, three or more decades ago. .

The generic requirement profile that requires the most topics at a level 5 is for a general administrative office, based on interviews with thousands of occupants. Yet, more than a third of its topics are not at level 5. Thirty two topics are higher and four are lower than level 5.

Other types of assets

Scales also for other types of assets, and for measuring service life.

The original set of ST&M scales were intended for office, administrative and dry lab facilities. They also serve as part of the topics for health care, education and other functional categories. Most of these scales are part of the ASTM/American National Standards referred to above. Additional scales have been developed for other types of assets, such as maintenance shops, service centers and service yards. Yet other scales deal with policy requirements from a portfolio management point of view, to measure service life and to set priorities for budgeting purposes.

Use outside North America

Scales can be used "as is" outside North America.

The standard scales can also be used in any country outside North America. Using the same scales in other countries would provide objective comparisons among facilities regardless of location. For instance, requirement profiles can then be compared regardless of company, culture or country.

Or, scales can be re-calibrated and edited to fit the local building stock.

It is unlikely, however, that in countries outside North America, a level 5 in the standard scales will calibrate to a recognized component of the national building stock. Instead, the mid-level of the older building stock would have a profile that could then be compared to the North American level 5. Alternatively, the scales might be edited for a particular country or region, for instance, to make a level 5 reflect the mid-level of that country's older building stock.

Comparing demand and supply

Graphic comparisons are powerful tools for decision-making.

As shown in Figure 1, the essence of the ST&M approach is that it permits consistent, objective, auditable comparison between demand and supply, between the level of required functionality and the rated serviceability of a facility, or of a design for a facility.

Figure 9 shows part of one page of such a comparison. There is one bar for each topic. If all the topics are compared, the barchart printout fills more than 4 pages. Consistent with Figure 1, the grey zone of each bar fills the levels for which the serviceability levels meets a requirement level. Where there is green showing, the facility has more serviceability than required, that is,

Figure 9. Comparison of functionality requirement profile with two properties on offer

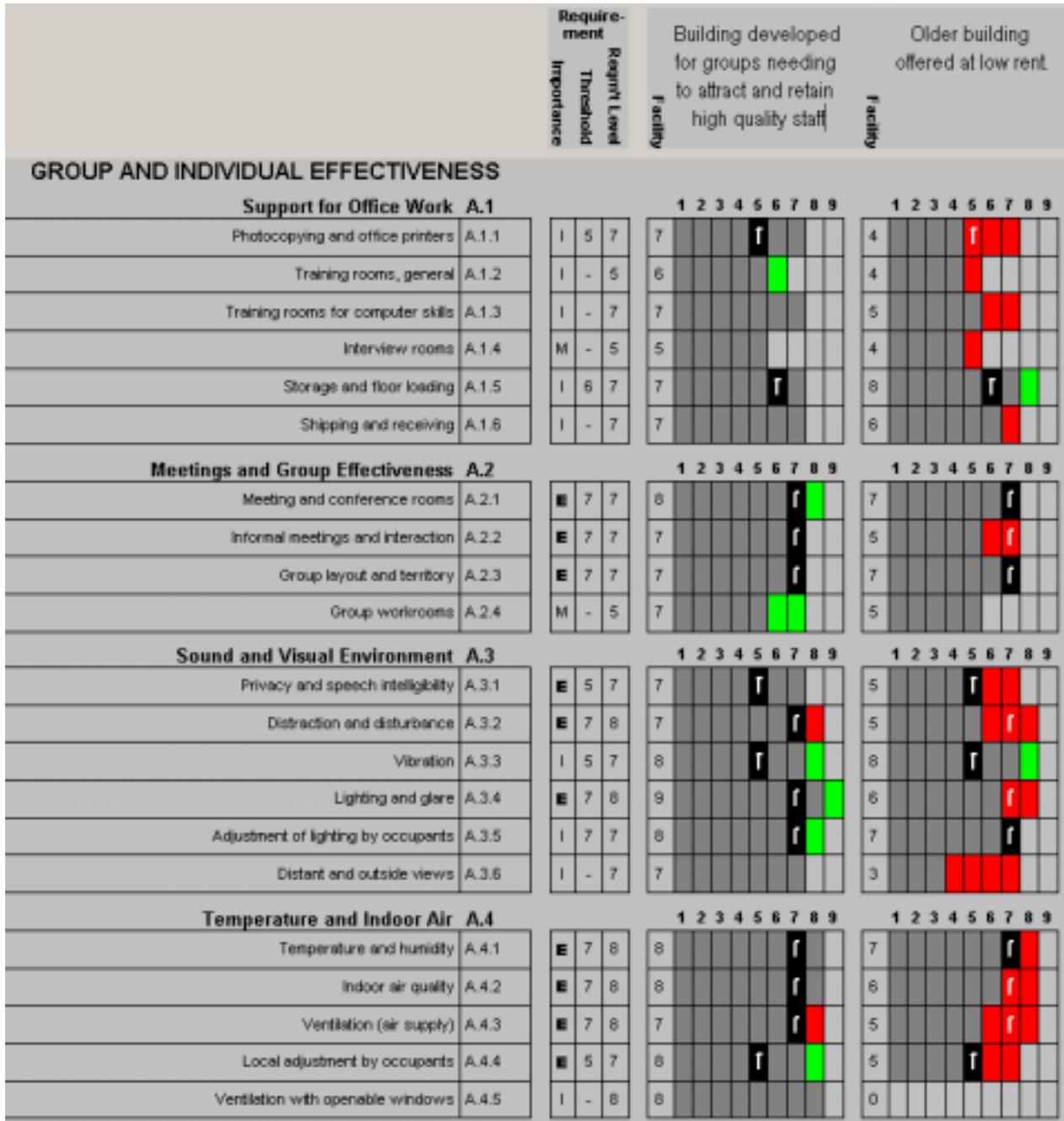
First 21 out of more than 100 topics

GREEN = Serviceability level is MORE than required

RED = Serviceability is LESS than required

GREY = Serviceability matches requirement

T = Minimum Threshold Level



there is a surplus of capability to meet the needs or support the operations of the users. Where there is red showing, the facility has less serviceability than required, that is, there is a shortfall of capability. Each white **T** indicates minimum threshold level required.

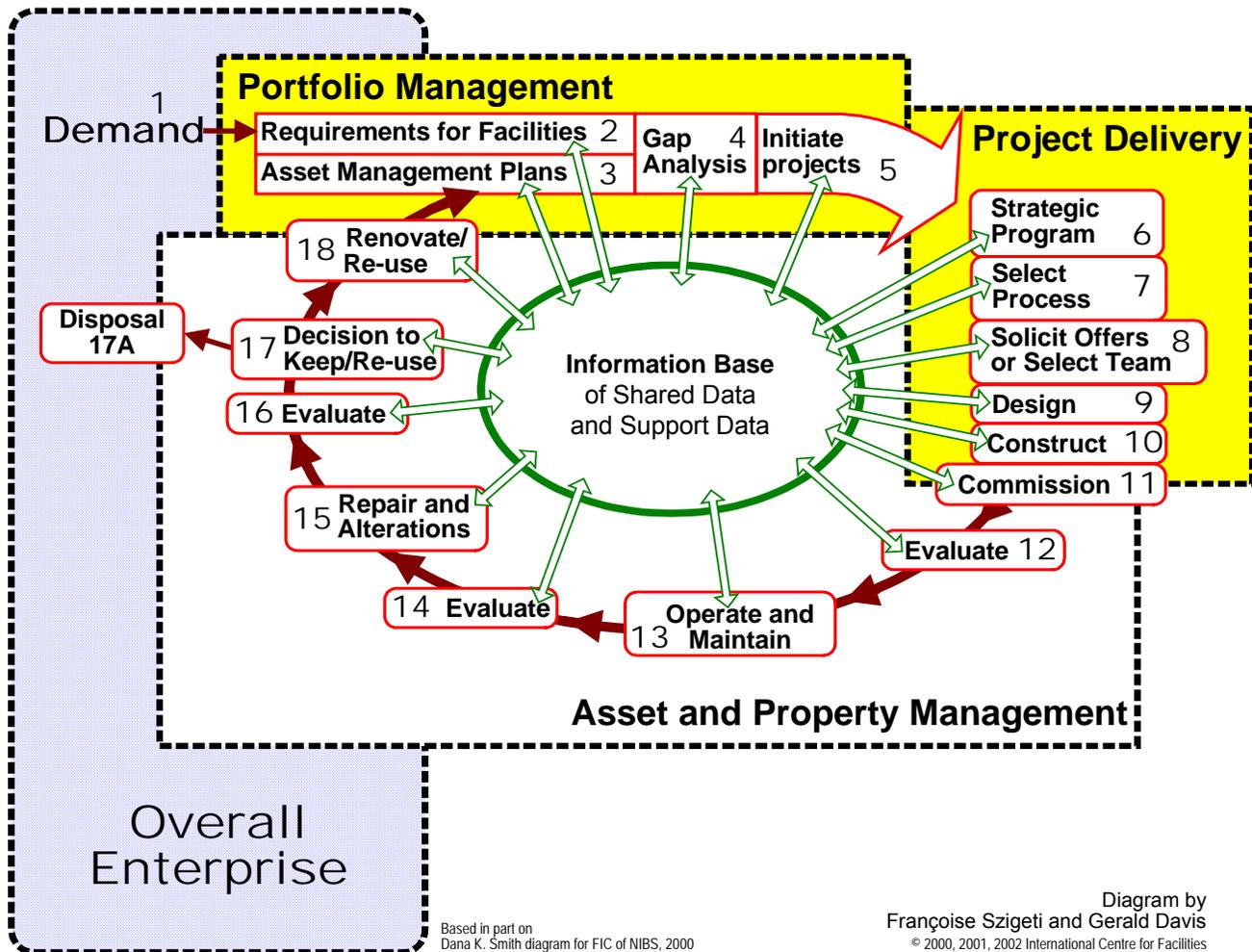
In Figure 9, one requirement profile is compared with two facilities. One facility meets the requirement on most topics, and does not fall below minimum threshold on any. The other facility is clearly inadequate for this group of occupants, since it falls below minimum threshold on many topics.

2. Functionality and Serviceability in the Life Cycle

Use ST&M for asset management at milestones during the entire life cycle of a facility.

Figure 10 diagrams the life cycle of a facility. The ST&M approach is useful in every phase in the diagram, that is, during the entire life cycle, starting with the analysis before a project is initiated and continuing until disposition, or until a major change or rehabilitation project.

Figure 10. Phases in the Life Cycle when ST&M data is used.



The numbers in Figure 10 identify typical activities in the life cycle of facilities. Those numbers are keyed to the explanations on the next pages, about the use of ST&M in each activity.

Once a functionality requirement profile has been created, it should be reviewed and adjusted whenever there is a significant change in mandate,

organisation or workflow. Some changes occur gradually over time, so functionality requirement profiles should be reviewed at least every five years.

The ST&M approach is used in many functional types of facilities. However, in the activity descriptions below, most examples refer to office workplaces, because the original scales were developed for them.

Serviceability rating profile is the core of an asset business plan.

All the levels of serviceability of a given facility, as a group, can be graphed as a single serviceability rating profile. Such a profile changes as property ages, or is renovated or altered. Such documentation is a useful part of the institutional memory of the status and changes that affect the facility over its life cycle, and serve as a convenient record.

1. Demand

Organizations without a functionality requirement profile can start by using one of the generic profiles created by ICF.

Each organization should have a **functionality requirement profile** that expresses the needs of each of its main categories of occupant groups, such as people doing routine administrative tasks, or its groups with much public contact. Each profile serves as a functionality baseline for the facilities that should be kept in the inventory.

Most occupant organizations do not now have a **functionality requirement profile**. Needs are rarely well articulated. For occupant groups lacking a functionality requirement profile, the International Centre for Facilities has developed a set of **generic functionality requirement profiles** to serve as a starting point.

Each generic profile represents the functionality needs of typical occupant units in one broad category of users. For instance, there are profiles for a generic general administrative office, for a corporate headquarters, for a high tech firm that is experiencing rapid change, and for a firm with advanced technology and slow change, and for organizations with special security needs. An organization can adapt one of these profiles to its own use, instead of having to develop its own profile(s) from scratch.

2. Requirements for Facilities

In addition to the scales, ST&M includes a method for estimating size of the space "envelope".

Most or all of the special requirements that derive from the culture and ways of working of an organizational unit will be provided for in the **functionality requirement profile**, using the functionality requirement scales. The amount of floor space needed, and proximities to or separations among main work , are groups not defined in the scales; instead other parts of ST&M provide for estimating the required space envelope, and diagramming the main proximity/separation requirements.

In some circumstances, using only a half of the topics, or even less, may be sufficient.

As noted earlier, the functionality and serviceability scales cover a wide range of topics, and more than 340 features. For most occupant organizations, at least a few are of minor importance, and only a quarter, or up to a half, are exceptionally important. Therefore, some organizations will create for each of their typical occupant groups a "Lite" **functionality requirement profile**.

Figures 13 and 14 show the topics that were selected for the Lite profiles of two different organizations. Each includes about 50 to 60 of the topics most important to them. Profiles created with these topics will present the levels of functionality or serviceability that will have the greatest effect on the effectiveness of each organization.

The asset management plan for each facility should include its serviceability rating profile.

3. Asset Management Plans

The asset management plan, or asset business plan, is the document that summarizes the physical and financial capabilities of a facility to house and support occupant groups. The **serviceability rating profile** of capabilities should be part of every asset management plan.

An asset management plan also includes the financial or business plan for the facility, including costs for operation and maintenance, costs and urgency of deferred maintenance, estimated market value and replacement costs, and a schedule of rents and revenues from the facility. It includes information about tenure (ownership, leasehold, planned disposition, etc.), about forthcoming milestone dates, about condition and needed remediation, any construction to remodel or rehabilitate expected in future years, and the general plans stating what groups, or category of groups, will occupy the facility.

Gap analysis of facilities in a portfolio.

4. Gap Analysis

During gap analysis of a portfolio, **demand and supply are compared**. The requirements of the users are compared against what is and will be available to meet those requirements. Shortfalls and surpluses are identified. Figure 13 gives a numeric tabulation that supplements the graphic comparisons, such as in Figure 9.

An organization may have a complete functionality requirement profile to compare against, or it may choose to compare against a subset of topics, in a Lite functionality requirement profile. It may also compare against one or more of the generic functionality requirement profiles created by the International Centre for Facilities, which cover several categories of occupant organizations.

Initiating a project if the match is not acceptable.

5. Initiate Projects

As a result of the gap analysis, it may be decided that the **match** between an existing **functionality requirement profile** and the **serviceability rating profile** of facilities now housing an occupant group is not be acceptable. Then, a decision may be taken to initiate a project proposal to provide new or changed facilities for that occupant.

The functionality requirement profile should be a component of the program for each project.

If such a problem is recognized, then, whichever **functionality requirement profile** was used, it should be confirmed or fine-tuned and customized, or a new profile created if necessary. Typically, this fine-tuning is a quick and easy task, which requires few elapsed days to organize and do. The outcome of the gap analysis should be confirmed with the up-dated profile, before proceeding into programming for a project.

If a project is found to be necessary, a first step is to ascertain the sources and availability of funds, by budget category.

**Statement of Requirements:
strategic programming.**

6. Strategic Program

In strategic programming, the essential functional information for initial cost estimates, and for concept design, are identified, and assembled as part of a Statement of Requirements. This includes at least sufficient information to start site studies and planning and massing studies:

- Description of the mission and main functions of the occupant group(s).
- Budget, based on estimated cost. Other financial considerations.
- Acquisition process.
- Overall size.
- Locality or site, and any specific site information, constraints and considerations.
- Timing, including required initial occupancy date, expected availability of funds, and other main milestone dates.
- **Functionality requirement profile to be used for initial planning.**
- Proximities and separations required for occupant groups.
- Specifics about special spaces that will not change during the project development process.

Determining the detailed requirements for typical unit spaces is best left until later, because often the requirements will evolve as occupants reconsider the changes they expect or need in their organization and corporate culture.

All of these bullet items are needed by the project team, whichever process will be used to acquire the facility. However, some processes, such as design-build may require more specific detail than others.

Select the process.

7. Select Process

The information in the **statement of requirements** from Activity 4 permits an informed choice of how to acquire the required functionality. For instance, the existing facility might be remodeled or rehabilitated; or a new facility might be acquired by traditional design-bid-build process or by a more integrated process such as design-build; or an existing facility might be leased; or a facility purpose-built for this tenant might be leased.

Solicit offers.

8. Solicit Offers or Select Team

If the occupant group will be a tenant in leased space, then a Solicitation for Offers (SFO) is prepared, based on the statement of requirements. The **functionality requirement profile** may be attached to an SFO, or its provisions may be incorporated into the text of the SFO by wording that calls for the specified level of functionality on each topic.

**Select team for a purpose-
built facility to lease or buy.**

If it is expected that a suitable facility will be purpose-built for lease or to own, potential landlords or design-builders may be invited to present their qualifications. The **functionality requirement profile** will help proponents to understand what will be required, and emphasize relevant capabilities.

Functional criteria in the statement of requirements will be helpful in selecting the proponent whose qualifications and proposal are most suitable. The **functionality requirement profile** will become part of the contract package for the new facility.

Select team for traditional design-bid-build.

If a traditional design-bid-build process will be used, selected parts of the statements of requirements, and especially the **functionality requirement profile**, should be available to firms competing to be selected as the design team or project manager.

Rate just before presentation of concept design(s) or schematics.

9. Design and preparation for commissioning

In the traditional design-bid-build process, the first task in the architect's basic service is to confirm the requirements to the owner, at an appropriate level of precision (not too much detail at start of the design process), in what may be called design or architectural programming.

Designs are tested for compliance with the **functionality requirement profile** by rating the levels of serviceability that can be expected if the design were to be built. Rating these levels can prove especially helpful when comparing designs with similar costs and completion dates.

Designs should be tested at least twice for compliance with the **functionality requirement profile**. The first time should be in the days leading up to presentation of concept design or schematics. By testing immediately before this milestone presentation, owner and occupants can objectively consider functionality issues, which otherwise are often obscured by the beauty of a presentation, or by a controversial design.

Even at this early stage, there is normally enough information to ascertain the levels of functionality that a proposed design would provide, on at least half the topics.

In a build-to-suit competition, **rating** three to six design proposals normally takes only a few days, and often results in a clear prioritization among proposals. Rating is usually done concurrently with financial analysis and other tasks in the review process, before the presentation to client management, and helps make the review more objective.

Commissioning starts during design.

In the planning and design of large or complex projects, the professionals who will commission and operate a facility, or surrogates for them, should have an active voice in setting design criteria. Their responsibility will be to ensure that functionality will not be compromised and that operating and maintenance costs will be within target for the entire service life of the facilities. Their first task will be to ensure that the Statement of Requirements, including the functionality requirement profile, are suitable.

Rate again near the end of design development, to confirm functionality.

The design should be **rated** a second time near the end of design development, in the days before a preliminary design is finalized and presented. If the budget is tight, some functionality is often lost after concept design, as cuts are made in the design in order to stay within the budget. **Rating** again just before presentation of preliminary design can confirm that the occupant requirements are in fact still being met, and reduce the risk of significant changes during the preparation of detailed construction drawings and

specifications, or worse, the risk of discovering the need for costly changes during construction.

Important for facility management, and for operation and maintenance.

This serviceability rating often will also bring to light strengths and concerns related to facility operations and maintenance. At this stage, it is still early enough to change design elements to **maximize functionality** of the facility from the perspective of the owner and operator, including operability and maintainability.

Critical input for value engineering.

A **serviceability rating** also provides essential input during value engineering studies by pointing out topics for which **surplus functionality** has been designed, and therefore where to start in identifying potential cost savings. A serviceability rating will also identify any topics which already have a **shortfall in functionality** and should not be cut further.

Rating each proposed cut in a project enables the team to **avoid reducing functionality** below minimum threshold level on any topic. It tells the team the functional consequences of each cost-cutting change. This is critically important to the business purposes of the occupants.

Rating during preparation of construction documents, and if the bids come in too high.

After design development, work starts on detailed construction drawings and specifications. Once these detailed documents are about 60 percent completed, they may be tested by conducting a third **serviceability rating**. This will ensure that functionality has not been lost in the hand-over from designers to the job captain in charge of the detailed construction documents, or in the working out of construction details.

10. Construction and early phase of commissioning

Rating when cost cutting is needed after bids are in.

If the price proposals for a construction project come in too high, it may be necessary to cut cost by revising the design and changing some features. When this happens, as noted above, it is important to verify that the changes have not reduced **functionality** below minimum threshold levels.

Rating when cost cutting is needed during construction.

Similarly, if it is necessary to make changes during construction, and to find the money for those changes by cutting other construction costs, effects on the match to **functionality requirement levels** should be ascertained, to ensure that occupant effectiveness at their work is not significantly compromised.

In move-in programming, the space planners gather the final details for layout of work stations and furnishings, and may adjust some partition locations as the count and final location of rooms is fine-tuned. This best occurs as close to move-in as practicable, typically a matter of months, not years, before completion of construction or build-out.

11. Move-in and Commission

Project evaluation during commissioning, and in POE.

When a project is evaluated during commissioning, or during post-occupancy evaluation (POE), a serviceability **rating** should be used to determine if the **required levels of functionality** have been achieved. This can typically be done in a few person-hours as part of the overall post-occupancy, or in about one day on site if done separately.

12. Evaluate

Project evaluation after

Evaluation of the facility may be needed if significant changes occur

construction, during occupancy.

during normal occupancy. In any evaluation, the **serviceability rating profile** should be compared against the **then current functionality requirement profile**. If several years have passed since the functionality requirement profile was approved by the occupying group, it may also be helpful to **verify** that the profile is still accurate.

For a property owner whose tenant is expected to move out, an up-to-date **serviceability rating profile** can be tested against the **functionality requirement profile** of potential other tenants. It should also be tested against the **functionality requirement profiles** of various market segments from which there is potential demand.

Selecting the priority requirements for operability and maintainability.

13. Operate and Maintain

The relative importance of requirements for operation and maintenance varies widely, depending on who is asked. As an example, the selected topics in the left column in Figure 14 includes eleven selected **functionality requirement** topics about the property and its management, operation and maintenance. They are important for those responsible for property or building management of the facilities occupied by tenants. The right column of dots in Figure 14 indicates the selected topics for an organisational unit that gave highest priority to attracting and retaining qualified staff in a difficult labor market. It includes only six topics about the property and its management and O&M.

Serviceability and condition change during the service life of a facility

Over time, the serviceability of many building systems, components and materials declines, such as roofing material, main heating and ventilating equipment, sealants around doors and windows, and door hardware and locks. therefore, serviceability levels on many topics should be verified. Typical changes in levels of serviceability and levels of condition during the service life of a facility are diagrammed in Figure 11, below. Of course, although this applies to some topics, such as the roof, or components of the mechanical system, it does not apply to others, such as the configuration of the floorplate or the location of the site.

As diagrammed at right in Figure 11, the service life of a facility is extended when a major repair or rehabilitation project occurs, such as replacing the roofing membrane or one of the main mechanical components after two or three decades.

After initial occupancy, what is required also changes. The kinds of work that occupants do evolves, and with it their working methods and functionality requirements change. One group of occupants is replaced by another, with different needs. Building codes change, as safety hazards and how to protect occupants are better understood. Then, the service life may be extended by refit or rehabilitation projects that bring the serviceability up to a new required level. This is diagrammed in Figure 12.

Figure 11. Level changes during the service life of a facility

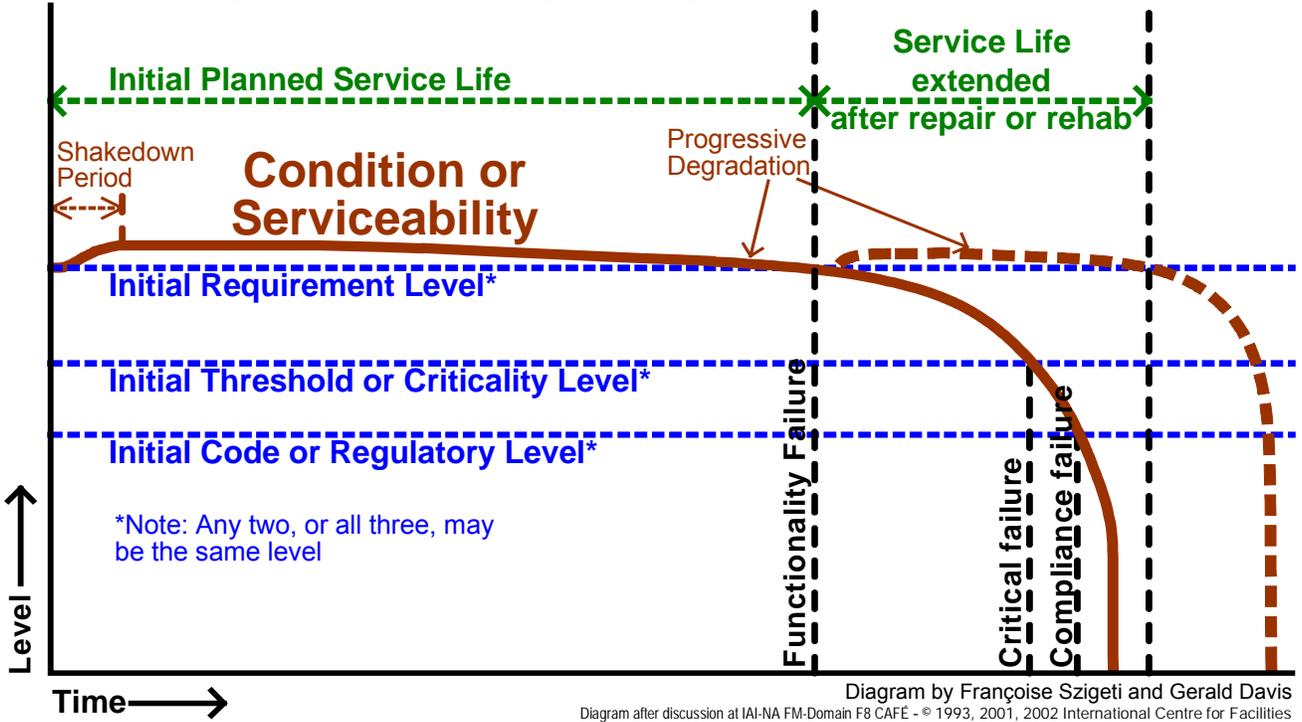
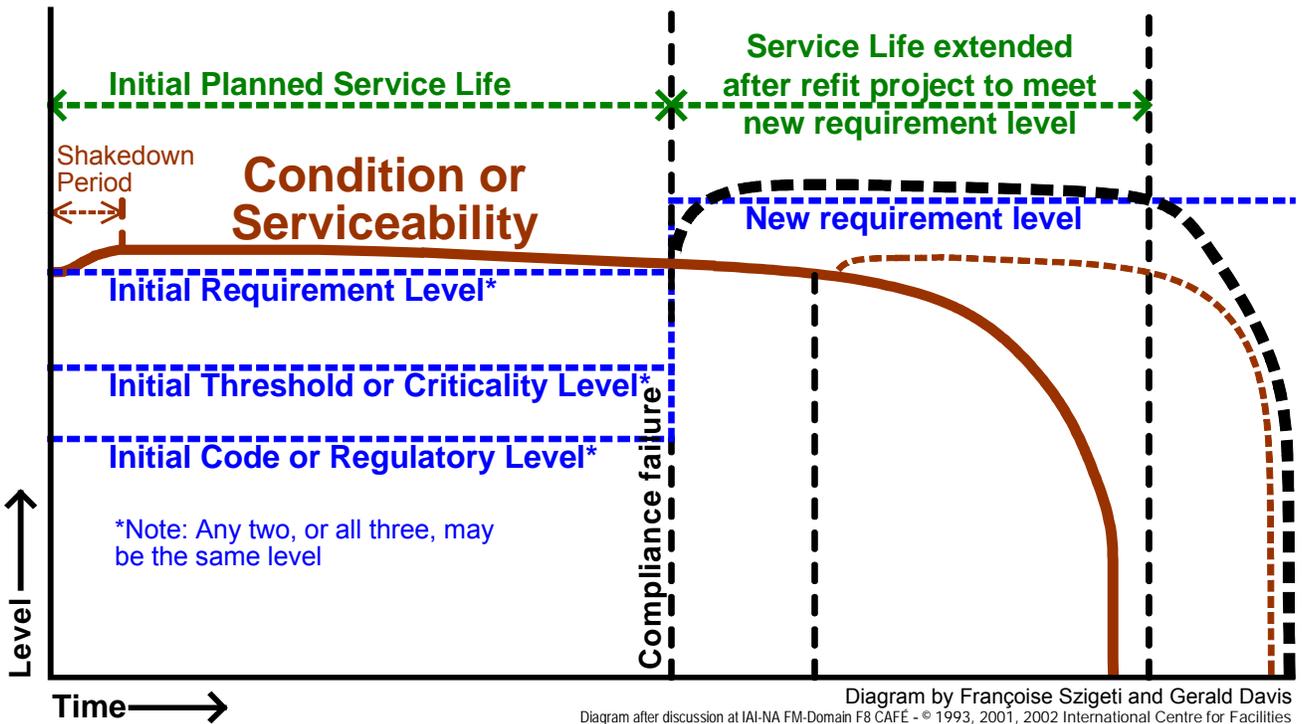


Figure 12. Requirement levels change during the service life of a facility



ST&M during the life cycle.

14. Evaluate

The **functionality requirement profile** should be confirmed or changed if the tenant organisation experiences significant changes in operations or in its external environment. Even if major organisational changes are not noticed, some significant changes in the profile(s) are almost inevitable, so a review is recommended after a few years – a five-year cycle is typical.

The facility also changes because of routine relocation of work groups. Therefore it is wise to review and update the **serviceability rating** of the facility after each major refit, remodel, or rehabilitation, and in any event at least once each five years.

Serviceability ratings and comparisons are expressed as a profile of levels and not a “bottom line” score.

Totals and averages for a portfolio of buildings

Serviceability rating profiles should not be expressed as a total of the serviceability levels, nor as an average of those levels. This would not be meaningful and would lump together many different kinds of strengths and concerns, and many different price tags. Worse, a single score or index number would likely mask significant gaps or deficiencies. Instead, a serviceability rating profile for a facility is far more informative than a single score and far less misleading.

A profile can be compared graphically, as in Figure 9, can be scanned quickly and permits “management by exception”. One facility is not necessarily better or worse than another, although they may have a different mix of levels of quality and capability. A facility can be quite appropriate for one occupant group and unsuitable for another. For instance, a building might have a mini-conference facility directly accessible off the main lobby, which could be very functional for a group with many visitors from outside the organization, whereas another group with a high need for confidentiality and few visitors would function better if its meeting rooms were dispersed and directly accessible to the staff areas.

Therefore, even though the arithmetic total or mean of rating level numbers might be identical, a building could match the requirement profile of one group but not the other. Depending on the functional needs of an occupant group, its location requirements and the financial envelope for the project, trade-offs can be made, based on such functionality and serviceability information.

Deviations from fit can be tabulated.

At the same time, the fit between a functionality requirement profile and several facilities can be expressed numerically. As an example, the serviceability of six design-build proposals were compared against the functionality requirement that was part of the Request for Proposals. Figure 13 gives the tabulation. In this example, Site 5 has the fewest topics for which information is lacking, and no significant shortfalls. However, it has 4 topics for which the serviceability rating is significantly higher than required. Those 4 topics should be checked to see if there is potential for cost savings by modifying the proposal to come closer to required levels of functionality.

Figure 13. Example: select design-build proposal

Significant Strengths	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Exceptionally important, and at least two levels above required functionality.	2	1	0	3	3	2
Important, and at least three levels above required functionality.	1	0	0	0	1	2
Total topics significantly above required level	3	1	0	3	4	4
<hr/>						
Significant shortfalls	Site 1	Site 2	Site 3	Site 4	Site 5	Site 6
Serviceability level less than minimum threshold	2	2	8	3	0	7
Exceptionally important, and at least two levels below required functionality.	2	1	4	2	0	6
Important, and at least three levels below required functionality.	2	1	4	3	0	4
Total topics significantly below required level	6	4	16	8	0	17
Topics for which serviceability level not known (lack information).	12	12	9	15	3	13

Selection of topics important for a “Lite” profile

There is no one best selection of topics for a “Lite” profile. The choice will in each instance depend on the objectives and priorities of the organization. A typical “Lite” profile uses about half the topics in the set of ASTM/American National Standard classifications, although some use only a quarter or a third, for example when scanning properties on offer to rent, to decide which to negotiate with.

The list in Figure 14 includes all the ST&M topics. Each column of dots indicates those topics that have been selected for inclusion in one Lite profile. The selections are different because each was created for a different organisation, each with its own objectives and priorities. Criteria for selection on in Figure 14 included:

- Left column: Topic is exceptionally important for facility managers in that organisation.
- Right column: Topic is exceptionally important for the typical occupant group of that organisation.

Figure 14. Different Occupant Groups Need Different Topics for "Lite"

Dots alongside a topic number and name indicate the topic was selected for a Lite profile. The left column of dots indicate which topics were selected by the group that provides facilities to the components of a large organization. The right column of dots, nearest to the topic number and title, indicates topics selected by a unit with a priority to attract and retain high quality staff in the changing labor market of the next decade or two.

A. GROUP AND INDIVIDUAL EFFECTIVENESS

A.1 Support for Office Work

- A.1.1 Photocopying and office printers
- A.1.2 Training rooms, general
- A.1.3 Training rooms for computer skills
- A.1.4 Interview rooms
- A.1.5 Storage and floor loading
- A.1.6 Shipping and receiving

A.2 Meetings and Group Effectiveness

- ● A.2.1 Meeting and conference rooms
- ● A.2.2 Informal meetings and interaction
- ● A.2.3 Group layout and territory
- A.2.4 Group workrooms

A.3 Sound and Visual Environment

- ● A.3.1 Privacy and speech intelligibility
- ● A.3.2 Distraction and disturbance
- A.3.3 Vibration
- A.3.4 Lighting and glare
- ● A.3.5 Adjustment of lighting by occupants
- A.3.6 Distant and outside views

A.4 Thermal Environment and Indoor Air

- ● A.4.1 Temperature and humidity
- ● A.4.2 Indoor air quality
- ● A.4.3 Ventilation air (supply)
- A.4.4 Local adjustment by occupants
- A.4.5 Ventilation with openable windows

A.5 Typical Office Information Technology

- ● A.5.1 Office computers and related equipment
- ● A.5.2 Power at workplace
- A.5.3 Building power
- ● A.5.4 Telecommunications core
- ● A.5.5 Cable plant
- A.5.6 Cooling

A.6 Change and Churn by Occupants

- ● A.6.1 Disruption due to physical change
- ● A.6.2 Illumination, HVAC and sprinklers
- ● A.6.3 Minor changes to layout
- A.6.4 Partition wall relocations
- A.6.5 Lead time for facilities group

A.7 Layout and Building Features

- A.7.1 Influence of HVAC on layout
- A.7.2 Influence of sound and visual features on layout
- A.7.3 Influence of building loss features on space needs

A.8 Protection of Occupant Assets

- ● A.8.1 Control of access from building public zone to occupant reception zone
- ● A.8.2 Interior zones of security
- A.8.3 Vaults and secure rooms
- A.8.4 Security of cleaning service systems
- A.8.5 Security of maintenance service systems
- A.8.6 Security of renovations outside active hours
- A.8.7 Systems for secure garbage
- ● A.8.8 Security of key and card control systems

A.9 Facility Protection

- A.9.1 Protection around building
- ● A.9.2 Protection from unauthorized access to site and parking
- A.9.3 Protective surveillance of site
- A.9.4 Perimeter of building
- A.9.5 Public zone of building
- A.9.6 Facility protection services

A.10 Work Outside Normal Hours or Conditions

- ● A.10.1 Operation outside normal hours
- A.10.2 Support after-hours
- ● A.10.3 Temporary loss of external services
- A.10.4 Continuity of work (during breakdowns)

A.11 Image to Public and Occupants (E 1667)

- A.11.1 Exterior appearance
- ● A.11.2 Public lobby of building
- ● A.11.3 Public spaces within building
- ● A.11.4 Appearance and spaciousness of office spaces
- ● A.11.5 Finishes and materials in office spaces
- A.11.6 Identity outside building
- ● A.11.7 Neighborhood and site
- A.11.8 Historic significance

A.12 Amenities to Attract and Retain Staff

- ● A.12.1 Food
- A.12.2 Shops
- A.12.3 Day care
- ● A.12.4 Exercise room
- A.12.5 Bicycle racks for staff
- A.12.6 Seating away from work areas

A.13 Special Facilities and Technologies

- ● A.13.1 Group or shared conference centre
- A.13.2 Video teleconference facilities
- A.13.3 Simultaneous translation
- A.13.4 Satellite and microwave links
- A.13.5 Mainframe computer centre
- A.13.6 Telecommunications centre

A.14 Location, Access and Wayfinding

- ● A.14.1 Public transportation (urban sites)
- A.14.2 Staff visits to other offices
- ● A.14.3 Vehicular entry and parking
- A.14.4 Wayfinding to building and lobby
- ● A.14.5 Capacity of internal movement systems
- ● A.14.6 Public circulation and wayfinding in building

B. THE PROPERTY AND ITS MANAGEMENT

B.1 Structure, Envelope and Grounds

- B.1.1 Typical office floors
- B.1.2 External walls and projections
- B.1.3 External windows and doors
- B.1.4 Roof
- B.1.5 Basement
- B.1.6 Grounds

B.2 Manageability

- B.2.1 Reliability of external supply
- B.2.2 Anticipated remaining service life
- B.2.3 Ease of operation
- B.2.4 Ease of maintenance
- B.2.5 Ease of cleaning
- B.2.6 Janitors' facilities

- ● B.2.7 Energy consumption

- B.2.8 Energy management and controls

B.3 Management of Operations and Maintenance

- B.3.1 Strategy and program for operations and maintenance
- B.3.2 Competences of in-house staff
- ● B.3.3 Occupant satisfaction
- B.3.4 Information on unit costs and consumption

B.4 Cleanliness

- ● B.4.1 Exterior and public areas
- ● B.4.2 Office areas (interior)
- ● B.4.3 Toilets and washrooms
- B.4.4 Special cleaning
- B.4.5 Waste disposal for building

3. Measuring Quality and Compliance for Performance-Based Building

Three Domains of Performance-Based Building

Three domains of performance-based building:

- **Demand.**
- **Production.**
- **Use and facility management.**

The announcement for the 2002 annual conference of CIB Working Commission W060 Performance Concept in Building states, "An important and critical success factor of Performance-Based Building is the integral treatment from the very first phase of project initiation throughout the design and build process to hand-over and use." The announcement provides several versions of a diagram of three "domains": demand (demand/use), production (supply), and use/facility-management (use/demand).

Figure 15 shows these three domains, and also the main activities of the life cycle of a facility, as diagrammed in Figure 10. This paper has focused on the domain of demand. As noted in the CIB announcement, in this domain, the client/users are supposed to be responsible (and liable) for defining and specifying what functionality is really needed. This paper reports on a family of tools and methods "(methods of measurement) to assess these expectations during the process and how to assess [how they are achieved] after delivery and hand-over".

Performance-based building is driven by needs of the enterprise, and measured against the initial program at planning stage, or strategic brief.

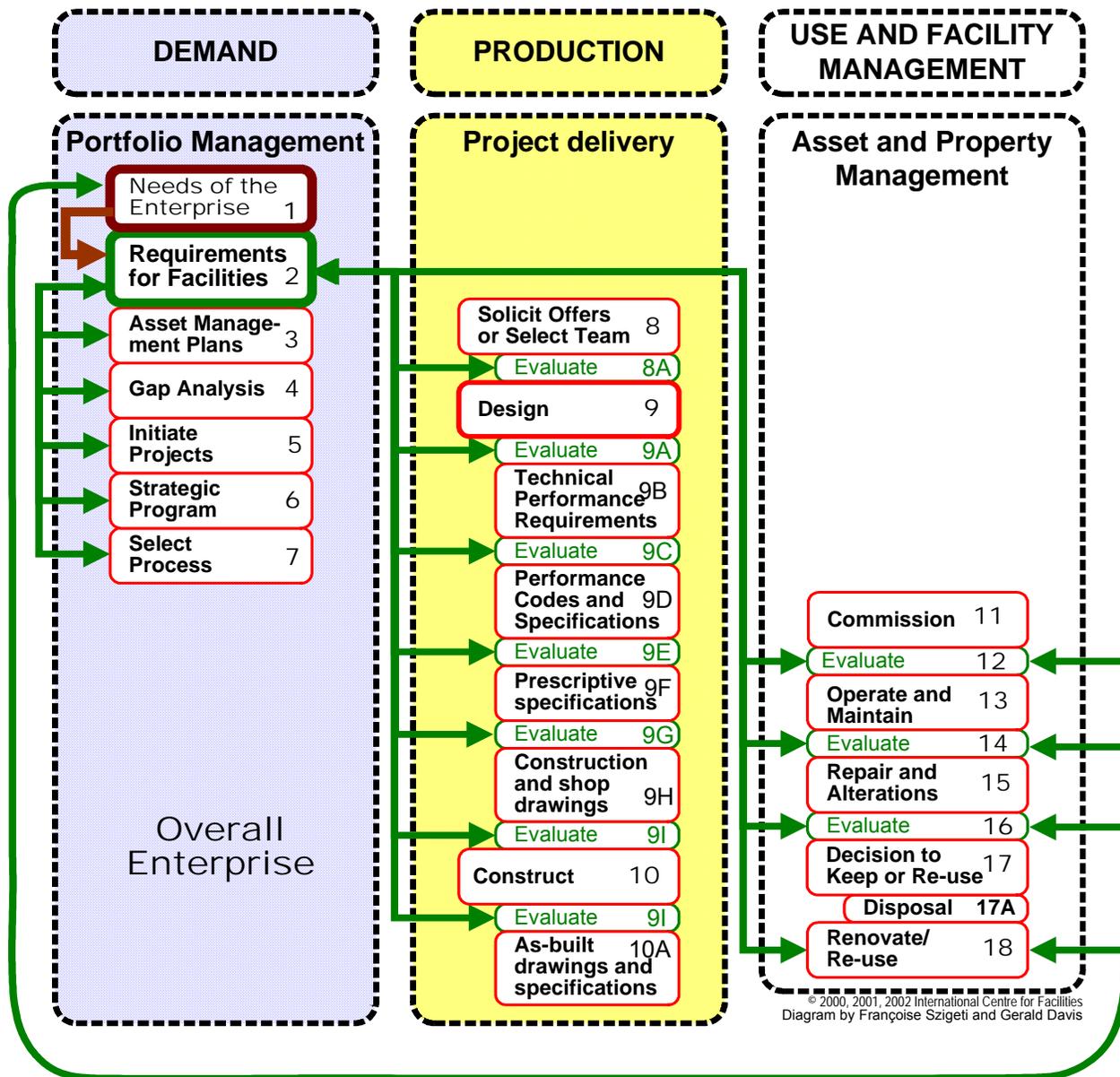
Figure 15 emphasizes the arrows that flow from and to Activity 2, Requirements for Facilities. For what becomes a new facility project, this is the first statement of requirements, sometimes called the "program at planning stage", or the "strategic brief." It should include the functionality requirement profile.

This profile should be kept current as an accurate statement of what is needed by the enterprise. As the enterprise evolves, the functionality requirement profile should be updated, because it is the measure against which the facility should be assessed. Each time there is a substantial change in the functions or activities of the enterprise, or of size or scope, the functionality requirement profile should be checked to ensure it is still valid. From experience, it seems that in any event, verification once each five years is desirable. This is because often people do not notice the "creep" in functions that occurs, until problems with a facility really start to "pinch", which means the facility is probably already impairing organizational effectiveness. At every stage thereafter, throughout the service life of a facility, this is the measure against which the facility should be tested.

The main work of Commissioning occurs at the hand-over to use, but it should start much earlier.

People involved in design and construction of buildings and infrastructure work mainly in the middle domain. Figure 15 complies with the CIB announcement in putting hand-over and commissioning (Activity 11) into the third domain, of use and facility management. However, Figure 10 recognizes that best practice typically includes Commissioning as an activity that should start early in the design process, taking into account requirements for how a facility will be maintained and operated.

Figure 15. Domains of Performance-Based Building



From user language to codes and specifications

The functionality requirement scales assist non-technical people to specify required performances.

Most people who work or live in buildings, when they think about it, can describe what they need to do while in the building where they work, or live, or exercise, or eat a meal, or shop. With the help of a checklist, such as the list of topics in Figure 2, they can tell which topics are particularly important for them, and which are of minor importance. That is how the selections of topics in Figure 14 were developed. With the help of a

questionnaire such as the functionality requirement scales, they can set many of the required performance levels that a building, or a facility in a building, must provide (column A of Figure 16) even though they are not able to specify these requirements in technical language.

Serviceability rating scales bridge between user everyday language, and the technical tests of building systems, components and materials.

The normal, day-to-day language in the functionality requirement scales cannot be used directly to assess how well a facility or a design complies. On too many topics, professional expertise and judgement, and technical test methods would be required. An intermediate translation is needed, from that normal everyday language of the users into the technical test methods of Column E of Figure 16.

The serviceability rating scales in column B of Figure 16 provide that intermediate translation. They do not ask what performance should be provided, since that has already been defined using the functionality requirement scales in Column A. Instead, at each level of a scale, they contain a description of physical features which, if called for in a design, or present in a building, that indicate whether the facility would likely meet the functionality requirement at that level. The user of a serviceability rating scale is asked, "Which of these statements best describes what is physically present in a facility, or what is called for in a design." That is non-judgmental, and can be verified objectively, and audited.

The ST&M information, with other program information, provides a basis for the business plan of a project.

Column C identifies other items of information and requirements which, taken together, comprise the strategic functional program for a facility, needed to permit initial cost estimating to set an overall project budget. To facilitate cost estimating, a cross-walk is being developed from the topic headings of the ST&M scales to the elements of Unifomat II, level 4.

The project budget is part of the financial performance requirements in Column D. This budget in turn becomes the basis for the financial analysis and business plan for the project, prior to the start of design.

Required performance and compliance measures in design and regulation.

Columns E and F refer to documents and regulations which require specific test results, but allow a building designer or provider latitude in how those results are achieved. Column F is still about the objectives and results to be achieved. In contrast, Column G is about the means of achieving those results. It refers to regulations or architectural specifications which state precisely what products must be used, or what engineering solution shall be employed. Requirements stated in prescriptive specifications leave little or no room for innovation by designer or builder.

Figure 16. ST&M as a performance-based component of the building process

Programming				Design				Construction and Commissioning			
A	B	C	D	E	F	G	H	I	J	K	Format
ST&M Performance-based functionality requirements	ST&M Serviceability features and indicators of capability	Other programming information	Financial performance requirements	Technical performance requirements	Performance codes and specifications	Prescriptive specifications	Construction drawings, Shop drawings and specifications	As-built drawings and specifications and manuals	Project evaluation	Facility, Product evaluation	
<i>Required levels of functional capability, expressed in users' everyday language, i.e. without terms of the building professions.</i>	<i>Features which act in combination to provide the required level of capability. The level is identified by what is physically present in a facility, or is proposed in a design.</i>	Description of the occupants and their activities, size of overall space envelope, any site location requirements, proximities and separations required in the design, criteria for special and typical unit spaces, etc.	Project financial proposal, giving required total costs; target and minimum viable revenues and yields, form(s) of tenure, required cash flows, etc.	Required levels of technical performance of building systems, components and materials.	Required performance of systems and components when certain conditions or loads occur.	Required components and materials necessary to achieve selected design and performance objectives. Model Documents.	Required shapes and sizes of what is to be built, giving precise dimensions and other properties.	Shapes and sizes of what was actually built, plus specifications of systems, components and materials as installed, plus catalog sheets and manuals for products and systems.	How the project process complied with criteria for cost, schedule, regulatory compliance, and technical compliance with the program.	How the facility in use complies with the original requirements and the requirements at time of evaluation, which may be different from original requirements.	What information is provided
<i>Examples: ASTM standard functionality requirement scales: (a) Aspect, (b) Topic (c) Element of required functionality</i>	<i>Examples: ASTM standard scales for rating serviceability. (a) Aspect, (b) Topic (c) Physical feature, and indicators of capability Scales for rating remaining service life and condition of a building or infrastructure asset.</i>	Examples: Components of some facilities programming documents prepared as part of owner-occupier documents provided to A&E team. Components of Request for Proposals for some design-build projects.	Examples: Financial feasibility analyses and criteria. Asset management plans. Asset business plans.	Examples: ISO Ctee Draft standards for single family housing. Requirements are expressed in 4 parts as: (a) Requirement or objective. (b) Criteria. (c) Test method. (d) Comment. Includes attributes	Examples: Some clauses or sections in existing building codes; some specifications for facility projects. New Zealand Building Code. Canada. Australia. Use of ISO 9000 series for building control in Sweden.	Examples: Construction specifications or clauses that use "Or equal".	Examples: Typical construction drawings, such as plans and construction details. Formerly were the blueprints used at a construction site. <i>ST&M rating of serviceability of design.</i>	Examples: Documents prepared as specific contract item, and delivered at completion of construction and shakedown.	Examples: Project process evaluation from analysis of info in the project files. Process review with project participants.	Examples: Building performance evaluation, POE, and <i>ST&M rating of serviceability</i>	Examples

There is a movement from prescriptive regulation and specification towards more performance-based building.

Each successive column to the right from E through H, is about stating requirements progressively more precisely and more prescriptively, giving less room for entrepreneurial initiative or invention. Some codes and regulations, and much of traditional architectural specifications, are almost as limiting as a doctor's prescription of a medicine: use this solution, and no other. The need for more open, less prescriptive requirements is now widely recognized.

Column E refers to ways of precisely specifying what technical test method shall be used to test and measure the performance of systems, components and materials. It assumes that the professionals who state these fine-grain technical requirements have a clear and precise understanding of what performances are needed, even though the owners and users can only describe their needs in non-technical, every-day language. Now, by using the functionality and serviceability scales, technical professionals can confidently establish an accountability chain that is transparent and auditable, all the way from user to technical test method.

ST&M through the life cycle of a facility.

As has been identified in the previous section, the ST&M approach can be used to test how performance during design, and then performance in use, comply with the functionality requirements, throughout the life cycle of a facility, whether a building or an infrastructure project.

Models of Performance Systems

The ST&M approach diagrammed alongside the movement towards performance-based regulation.

Figure 17 diagrams several two approaches to specifying the performance that is required, and ascertaining whether it is provided as required. On the left is the functionality and serviceability model. On the right are the top down and bottom up models for building regulation and building codes. Work is now under way in several venues to apply the principles of performance-based building to the regulatory systems of the world. For instance, in the right column, the bottom up approach is being applied in Canada, while the top down approach is being explored in some regulatory bodies in the USA.

Figure 17. Systems for specifying and measuring performance

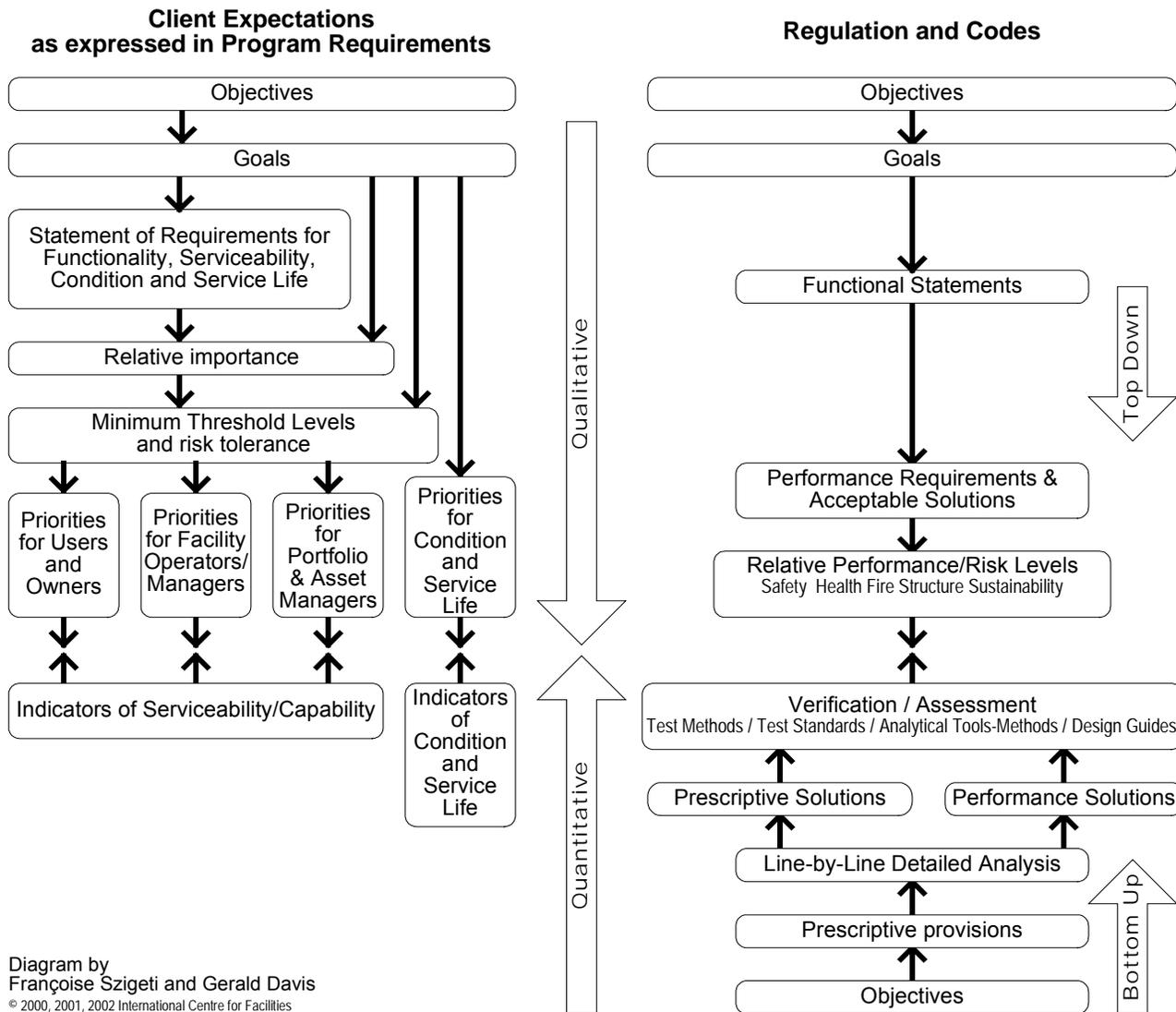


Diagram by
 Françoise Szigeti and Gerald Davis
 © 2000, 2001, 2002 International Centre for Facilities

Quality Management and ISO 9000

Quality management and ISO 9000.

Quality is described in ISO 9000 as the “totality of features and characteristics of a product or service that bear on its ability to satisfy stated and implied needs”. Those who provide a product or service, e.g. a facility, and its management and operation (O&M), should ascertain the explicit and implicit requirements of the customers (occupants), decide to what level those needs should be met, meet that level consistently, and be able to show that they are in fact meeting those requirements.

The starting point for Quality Assurance programs is the ability to determine and assess features and characteristics of the product or service, to

relate them directly to customers' needs, expectations and requirements, and to document it all in a systematic, comprehensive and orderly manner. A Quality Management System should include the means to monitor the compliance of all production phases, and to verify that the final product meets those stated and implied needs of the customer.

The ASTM Standards for Whole Building Functionality and Serviceability provide that starting point for a quality management system. They include the means to monitor and verify compliance, with respect to facilities. These standards provide explicit, objective, consistent methods and tools applicable to the field of building construction and real property. They are unique in that they are the only normative, standardized method to apply the concept and application of ISO 9000 to the creation of buildings as large and complex products.

ST&M answers questions

Applications in corporate real estate, portfolio and facility management, and user operations.

Functionality and serviceability, with the Serviceability Tools & Methods approach, have been used to answer questions such as:

- Should we stay in this facility or move?
- Which properties on offer should we decide to negotiate about?
- How do we assess the functional quality of our portfolio?
- How do we assess the functional quality of designs proposed for new or remodeled facilities?
- Which of these designs best match our program requirements?
- What are our typical functional needs? Can we take care of our special requirements
- Can we prepare corporate norms?
- For our regional offices, what are our typical needs?
- Can we compare the typical needs of similar groups?

Appendix

Terminology

facility function, *n*—purpose or activity for which a facility is designed, used, or required to be used.

functionality, *n*— being suitable for a particular use or function, ASTM E1480-92 (98)

facility performance, *n*—behaviour in service of a facility for a specified use.

DISCUSSION: The scope of this performance is of the facility as a system including its subsystems, components and materials, and their interactions such as acoustical, hydro-thermal, and economic, and the relative importance of each performance requirement.

facility serviceability, *n*—capability of a facility to provide the range of performances for which it is used or required to be used, over time, ASTM E1480-92 (98 – proposed revision 2002)

functional suitability, *n*—degree of match between the functionality requirement of a specific user and the serviceability of the facility being considered.

facility suitability, *n*— the degree of “fit” between requirement and asset, considering (a) the functionality requirement compared to the serviceability rating, and (b) the requirement for service life and condition compared to the expected service life.

facility durability, *n*—capability of a facility to maintain serviceability for a specified duration.

life cycle, *n*— the life of the facility, including planning, design, acquisition, operations, maintenance and disposal.

service life, *n*— the duration that the facility is in service or capable of being in service.

To accomplish the aims, objectives, goals, and targets of society, groups, and individuals, there is a trend to use a "performance approach" to define levels of expected results, describe levels that indicate that the service or product that would provide the required results at the same level, and measure actual results. The terms below reflect this dialog between Demand and Supply in a consistent way.

Demand Uses - Needs - Requirements - Wants - Wishes	Supply Service
Users Occupants -- Facility Managers / Building Managers -- Portfolio Managers – Visitors Other Stakeholders, such as Investors, Insurers, Municipalities, Code Officials, etc.	Constructed and Other Assets Facilities – Properties -- Buildings -- Building systems, elements and components, products and materials Infrastructure elements, such as bridges, highways, municipal waste systems, etc. Materiel
Define / State / Set	Provide / Assess / Rate
Inputs	Outputs
Ends, results, outcomes	Means, solutions
Functional statement	Performance statement
Statement of Requirements (SOR)	Explicit and implicit performance
Functional element	Physical Feature
Bundle of required functional elements	Combination of physical features
Functionality	Serviceability
Functional Performance	Technical Performance
Functionality Requirement Scales	Serviceability Rating Scales
User Functional Requirement	Asset / Facility capability
Functionality Profile	Serviceability Profile - Performance Profile
Functionality Requirement Profile	Serviceability Rating Profile
Functionality Level	Serviceability Level
User/Occupant Functions - Activities	Asset / Building/Facility Features
Bundle of Functions	Combination of Features
Description of Functions - Activities - Needs	Indicators of Capability
Demand for Functionality	Supply of Serviceability
Level of functionality	Level of Serviceability
Level of Demand (0 and 1-9)	Level of Service (0 and 1-9)
Criteria	Measure / Verification / Test method, etc.

Note: In Building Condition Reports (BCRs) or Facility Assessment Reports, if "functionality" is referred to, it is often a category of technical deficiency, which addresses the operative capabilities of a building component or system, not the user's requirements to be satisfied by the facility as it would be defined in the *ASTM Standards on Whole Building Functionality and Serviceability*.

These terms are compatible with the Performance System Model being proposed by the Inter-jurisdictional Regulatory Collaboration Committee (IRCC) and with the terms used in the CIB Report 64.

Index

- 50,000 population
 - town of, 7
- 9
 - range 1 to 9, 7
- 9 level
 - calibration for, 11
- accountability chain, 33
- acoustic control, 7
- acquisition process
 - in strategic program, 21
- activities
 - in the life cycle, 18
- administrative office
 - generic requirement profile for, 15
- air
 - in meeting and conference rooms, 7
- American National Standards, 3, 15
- asset management, 3
- asset management plans
 - phase of service life, 20
- asset manager, 14
- assets
 - other types of, 15
- ASTM, 3
 - original standards, 15
- attract and retain staff
 - criteria for selecting topics for Lite, 24
- attribute (topic), 4
- auditable, 4
- average level
 - level 5 not best, 11
- average of levels
 - discouraged, 26
- baseline, functionality, 19
- BOMA Class B building, 7
- budget
 - in strategic program, 21
- budgeting
 - set priorities for, 15
- build to lease
 - in process to acquire, 21
- building codes, 33
 - change over time, 24
- building stock
 - calibrate against, 15
 - build-to-suit competition
 - comparing functionality of proposals, 22
 - bundle
 - of required functions, 5
 - calibrated
 - scales, 4
 - calibration
 - re-calibration is under way, 11
 - Canada
 - approach to performance based regulation, 33
 - ceiling height
 - in meeting and conference rooms, 7
 - change
 - in functions of the enterprise, 29
 - CIB W060 Performance Concept in Building, 29
 - Class B buildings
 - on BOMA scale, 7
 - codes and regulations, 30
 - codes, building, 33
 - combination of features
 - in guideline, 12
 - commissioning, 23, 29
 - and move-in, 23
 - starts during design, 22
 - compare
 - with other organizations, 5
 - comparison between demand and supply, 3
 - components
 - service life of, 14
 - concept design or schematics
 - rate just before presentation, 22
 - condition
 - in asset management plan, 20
 - condition degrades during service life, 24
 - construction, 23
 - construction drawings, 23
 - core zone
 - of an embassy, 11
 - corporate headquarters
 - generic functionality requirement profile for, 19
 - cost cutting, 23
 - country
 - use in any, 15
 - culture
 - requirement profiles compared regardless of, 15
 - customer, 34

- date, required initial occupancy
 - in strategic program, 21
- deferred maintenance
 - cost and urgency of, 20
- demand, 3
 - comparing, graphically, 15
 - domain of performance-based building, 29
 - in life cycle, 19
- demand, terms for, 37
- demanding, most technically, 12
- design build process
 - may require more specific detail in program, 21
- design development
 - rate near end of, 22
- design-bid-build process
 - select process, 21
- design-build process
 - select process, 21
- developers, what would be best for them, 15
- disposal
 - of facility, 14
- domain
 - of performance-based building, 29
- durability, of facility, definition, 36

- effective
 - all level 5 not the most, 11
- effectiveness
 - of workers, 4
- embassy
 - security for, 11
- emergency triage
 - example in guideline, 13
- entrepreneurial initiative, 33
- envelope, space, overall size
 - in space program, 21
- evaluate
 - if significant changes in tenant organization, 26
- evaluation
 - during commissioning, 23
 - during normal occupancy, 23

- facility durability, definition, 36
- facility management
 - domain of performance-based building per CIB060, 29
 - important to rate for during design, 23
- facility serviceability, definition, 36
- facility suitability, definition, 36
- features, of facilities, 5

- financial or business plan
 - in asset management plan, 20
- fit
 - between facility and requirement, 5
 - fit can be expressed numerically, 26
 - fit, example of table, 27
- five year cycle
 - for evaluation, 26
- floor space, amount needed, 4
- forecast service life, 14
- formats, to describe organization, 4
- front-end planning
 - core of, 4
- functional
 - all level 5 not the most, 11
- functional suitability, definition, 36
- functionality requirement profile
 - change during the service life, 24
 - in demand phase, 19
 - most occupant groups not now have, 19
- functionality, definition, 36
- functions
 - required functions, 5

- gap analysis
 - phase in life cycle, 20
- general administrative office
 - generic requirement profile for, 19
- generic functionality requirement profiles, 19
- generic requirement profile, 15
- green
 - level is more than, 16
- guideline
 - Figure 6, for scales for offices, 12
- guidelines
 - for calibration, 7

- health care facilities
 - Guideline for, 13
 - guideline for levels, 7
- high tech firm
 - generic functionality requirement profile for, 19

- illumination
 - in meeting and conference rooms, 7
- important
 - in Guideline, 12
- index of serviceability
 - discouraged, 26
- institutional memory, 19
- insurer, 14

- integrated process
 - in select process, 21
- intermediate translation from occupants to technical, 31
- International Centre for Facilities, 4
 - web site, 4
- investor, 14
- ISO 9000, 34
- jail
 - scales not have enough on security, 11
- language
 - non-technical, 4
- language, every day normal, 33
- language, performance, 5
- least
 - for a topic, 11
- least, in scales, 4
- lender, 14
- level 5
 - never the optimum profile, 11
- level 9
 - calibration for, 11
- level, in scales
 - 1 to 9, plus 0, 7
- levels, in scales, 4
- life cycle
 - diagrammed in Figure 10, 18
- life cycle, definition, 36
- life cycle, of a facility, 3
- lighting
 - in meeting and conference rooms, 5
- Lite
 - selection of topics, 19
- Lite list of topics
 - selecting priority requirements for, 24
- Lite profile, example of selection of topics, 28
- Lite profiles, selection of topics, 27
- locality or site
 - in strategic program, 21
- maintenance shops
 - scales for, 15
- maintenance, deferred
 - cost of, in asset management plan, 20
- management by exception, 26
- market
 - testing serviceability rating profile against, 23
- match between needs and facilities, 3
- materials
 - service life of, 14
- measuring, 3
- meeting and conference rooms
 - combination of features, 7
- mid-range
 - in Figure 6, guideline, 12
- milestones
 - in the life cycle, 18
- Minimum threshold level
 - T indicates, 16
- most
 - level 9 most technically demanding, 12
- most to least, 7
- most, in scales, 4
- move-in programming, 23
- must not have
 - in guideline, 12
- needs
 - of the enterprise, 29
 - rarely well articulated, 19
 - verify at least after 5 years, 29
- non-technical language, 4
- North America
 - use scales outside of, 15
- not applicable
 - in scales, 14
- not have
 - must not have, 14
 - must not have, in Guideline, 12
- occupant groups, 19
- occupants
 - info about in asset management plan, 20
 - involved, 4
 - level 5 not what is best for, 11
- office facilities
 - guideline fo levels for scales for, 7
- office workplaces, 18
- operation and maintenance
 - activity in the service life, 24
 - important to rate for during design, 23
- operation and maintenance costs
 - in asset management plan, 20
- organization, description of, 4
- owner, 14
- performance, technical testing of, 33
- performance-based building, 3
- Performance-Based Building
 - three domains of, 29
- performance-based regulation, 33

- POE, post occupancy evaluation, 23
- portfolio management, 3
 - policy requirements, 15
- portfolio manager, 14
- preliminary design
 - rate near end of, 22
- process, select
 - stge in service life, 21
- production
 - domain of performance-based building, 29
- profile
 - changes as property ages, 19
 - serviceability rating profile, 19
- profile, serviceability rating, 5
- profiles
 - not expressed as averages, 26
- program for each project
 - should include functionality requirement profile, 20
- program, strategic
 - activity in service life, 21
- programming
 - functional programming, 4
 - move-in, 23
- programming, architectural, 22
- projects
 - initiation if match not acceptable, 20
- property management
 - criteria for selecting topics for Lite, 24
- property manager, 14
- proprietary information, 11
- proximities
 - requirements for, 19
- proxximities
 - in strategic program, 21
- public transportation, 11

- quality management system, 34
- questionnaire
 - multiple choice, 4

- rater, person who rates, 5
- red
 - level is less than, 16
- regulation of building, 33
- remediation
 - info in asset management plan, 20
- renovation
 - changes serviceability rating profile, 19
- replicable, 4
- required functions, 5
 - bundle of, 5

- requirement profiles
 - compared regardless of country, 15
- risk
 - of problems in service life, 14
- rooms, programming for final location of, 23

- scales
 - calibrated, 4
 - not describe all possible features, 7
 - sample set is presented, 4
 - two kinds, 4
- security
 - most, might be found at..., 11
- security, special needs for
 - generic functionality requirement profile for, 19
- separations
 - in strategic program, 21
- separations among work groups
 - requirements for, 19
- service centers and service yards
 - scales for, 15
- service life
 - extended by major repair or rehab, 24
 - forecast, 14
 - guideline for, 14
 - guideline for levels, 7
 - measure, 15
- service life, definition, 36
- serviceability
 - goodness or badness depends on what is required, 5
 - serviceability level changes over time, 24
 - serviceability rating profile
 - part of every asset management plan, 20
- Serviceability Tools, publication, 4
- serviceability, definition, 36
- site
 - in strategic program, 21
- size, overall
 - in strategic program, 21
- Solicitation for Offers, 7
- solicitation for Offers (SFO)
 - phase in service life, 21
- space envelope
 - method for estimating, 19
- space envelope, overall size
 - in strategic program, 21
- special spaces
 - in strategic program, 21
- specifications, 23
- Statement of Requirements, 4
 - should include strategic program, 21

- Statements of Requirements, 3
- suitability, facility, definition, 36
- suitable
 - facility or design proposal, 5
- supply, 3
 - comparing graphically, 15
- supply, terms for, 37

- technical test methods, 33
- temperature
 - in meeting and conference rooms, 7
- tenure
 - in asset management plan, 20
- terminology, 36
- test methods, 33
- Threshold level
 - T indicates minimum, 16
- threshold, minimum level
 - in Guideline, 12
- timing
 - in strategic program, 21
- topics
 - attract and retain staff, 4
 - more than 100, 4
 - operating, building, 4
 - security for staff and protection of assets, 4
 - support for information technology, 4
 - support for office work, 4
 - temperature and indoor air, 4
- translation, intermediate from occupants to technical, 31
- transparent, 4
- transportation,
 - public, 11
- types of facilities, functional, 18

- USA
 - approach to performance-based regulation, 33
- use
 - domain of performance-based building, 29
- user, 14

- value engineering studies
 - critical input to, 23
- visitor
 - traffic, 11
- visual access to the outside
 - from meeting and conference rooms, 7