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PERFORMANCE BASED BUILDING THEMATIC NETWORK 2001-2005



PERFORMANCE BASED BUILDING: CONCEPTUAL FRAMEWORK

PeBBu Final Report
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Performance Based Building: Conceptual Framework

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FINAL REPORT

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Performance Based Building Network (PeBBu) is a thematic network funded under the European Commission's (EU) 5th framework - Competitive and Sustainable Growth and has been operational from October 2001 till September 2005. This project has been managed by CIBdf, The Netherlands. The PeBBu Network has been facilitating in enhancing the existing performance based building research and activities by networking with the main European stakeholders and other international stakeholders. The network has also been producing synergistic results for dissemination and adaptation of performance based building and construction. More than 70 organisations worldwide have been participating in the PeBBu Network.



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PREFACE



The PeBBu project is an EU funded “Thematic Network” dedicated to the exploration of the Performance Based concept, as it applies to the Building and Construction Sector. PeBBu has made great strides in bringing people together to share their work, in pulling together information and knowledge, and in focusing more attention on this important “Theme”. Starting in the fall of 2001, and completed in the fall of 2005, the PeBBu Thematic Network project has brought together, at a number of meetings, members of CIB from over 30 organizations in Europe and others from organizations around the world. (Bakens, Foliente and Jasuja 2005, CIB 2003, Lee and Barrett 2003, PeBBu 2002).

The Compendium of Statements of Requirements project (PeBBuCo in short) was set up by the CIB to provide a kind of content liaison across the different PeBBu tasks groups and to ensure that, at the end of the project, there would be a shared understanding of a “Performance Based ” approach as it applies to Building (PBB). To do so, documents were developed in support of the main PeBBu project to confirm what is understood by PBB. In particular, the PeBBuCo team has prepared a “consensus based conceptual framework” for this project. This consensus has been significantly accomplished by presentations, papers and other communications with members of PeBBu. (CIB 2003, PeBBu 2002, Prior J J and Szigeti F. 2003a, Prior J J and Szigeti F. 2003b, Prior, J. J., Szigeti, F. & Oostinga, D. 2003, Szigeti 2005, Szigeti and Davis 2005a and 2005b, Szigeti, Bourke and Prior 2005, Szigeti et al 2004). These documents were disseminated at meetings and by e-broadcasts to the members of the PeBBu Network. This Conceptual Framework Report summarizes the presentations and papers that have explored what is meant by Performance Based Building in the course of the PeBBu project. It complements the Compendium of Statements of Requirements Report, bound separately. The Compendium includes case studies of PBB projects, a terminology, a selected bibliography, and other supporting documents.

In practice, PBB still means different things to different people depending on their point of view. That point of view is often coloured by their relationship to the overall life cycle management of constructed assets, and whether they are on the client (demand) side of part of the supply chain. Also, the implementation of PBB can vary greatly depending on whether it is applied to procuring nails, choosing a home, designing the new Bilbao Museum, testing the performance of a flat floor, or managing a portfolio of thousands of assets scattered world-wide.

Acknowledgements

This report has been made possible thanks to joint funding from the Dutch Government Building Agency (GBA) / Rijksgebouwendienst (RGD), the US General Services Administration (GSA) and the CIB, and also thanks to in-kind and financial support from the International Centre for Facilities (ICF) and the Building Research Establishment (BRE). We would like to take this opportunity to thank the other members of the PeBBuCo team: Lynne Blair and Joan Wilson at ICF, and Kathryn Bourke, Michael Clift, and Josephine Prior, at BRE, participated in different ways. Without their contribution and participation, this work would not have been possible. When starting a project such as this one, which is intended to break new ground, it is always difficult to predict what will happen, what the actual level of effort necessary will be, and what the actual results will be. We are grateful to the CIB and to its Secretary General, Wim Bakens, for having had the foresight to embark in this adventure, for their trust in our ability to pull it together and for their patience and support.

CONTENTS



	<i>Preface</i>	3
	<i>Contents</i>	5
1.1	WHAT IS PERFORMANCE BASED BUILDING (PBB)	9
1.2	LINKING TO OTHER PEBBU SCIENTIFIC DOMAINS	18
1.3	PERFORMANCE BASED CODES	20
1.4	STATEMENTS OF REQUIREMENTS (SOR)	22
1.5	PERFORMANCE REQUIREMENTS	33
1.6	LOOKING TO THE FUTURE	37
1.7	REFERENCES	40



What is Performance Based Building (PBB)





1.1 What is Performance Based Building (PBB)

The Performance Concept is Simple

The notion of performance is used everywhere and applies to everything!! Car buffs, computer nerds, sports fans, consumer advocates, people or groups doing benchmarking, bosses, Human Resources (HR) specialists, business analysts, they are all defining and comparing aspects of required “target” performance and real performance delivered.

After many discussions since the start of the PeBBu project in 2001, the consensus within PeBBu is that the simplest, most useful, and clearest definition is contained in CIB Report #64:

“The **Performance** approach is [...] the practice of thinking and working in terms of **ends** rather than means.” (Gibson 1982, p4) [emphasis added]

“It is concerned with **what** a building or a building product **is required to do**, and **not** with **prescribing how** it is to be constructed.” (Gibson 1982, p4) [emphasis added]

The second sentence quoted above provides the focus of the Performance based approach to the building and construction industry sector. Gibson explains further that:

“In some parts of the building materials industry, performance specifications are known as ‘**end result**’ specifications, while prescriptive specifications are known as ‘**recipe**’ specifications.” (Gibson 1982, p4 footnote)

So, the essence of how PBB differs from traditional practice is that it does not prescribe how to get things done. In a Performance based approach, all decisions, choices, and tradeoffs start with the **required performance-in-use** rather than prescribed solutions for how to respond to the stated needs. The supplier responds with an offering that includes the **estimated performance** of that offering. How that performance is established, verified and validated, is one of the areas that needs much further research.

The Concept is not New

The Performance approach, as it applies to building, is not new; it can be traced back thousands of years. “King Hammurabi of Babylon, who reigned from BC 1955 to 1913, is credited with the first recorded building regulation. [] It can still be viewed today inscribed on an obelisk housed in the Louvre museum, Paris.” (Gross 1996)

This is part of what King Hammurabi said: “Article 229. The builder has built a house for a man and his work is not strong and if the house he has built falls in and kills a householder, that builder shall be slain”.

King Hammurabi provided a performance statement. He addressed structural safety entirely in terms of user requirements, did not state how to construct the building, and did not refer to building structure or building materials.

Performance Based Building (PBB) focuses on the target performance required for the business processes and the needs of the users. It is about defining the requirements and fitness for purpose of a building, constructed asset or facility, or a building product, or a service, right from the outset.

The Performance approach can be used whether one is dealing with existing or new assets, leased or owned. It can be implemented at any time, and used throughout the life cycle of the asset. It can apply to the whole process or to part of the process. It can be used for parts of the life cycle management process

only. It is not an all or nothing situation, but whether the PBB approach is explicitly used or not, a required performance is always embedded in the process.

It is applicable to the procurement of constructed assets and to any phase of the whole life cycle management of such assets, such as strategic planning, portfolio and asset management, briefing/programming, design and construction, operation and maintenance, management and use, renovations and alterations, as well as to codes, regulations and standards (compliance).

It includes many topics and criteria, which can be categorized as physical, functional, environmental, financial, economical, psychological, social, etc. These are normally tailored to a project, depending on the context and the situation.

The Performance approach, by making explicit the requirements of the client, is congruent with a “quality management and assurance” system as defined in the ISO 9000 and 9001:2000 standards (ISO 2000a and 2000b, Szigeti and Davis 2002, Davis and Szigeti 1996a and 1996b).

How does the prescriptive approach differ?

A prescriptive approach “describes **means** as opposed to ends, and [is] concerned with type and quality of materials, method of construction, workmanship, etc.” (Gibson 1982). Prescription, in particular as embodied in Codes and Regulations, is comparatively recent. For instance, the first National Building Code of Canada was published in 1941. “Codes and regulations are enacted by a jurisdiction [...] to regulate the design, construction and/or use of buildings.” (Hattis & Becker 2001) Codes and regulations respond to the need to protect the public, in matters related to fire, health, safety, security, etc., or to protect society, in matters related to environmental protection, energy savings, sustainability, etc. The content of prescriptive codes is based on experience of what works and what does not, and is usually included because an accident causing injury or death requires remedy to avoid a repeat, or because of some other hazardous situation, or because of some recognized social need. There is currently a trend towards the creation of performance, or objective based codes (See below).

The Nordic Model as a Point of Departure

The search for a different set of methods and tools to complement the traditional prescriptive ones is taking place in many countries, in the public and private sectors, as well in the regulatory realm.

In the 1970s, this search gave rise to the so-called “Nordic Model” (NKB 1978). The development of performance-based and objective-base codes is based on this model, and links easily to one of the key characteristics of the Performance approach, the dialog between the WHY + WHAT and the HOW. It is reported somewhat differently by different authors (Foliente 2000, Hattis and Becker 2001, Meacham et al. 2002, Meacham et al 2005), and can be shown in a summary diagram. (Figure 1)

Two Key Characteristics of the Performance Concept

Two key characteristics of the Performance concept are:

- (a) the use of **two languages**, one for the demand for the performance and the other for the supply of the performance, and
- (b) the need for **validation and verification of results** against performance targets.

(a) Two languages -- The Performance concept requires two languages. On the one hand, there is a requirement (demand) and, on the other hand, there is a capability to meet that demand and perform as required (supply). The language of the client is needed on the demand side and the language of the provider is needed on the supply side. These languages are different and it is important to recognize this fundamental difference. (Figure 2). (Szigeti, Davis, and Hammond 2005, p.108)

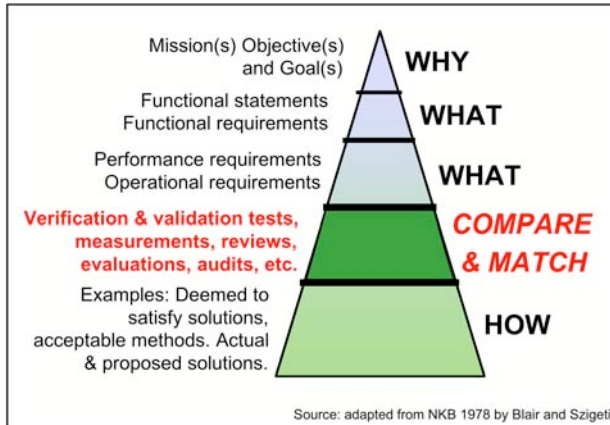


Figure 1. Adapted from the Nordic Model

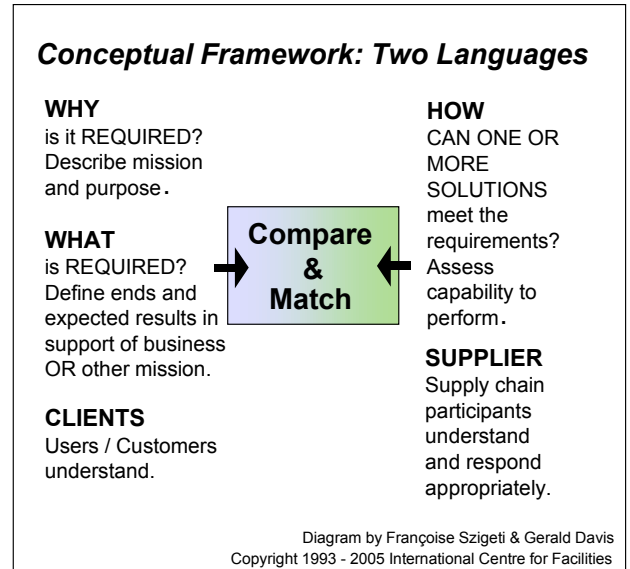


Figure 2. WHY + WHAT and HOW
 Two languages

Conceptually, the dialog between client and supplier can also be expressed as two halves of a “hamburger bun”, with the statement of the requirement in functional or performance language (FC) matched to a solution (SC) in more technical language, and the matching, verification / validation that needs to occur in between. (Figure 3). (Ang, Groosman, and Scholten 2005, Spekkink 2005, Gielingh, Suhm, and Bohms 1993, and Gielingh 1988)

In a recent paper (Ang, Groosman, and Scholten 2005), the Hamburger Model is described as follows:

“The functional concept (FC) represents the set of unquantified objectives and goals to be satisfied, related to performance requirements to fulfil these needs. The solution concept (SC) represents the technical materialization that satisfies at least the required performance. The development or selection of a solution concept is a design decision. The assumed or actual realization allows for the determination of expected or real performance. This performance differs in general from the required performance and shall be at least equal to the required performance.

A validation method, by measurement, calculation, or testing, is necessary to evaluate the performance and to compare alternative solutions. Systematic decomposition creates a coherent set of performance requirements and technical solutions with appropriate validation methods. The structure of an object is being described by decomposition and the pertaining set of performance requirements and verification methods is developed and organized.”

To compare effectively between demand and supply one of the methodologies that can be used is a gap analysis based on calibrated scales that measure both the levels of requirements and the capability of the asset that is either already used, or being designed, or on offer to be bought, or leased. That methodology is an ASTM and American National (ANSI) standard and is currently being considered as an ISO standard. (Szigeti and Davis 2001) It has also been translated into French, in collaboration with the CSTB (Centre Scientifique et Technique do Bâtiment), and won the first IFMA French Chapter FM Award in 2004. (Catarina et al 2004)

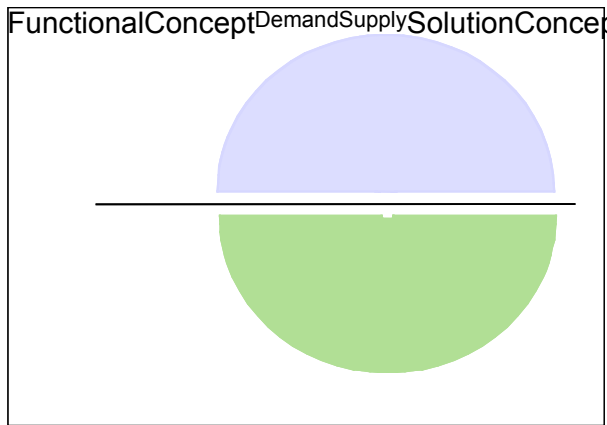


Figure 3. The Hamburger Model

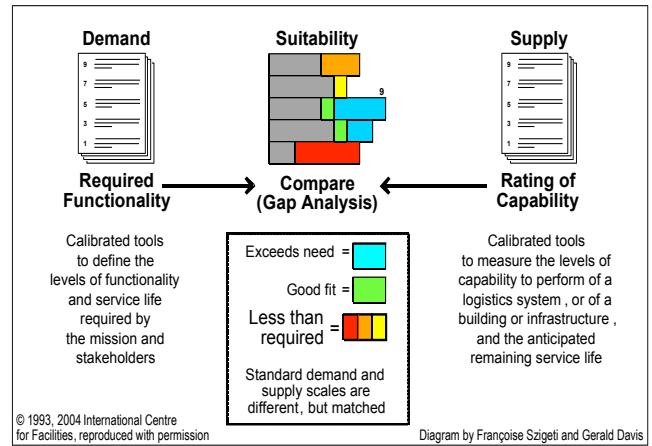


Figure 4. Suitability.

Compare capability of supply to demand requirements

As part of this process, needs and intended use are translated into required performance and made explicit. (Figures 5 and 6). (Spekkink 2005) Based on such information, validation of the solution during commissioning and use can be made easier and more transparent.

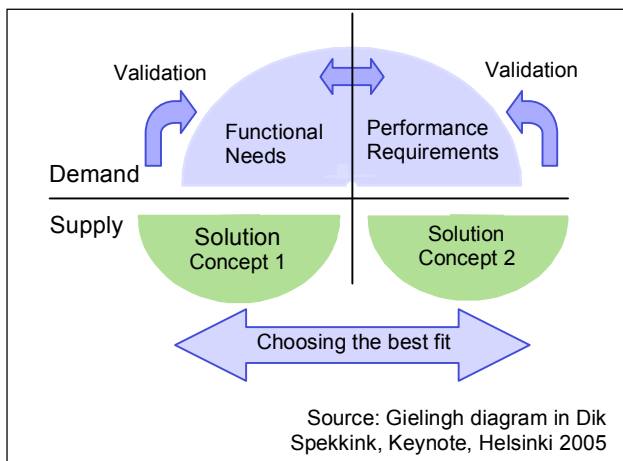


Figure 5. Finding the most “appropriate” solution

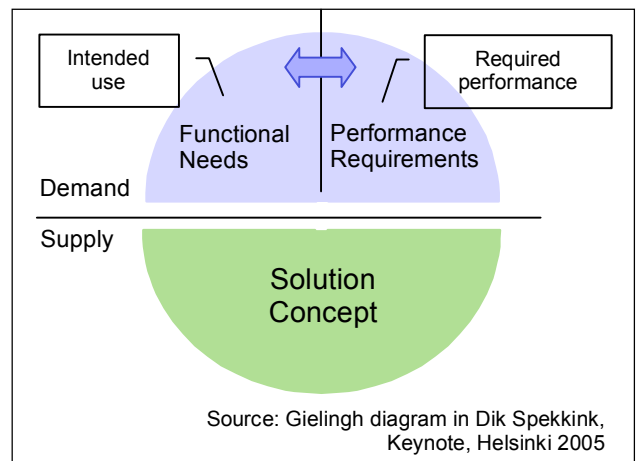


Figure 6 Needs and Requirements

(b) Evaluation, validation and verification: Tests, measurements, reviews, audits, etc.

Clients say “At the end of the day, we need to be able to verify that what we get, at move in and over the life cycle of the facility, is what we asked for and paid for” (Hammond, et al 2005). More and more, clients want and need to be able to measure the performance of the real estate properties and other constructed assets they use in support of their mission, objectives and operations. Including a validation method with key performance indicators as part of the Statement of Requirements is therefore a major characteristic of the Performance concept. Solutions can be evaluated and validated against demand using many different approaches and tools. (Figure 7). (Spekkink 2005)

This dialog between the two sides to the “performance” transaction, and demand (FC) / supply (SC) matching process, identification of appropriate solution, evaluation and validation, applies all through the “supply chain”, whether it is done explicitly and transparently or implicitly and intuitively (Figure 8). (Spekkink 2005)

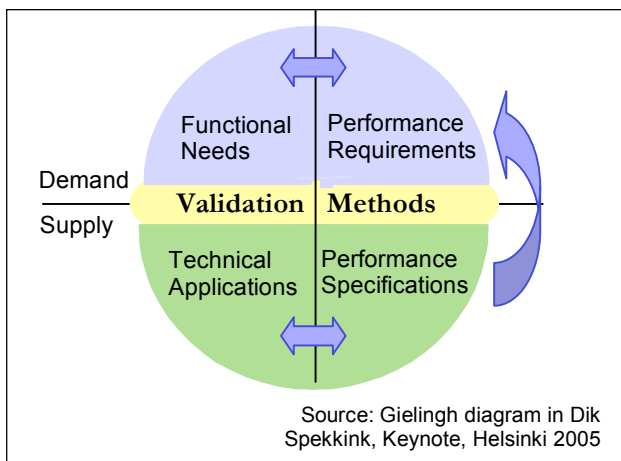


Figure 7. Translation and Validation

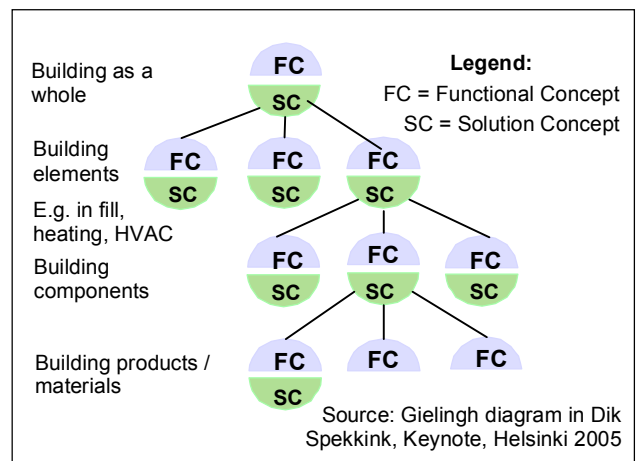


Figure 8 Application through the supply chain

Each time there is a request for proposals, or a contract to procure, the need for explicitly stating the requirements of the client has to be considered. This applies from the mission of the organization all the way to the choice of materials, or the provision of any other resource.

Professionals in practice have adopted demand and supply to refer to the client and provider sides of the transaction. These are basic market terms. They are well understood in business circles and therefore meaningful in communication with clients. Comparing and matching are essential to the application of the Performance concept. To do so, it is necessary to be able to describe both sides, each on their own terms, and yet be able to compare apples and apples. (Ang 2001, Blyth and Worthington 2001, Davis, et al 1993a and 1993b, Gibson 1982, McGregor and Then 1999)

The relationships between demand and supply, in the context of the built environment, are complex. Mallory-Hill, using the demand / supply concept presented in the ORBIT-2 study as a starting point, (Davis, et al 1985a and 1985b) looks at the three major dimensions to be considered, one for demand and two for supply. The building and architectural systems interact and indicators of capability need to address this combination of systems. (Figure 9) (Mallory-Hill 2004)

Evaluations and reviews, as part of asset and portfolio management, design, construction, commissioning, POEs, CRE-FM, and benchmarking, need to refer back to explicit statements of requirements, otherwise they are based on perceptions, intuitions and guesswork.

So, whether or not a “pure” performance approach is used, there is a need for making requirements more explicit and linking those requirements to the objectives for the project or for the management of a portfolio of assets. Altogether, an evaluative stance is therefore useful throughout the Life Cycle of constructed assets. (Figure 10) (Preiser and Vischer 2005)

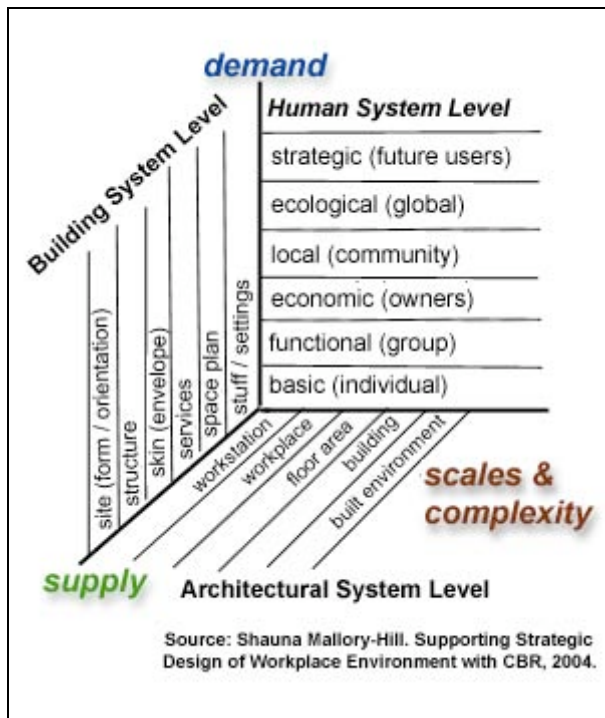


Figure 9. Demand /Supply: scales & complexity

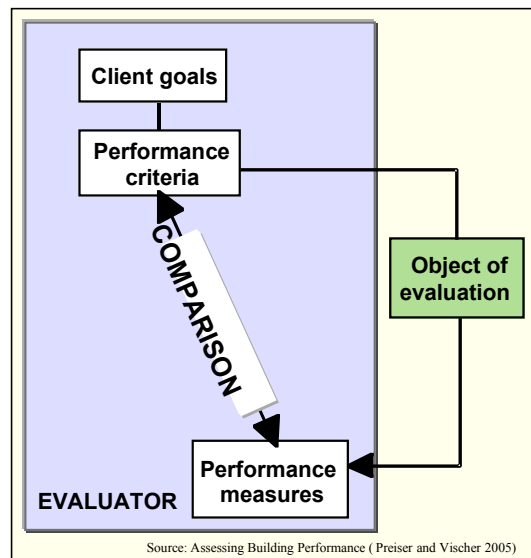


Figure 10. Basic feedback system

In the first chapter of *Assessing Building Performance*, Preiser notes that:

“In the case of building design, goals and performance criteria are usually documented in the functional programme or brief, and made explicit through performance language, as opposed to specifications for particular solutions and hardware systems”. (Preiser and Vischer 2005, p5)

“[] Building performance evaluation is the process of systematically comparing the actual performance of buildings, places and systems to explicitly documented criteria for their expected performance.” (Preiser and Vischer 2005, p7)

Gibson explains:

“Evaluation of the suitability for use of building designs or products involves **matching** the performance of potential solutions with the applicable performance requirements.” (Gibson 1982, p18) [emphasis added]

The PBB conceptual framework, presented in Figures 1 to 10 above, is fully compatible with this description of the role of evaluation by Gibson and Preiser.

It is not all one or the other

Using a Performance Based approach does not preclude the use of prescriptive specifications when the use of such specifications is more effective, efficient, faster, or less costly, or when the accumulated experience means that the performance of the solution is well established and known to be the most appropriate in that situation.

When that is the case, it is useful to remember that prescription, whether in codes, standards, or specifications, is implicitly based on past performance, prior experience, observation, tests or study.

Indeed, Gibson states:

“In principle, all prescriptive specifications or design details for general use, [...] should state the level of performance expected to be achieved, where this can be confidently predicted from experiment, calculation or feedback from use. This can help provide continuity and consistency between design decisions taken at different stages of a project, and should also reinforce caution about making untested changes to established details or products, which can have a disastrous effect on their performance.” (Gibson 1982, p4)

There is not yet enough experience with the Performance Based Building approach. Therefore, it is not likely that a facility will be planned, procured, delivered, maintained, used and renovated using solely Performance Based documents at each step of the way, down the supply chain, to the procurement of products and materials.

Prescriptive specifications will continue to be useful in many situations. Prescriptive codes, regulations and specifications are rooted in the experience of what has worked in the past—they are the expression of the performance embedded in the chosen solution and of the knowledge and experience of those who use them. PBB is part of a continuum. **It is not either performance or prescription.** Blending the two is often having the best of both worlds.

Whether explicit or implicit, performance is at the heart of all procurement transactions. If clients (customers) have already had experience with the item they want to procure, they might then precisely specify the item to be procured, or how to construct it, and how the item will be procured and delivered. For instance, large organizations often prepare Design Guides to procure repetitive constructed assets. The down side of Design Guides is that, unless such documents are regularly updated and take feedback from the field into account, they run the risk of codifying misunderstandings and mistakes, stifling change and innovation, freezing solutions, and keeping the customer from benefiting from the knowledge of the provider ... which is why performance based documents that spell out the WHY and the WHAT rather than the HOW are to be preferred.

On the other hand if the project is unique or specifically intended for one initial client, like a new Headquarters, then it is essential that the values and objectives of the client be clear and expressed in terms that can be matched against results. Unless constructed assets can be prototyped and repeated, such as some housing products, campus modules, barracks, etc., they always have some unique characteristics, due to the site, the local climate, the mix of users, the mix of stakeholders, and the unique supply team. (See Figure 22)

Unless the client uses one “integrated” team, with a proven track record, under one contract to design and build, and sometimes to also operate the facility, and even finance the project, the traditional building process consist of a series of hand-overs between players who may not have worked together on prior projects. Integrated teams are supposedly assembled to be able to respond to clients with an “integrated” approach, taking advantage of the synergy of the team members, and to have accumulated experience, based on their work together on prior projects.



Why is PBB) likely to become more and more prevalent?

Why all the fuss about PBB? (Prior and Szigeti 2003a). Because governments and businesses are “performance oriented” and “customer focused”. In trade, as well as in business, there is a strong trend towards using a Performance Based approach, with the World Trade Organization leading the charge.

Clause 2.8 of the Agreement on Technical Barriers to Trade of the World Trade Organization (WTO 1997) states:

“Wherever appropriate, Members shall specify technical regulations based on product requirements in terms of performance rather than design or prescriptive characteristics.”

“Private and public organizations are driven by the need to perform. Organizations need to convince their stakeholders that they are fulfilling their mission, their objectives, their goals and targets. Organizations use ‘key performance indicators (KPI)’ to prove that they are meeting the targets that have been set by senior management. Therefore performance measurement (PM) becomes central to managing organizations, their operations and logistic support.” (Zairi 1994)

“Performance measure (PM) should be aimed at establishing whether expectations have been fulfilled at each stage of the customer-supplier chain. The overall measure should reflect what has been delivered to the end customer and whether customer satisfaction, the ultimate goal, has been achieved.” (Zairi 1994)

Making it explicit is the key

At each hand-over point from Mission / Objective all the way to the last transaction in the supply chain, the basis for the decisions and choices should be as transparent and explicit as practicable. This is particularly true of procurements in the public sector and for publicly traded corporations, regardless of the specific procurement route. Design-Build, Public Private Partnerships (PPP), and Private Finance Initiative (PFI) and similar procurement approaches are particularly suited to the use of a strong PBB application. If the expected results are not made explicit and verifiable then these procurement methods will likely be more prone to disappointments and legal problems,

Constructed assets are one of the resources used by people and organizations to support their activities as they, themselves, pursue their objectives and missions. Slowly, but surely, organizations are laying down the law ... literally. Clients say: ‘Show us how you verify that you are delivering to us the expected performance. Make it transparent, explicit, comprehensive, measurable, traceable, and auditable, using methods and tools that are easy to use, can be computerized and are interoperable.’ (From authors’ discussions with clients)

At this time, the government of the United States of America (USA) includes probably the largest set of organizations that are implementing the most comprehensive Performance Based approach program from the very top. In 1993, Congress passed a law titled “The Performance and Results Act, 1993” (GPRA). It requires all government agencies to prepare Strategic Plans that also include a Performance Plan (US Government 1993).

In February 2004, the Executive Branch of the US government issued an Executive Order detailing how government assets will need to be managed, including reporting on key performance indicators (KPIs) on a quarterly basis (US Government 2004). To implement this Executive Order, US government agencies are assembling the current measures of performance that are used to assess the performance of their constructed assets. A report has recently been published by the Federal Facilities Council (FFC 2005) detailing those KPIs.

In an interview of two of the most senior managers at GSA (Piacente 2004), these developments are described thus:

“Common sense is also the driving force behind a seven-year-old U.S. General Services Administration effort to collect and compare data on the 3.4 billion square feet of real property owned by various agencies of the U.S. Government. GSA’s initiative, though not directly tied to the GPRA, has worked in concert with the GPRA to help ignite a performance-based culture change in the management of federal agencies.”

In the US government, performance-based contracting is mandatory. The USA Federal Acquisition Regulations (US Government 2000) state that:

“Performance-based contracting means structuring all aspects of an acquisition around the purpose of the work to be performed, with the contract requirements set forth in clear, specific, and objective terms with measurable outcomes as opposed to either the manner by which the work is to be performed or broad and imprecise statements of work.”

As a result, agencies of the US Government are applying the same “performance” approach to the logistics that support their operations, including all capital assets. As an example, in a recent paper, Hammond reports on how ... “The US Coast Guard is fundamentally changing the way it manages its resources in response to a policy shift focused on performance results.” (Hammond, et al 2005).

In Europe, there are many initiatives, both at the national and at the Union level, such as the Construction Product Directive. The PeBBu project has assembled the first international report on the PBB “State-of-the-Art”, which brings together those developments. (Lee and Barrett 2003) Other countries, such as Australia and Singapore, are moving fast in that direction. (Huovila 2005)

All procurement/acquisition processes can be either Prescriptive or Performance Based. As noted above, some, such as Design-Build, Private Finance Initiative (PFI), Public Private Partnership (PPP), etc., are particularly well suited to be Performance Based. To get the benefits from these procurement approaches, it is essential to integrate the services of the supply chain in order to get innovative, less costly, or better solutions by shifting decisions about “how” to the integrated team. On the other hand, command and control management processes are usually inherently prescriptive. Therefore, one can expect those types of organizations to continue to feel more comfortable specifying known solutions.

1.2 Linking to other PeBBu scientific domains

Exchange of information with the PeBBu Domains through the project

At meetings and workshops of all PeBBu Domains, at least one member of the PeBBuCo team attended, so that we could cover all the discussions. As well, the PeBBuCo team presented elements of the Conceptual Framework at all PeBBu meetings. At all those meetings, there were discussions and lively exchanges about the meaning of PeBBu. In one way or another, therefore, the key elements of this Conceptual Framework have been integrated into all the Domains reports, and key elements of the thinking of the PeBBu Domains are reflected in this document. Some Domains have put more emphasis on their own Conceptual Framework. All are congruent with this report.

PeBBu Domain 2 (Indoor Environment)

We include here some of the visuals from PeBBu Domain 2. The Domain 2 group has added visual tools to the PBB overall conceptual framework. These provide a suggested approach to the implementation of the overall framework at a more detailed level of information. An interesting visualisation of the performance approach in the building process is given by Huovila and Leinonen (2001). This is presented in Figure 11. The

figure is adapted from illustrations by the Government Building Agency in the Netherlands. This agency is an example of an organisation that already has, to a high degree, implemented the performance approach.

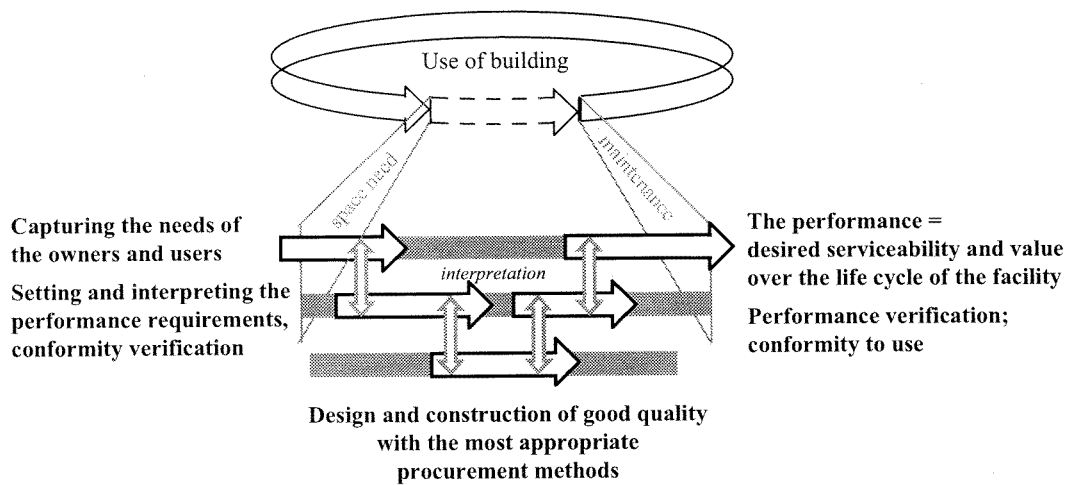


Figure 11. The performance approach in the building process (Huovila and Leinonen 2001).

In Figure 11 the definition of performance, is summarised in its total context, starting with the building life cycle with one or more occurring performance requirements. It presents the time frame in which performance requirements can be positioned and the abstraction level at which performance criteria should be set. The level in this case is proportional to the subjectivity of the performance description. The vertical arrows indicate the translation that has to be made to get to the specific (lower) level.

In Figures 12 and 13, the PeBBu Domain 2 group used a visual language, based on the work of Mallory-Hill (2004) (See Figure 9), to prepare a performance matrix that relates the building object to stakeholders (people) and building phases (time line). These are two critical dimensions that affect the definition and evaluation of performance, but there are others.

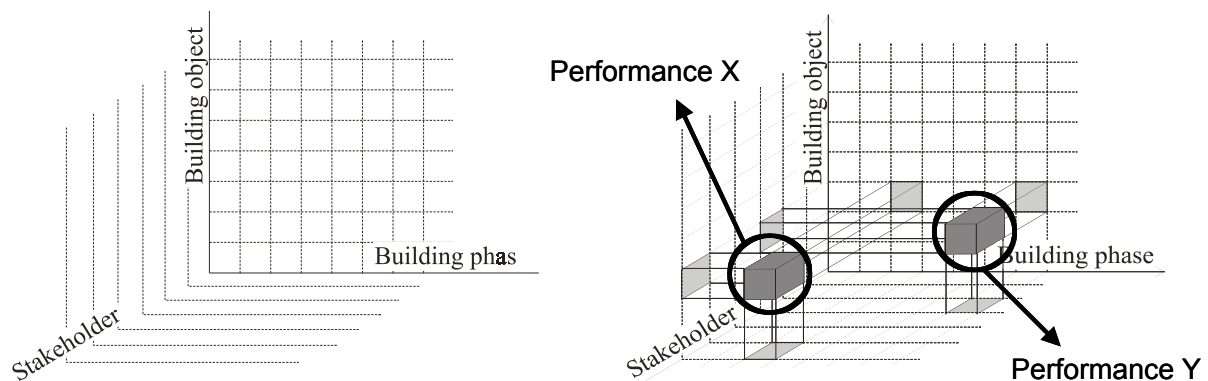


Figure 12. Visualisation of the matrix approach for PBB (left) and the application of the matrix (right).

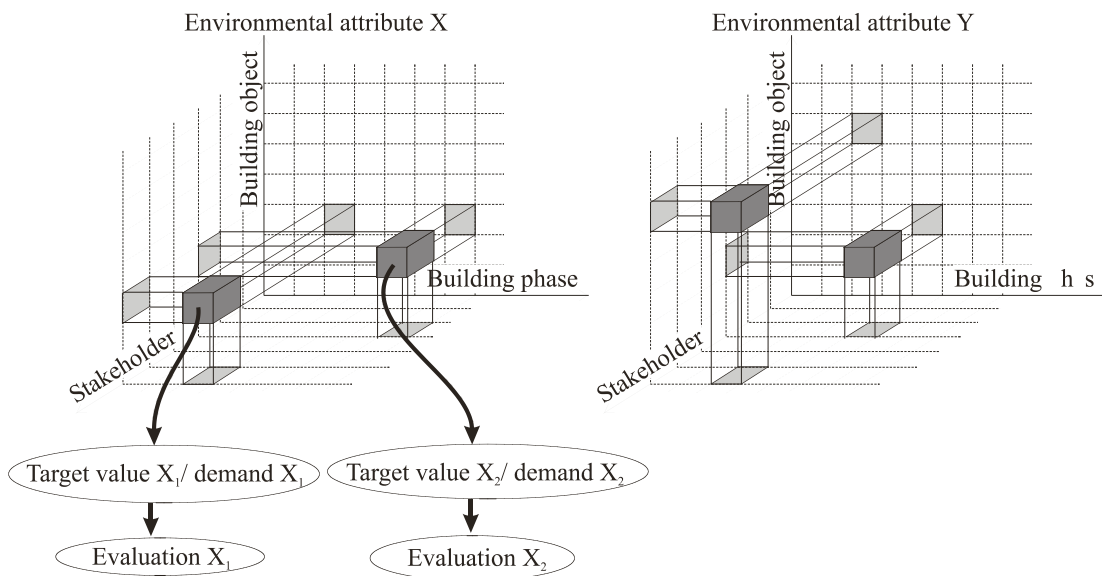


Figure 13. Performance matrix, filtered for Environmental attribute X.
 For attribute Y other positions in the matrix may be important.

The Domain 2 report describes this matrix as follows: “The main idea of the above-described framework, in fact a database, is that it should bring together all the information with respect to PBB and categorise it in a logical way. [...] This point-of-departure, however, leaves some questions with respect to the subdivision of stakeholders, building phases and building objects, i.e. the axis of the matrix. Furthermore, when dealing with a certain performance criterion, a methodology is required to position this criterion and its related environmental attributes, target values and evaluation procedures in the matrix.” (Loomans and Bluysen 2004)

1.3 Performance Based Codes

How does the performance based approach play out in the regulatory world?

In the building and construction industry, over the last 20 to 25 years, prescriptive codes, regulations, standards, and specifications, have been perceived as "getting in the way" of innovation, making change difficult and costly to implement, and creating technical restrictions to trade. These concerns have been the major drivers towards the use of a Performance Based approach to codes, regulations and standards. (Ang, Groosman, and Scholten 2005, Bergeron 2004, Meacham, et al 2005) Performance-based building regulations have been in place or are being developed in various countries. Although these regulations have been relatively successful, they have not yet reached their full potential. In part, this can be attributed to the fact that the overall regulatory system has not yet been fully addressed, and gaps exist in several key areas. For example, the overall regulatory system includes public policy, education, technology, support (infrastructure) frameworks, and overall system management issues.

Hattis and Becker (2001) reported that four goals define the development of performance standards for housing at ASTM (ASTM subcommittee E0.66) and ISO (ISO TC59/SCI4/WG10) and state that these are applicable to other building types.

Those goals are:

“1. to facilitate the **satisfaction of user needs** [...],

2. to facilitate **innovation** [...] by providing a systematic framework for evaluation and acceptance,
3. to facilitate **communication** among all [...] stakeholders in order to achieve rational choice of [...] facility and [...] products,
4. to facilitate **international trade** [...] systems and [...] products by replacing prescriptive standards that may serve as restraints.”

According to Hattis and Becker (2001), the overall goal for establishing a performance based code is the creation of a framework for acceptance of alternative materials, design, and methods of construction, i.e. to facilitate innovation.

This is confirmed by Bergeron, Desserud, and Haysom (2004) with respect to the creation of the new Canadian “Objective-based code”.

Bergeron states that:

“One portion of Canada’s code using community – primarily designers and product manufacturers – was pushing for the National Code Documents to be more accommodating to innovation and performance-based codes were perceived to be the types of codes that best satisfy this need.” (Bergeron, Desserud, and Haysom 2004)

So, why the shift of emphasis to “objective based” with regard to the Canadian codes? Because “Objectives” are at the top level of all illustrations of the Performance Based concept: the Total Performance System Models (Figure 14), the Nordic Model (Figure 1), and the System Approach (Hattis and Becker 2001). Bergeron, Desserud, and Haysom (2004) explain how the Canadian code group analyzed each line of the existing Canadian Building Codes to clarify the link between the content of the codes and the underlying objectives for the codes. They also emphasize that the process included a major program of consultation with the main stakeholders for the codes: the Canadian provincial governments, the communities at the local level, the professions, and also the public at large.

This link is described as follows:

“Objectives state society’s, organizations’, or individuals’ demands, such as the safety of occupants, or enough space for a new child, or minimizing the use of non-renewable resources by the asset. At the next level, Functional Statements describe the function of the building or element in meeting the overall objective and the sub-objectives; Performance Requirements are detailed statements leading to achievement of the Functional Statements; and Acceptable Methods are specific methods to be used to achieve the performance requirements which in turn meet the objectives”. (Prior and Szigeti 2003a)

Bringing non-regulatory and regulatory models together

The “Total Performance System Models” diagram (Meacham, et al 2002) maps the flow of decision making from society and business objectives to construction solutions (Figure 14). This diagram brings together Non-Regulatory and Regulatory models.

The difference between the regulatory and non-regulatory parts of the Total Performance System Models is that one is mandated by codes and regulations that have the force of law, whereas those other functional requirements, that are included in Statements of Requirements and defined by a client for a project, are part of what the client requires and is willing to pay for. Functional requirements mandated by Codes and Regulations are included in the Statement of Requirement for a project, at a level of performance either explicitly or implicitly at least equal to the level mandated by the code.

In their “Statement of Requirements (SoR)”, clients need to state their objectives and goals in broad terms. These can then be broken into “aspects (group of topics)”, “topics” and “functional elements (sub-topics)”,

expressed as Functional Statements that are more and more precise (granularity). These apply to a hierarchy of demand, from society to materials (Figure 8 above and Table I below). It is important to note that the two models, regulatory and non-regulatory, are congruent. This is made clear in Figure 14.

The right-hand side of the diagram shows the requirements mandated by Codes and Regulations with the force of law. These are expressed in Functional Statements, and include for example, all design and construction issues that have a bearing on health and safety.

The left-hand side illustrates what the client is willing to pay for. These requirements have no basis in regulation or law. The upper half of the diagram on the left shows client expectations, and the lower half shows the tools, measurement techniques and indicators which can be used to assess how well client expectations are met.

At the top of the diagram client expectations are expressed at their highest level first, then translated into Statements of Requirement, then sorted into priorities, then considered according to the priorities of the various interest groups. Starting at the bottom of the diagram the quantifiable and measurable performance indicators of the Project, Facility, or Asset, are mapped. The indicators begin with test methods, standards and tools, and move through indicators of serviceability, condition and service life that will be understood, measured and acted upon. Other aspects or attributes of the project can be defined and assessed in a similar manner. This is congruent with the Nordic Model. (See Figure 1)

1.4 Statements of Requirements (SoR)

Performance is a core concept in the business world

Over the last decades, there has been a growing recognition of the need to consider buildings and constructed assets in the context of business, from the perspective of end users and as “means of production”, instead of considering them only as overhead costs. Constructed assets, whether owned or leased, are a useful support to business ends. Concepts such as Demand, Supply, Production, and Use, help to understand the relationships between building occupants and users (demand) and those who provide, maintain and operate the constructed assets (supply).

“Key Performance Indicators” (KPIs) are one of the essential tools of business management. Indeed, the business world knows the concept very well. People have ‘yearly performance reviews’. In some companies, staff rate the performance of their bosses, as well as the other way around, including peers rating peers. These performance reviews are based on performance targets that have been explicitly agreed to at the beginning of the period.” (Zairi 1994)

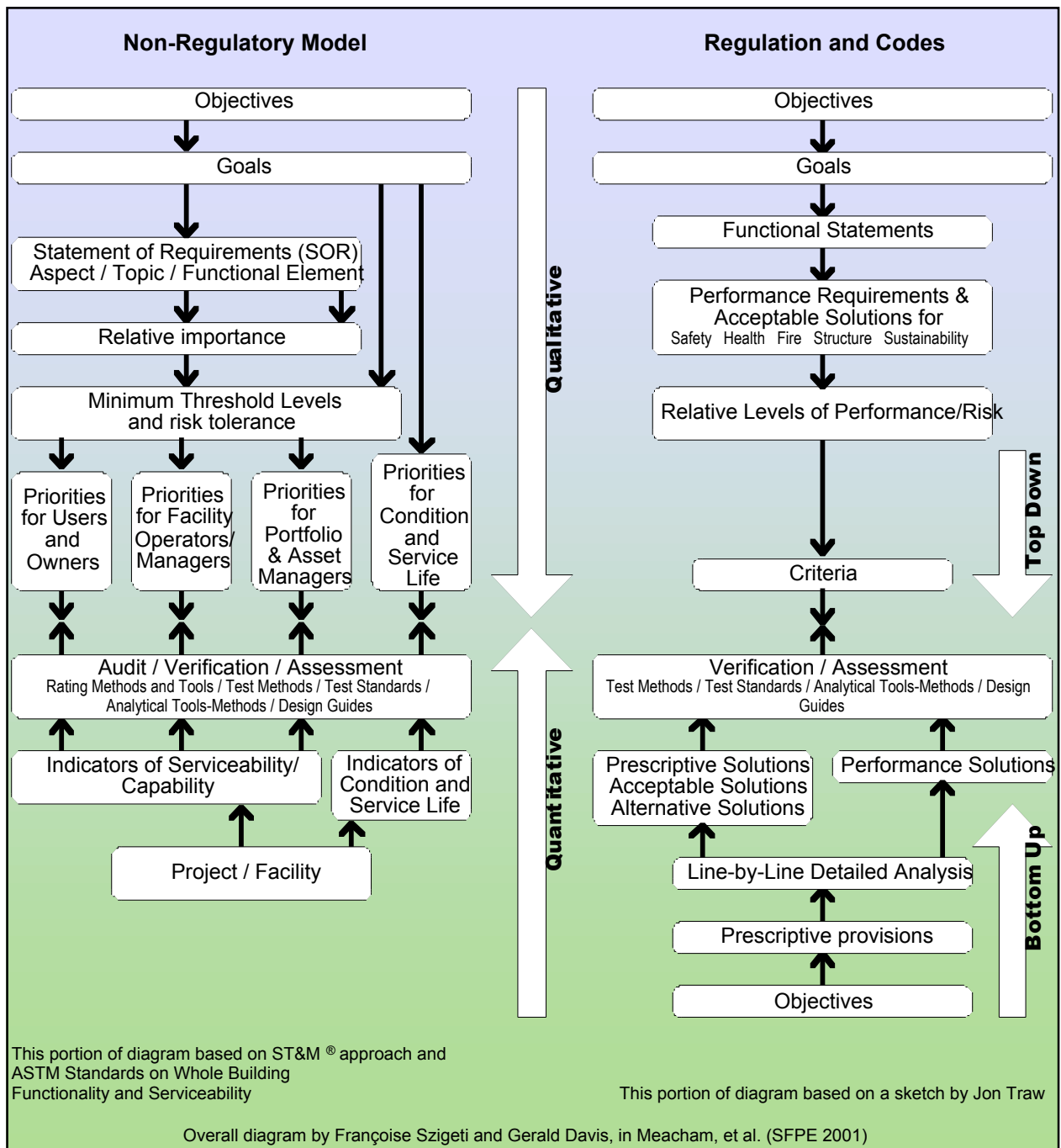


Figure 14. – The Total Performance System Models:
 A Framework for Describing the Totality of Building Performance

A Reference for the Whole Life Cycle Management of Facilities

Statements of Requirements are at the core of this Conceptual Framework. (Figure 15) (Szigeti and Davis 2001) They provide a key to the implementation of PBB. (Prior and Szigeti 2003b)

User functional needs and performance requirements, whether explicit or implicit, are embedded in the documents (SoRs) prepared by clients or in the verbal statements that are communicated to suppliers. They include, or should include information about what is essential to the client.

SoRs function like those performance targets that bosses and employees discuss during the performance reviews. They provide the anchor for the Whole Life Cycle Management of assets, and the link to Demand. SoRs will take different forms depending on who the client and use is, what is being procured, at what phase of the Life Cycle or where in the supply chain a document is being used.

What are the questions behind the question? Clients of the building industry often ask:

- “Did we get what we asked for?”
- “Can we measure, verify, that what is produced, or what we buy, or what we rent, meets our Statement of Requirements?”
- We need Fitness for Purpose “at a given cost”.
- We need affordable, appropriate Quality. No more, no less.
- We have new requirements. There are no existing solutions. We need the suppliers to be innovative. We want suppliers to respond and show us how what they have on offer will meet our requirements.

SoRs are, or should be, dynamic, not static, documents that include more and more details as projects proceed. They are part of a continuous process of communication between clients (demand) and their project team (supply). This process is known as “briefing” in UK and Commonwealth English, and “programming” in American English. Both terms are used in Canada.

An SoR is normally prepared for any project, whether it is a PBB project or not. This can be a green field project, or a renovation project of an existing asset, or a move preparation project to leased or owned facilities. Assembling such a document usually leads to a more appropriate match between the needs of clients and users and the constructed assets.

Asking questions to prepare a comprehensive SoR, and to support and document decisions, gives the provider team a clearer understanding of the project at hand. This process builds on the documents prepared by the client as part of the planning process that occurs even before there is an actual project. How detailed the documentation is at each stage depends on the complexity of the project and on the procurement route chosen for the project. How much of the information is in the documentation prepared by the client prior to project initiation, how much is included in the Request for Proposal, how much is written into the contract, and how much is added in the course of the project delivery, will vary with each situation.

Herewith is a sample of the questions that the SoR might answer with regard to a building project as a whole.

- What is the building, facility, or constructed asset for? Why is it needed, and by whom?
- Is this a typical building, facility, or constructed asset? Or is this a unique project?
- Is this SoR intended for a new facility, or for a renovation or alteration? Has the decision been made to move? Has the procurement route been chosen?
- What mission(s) or objective(s) does the project respond to and support? What task(s) does the facility need to facilitate?

- What levels of performance are appropriate in this situation on specific criteria, and within what budget?
- Has an assessment been made of the facilities currently used by the intended users of the project?
- What is the expected service life of the whole, and of components, parts, etc.? Are there some critical functions that require special support?
- What will be the first costs, and what are the predicted life cycle costs?
- What are the predicted costs to occupy the facility in each year of the years we intend to occupy it?
- Does the client require that the building be designed to return energy to the grid?
- What level of labelling (e.g. BREEAM, LEED) is the client targeting?
- Will the activities housed produce hazardous waste, or other kinds of pollution? If so, what is required to deal with this situation? What impact will this have on the environment?
- What about the use of water and other resources?
- What kinds of accessibility does this project require?
- Etc.

SoRs, as understood in ISO 9000, include not only what the client requires and is prepared to pay for, but also the process and indicators that will provide the means to verify, and validate, that the product or service delivered meets those stated requirements.

SoRs provide the reference point for the Whole Life Cycle Management of a facility or constructed asset, as a complete product. It is important for the project delivery team therefore to be able to predict not only the performance of the parts but also how the whole will perform when all the parts are put together. They provide the information that anchors a Performance based approach.

Figure 15 (Szigeti and Davis 2001) illustrates these relationships and the Life Cycle Management of Facilities, and other constructed assets. It shows the Life Cycle from the perspective of those who manage, operate, maintain and use them, whether as owner-occupier or landlord. It also shows the key role of SoRs as the documents of reference throughout. User and stakeholder requirements define the objectives for the constructed assets to be provided for a specific purpose, but independent of what solution might be chosen. They can be expressed in qualitative or quantitative terms, or both. Performance requirements translate user requirements in more precise quantitative and technical terms, usually for a specific purpose. (Gibson 1982)

Figure 16 (Szigeti and Davis 2001) illustrates that in the near future, the core of such a Life Cycle Management process will be a shared and interoperable information base that can be accessed by all stakeholders in real time. Parts of such information bases will likely be organized using standard protocols, formats and field identifiers such as are being created for BIMs (Building Information Models) such as the US National BIM standard, and for IFCs (Industry Foundation Classes) standardized by the IAI (International Alliance for Interoperability).

SoRs will be added to during the different phases of the life of a facility. They will be updated and managed using computerized tools and will contain all requirements throughout the life of the facility as part of the information base for portfolio and asset management. They will also exchange information into and from the Enterprise Resources and financial data for the organization. In this manner, it will be possible to directly link the mission of the organization to the constructed assets that support the organization.

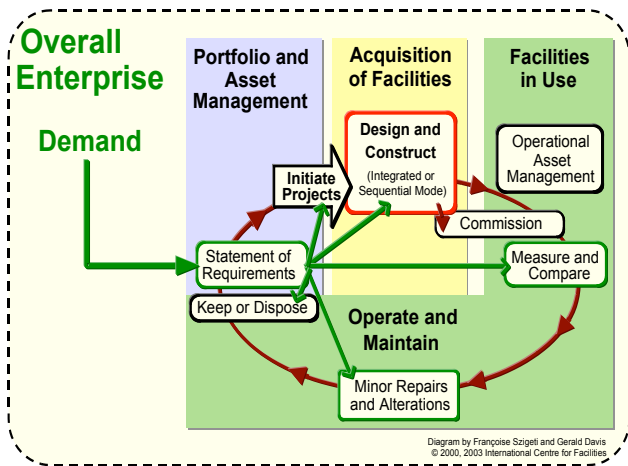


Figure 15: SoR and Whole Life Cycle Management

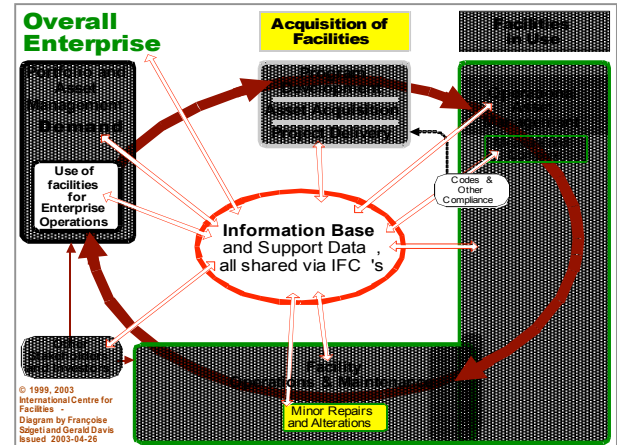


Figure 16. Information and Whole Life Cycle Management

How do PBB SoRs fit in

Over the years, the CIB and its Working Commission W060 have organized a number of conferences and published proceedings that document how PBB is implemented in practice (For a list of such publication see the bibliography in the Compendium of Statements of Requirements or visit the CIB Website).

Major owner-occupiers and their property management groups have implemented a PBB approach on specific building programs. (Ang et al 2001, Szigeti, et al 2004, Hammond, et al 2005) The Compendium of Statements of Requirements includes several case studies of such programs. (Szigeti, Bourke and Prior 2005) A summary of this task and document was presented during the PeBBu day at the Conference “Combining Forces – Advancing Facilities Management & Construction through innovation” (Szigeti 2005).

As part of the world-wide move to implement a PBB approach and to develop tools that will make it easier to shift to PBB, the International Alliance for Interoperability (IAI) set up projects to map the processes that are part of Whole Life Cycle Management. Figure 17 shows how the scope of two IAI projects, *Portfolio and Asset Management: Performance (PAMPeR) and Early Design” (ED)* relate to each other and to the whole life cycle of facilities.

Figure 18 lists many of the categories of information which may be part of an SoR, and part of the flow of information among software applications for the management of constructed assets. The IAI has developed a system of standard rules for tagging or labelling pieces of such information. This system includes Industry Foundation Classes (ifc) of information, and Property Sets for supporting information. For example, IAI has defined a property set of data fields and field identifiers for holding whatever levels might be selected from scales of demand and supply (see Figure 4), and the results from comparing the two. By correctly tagging such data, different software applications can access each other’s data.

As data is labeled in compliance with the IAI rules for IFCs and related property sets, it will be easier to use computers to capture and exchange performance related data and analyze results. The IAI efforts are complemented by many other efforts to create standards for the information to be captured and analyzed to verify performance-in-use. PBB will become more accepted as these activities gain momentum and more is learned in practice.

Figure 19 shows in summary the flow of information over the life cycle of a facility or constructed asset, from a management point of view. This includes the feedback loop that links a facility in use to the requirements and capabilities that are compared and matched whenever decisions are needed, for instance as part of portfolio management, during the feasibility phase before a project is launched, at the start of the project, during design, construction and commissioning, when resources need to be allocated for operation, maintenance and repair, when major alterations, repairs or renovations have to be procured, and so on.

Figures 20 and 21 show how SoRs are integrated in the processes at another phase in the Life Cycle Management of Facilities (Hassanain 2003, p55). These Figures show the application of PBB to Asset Maintenance.

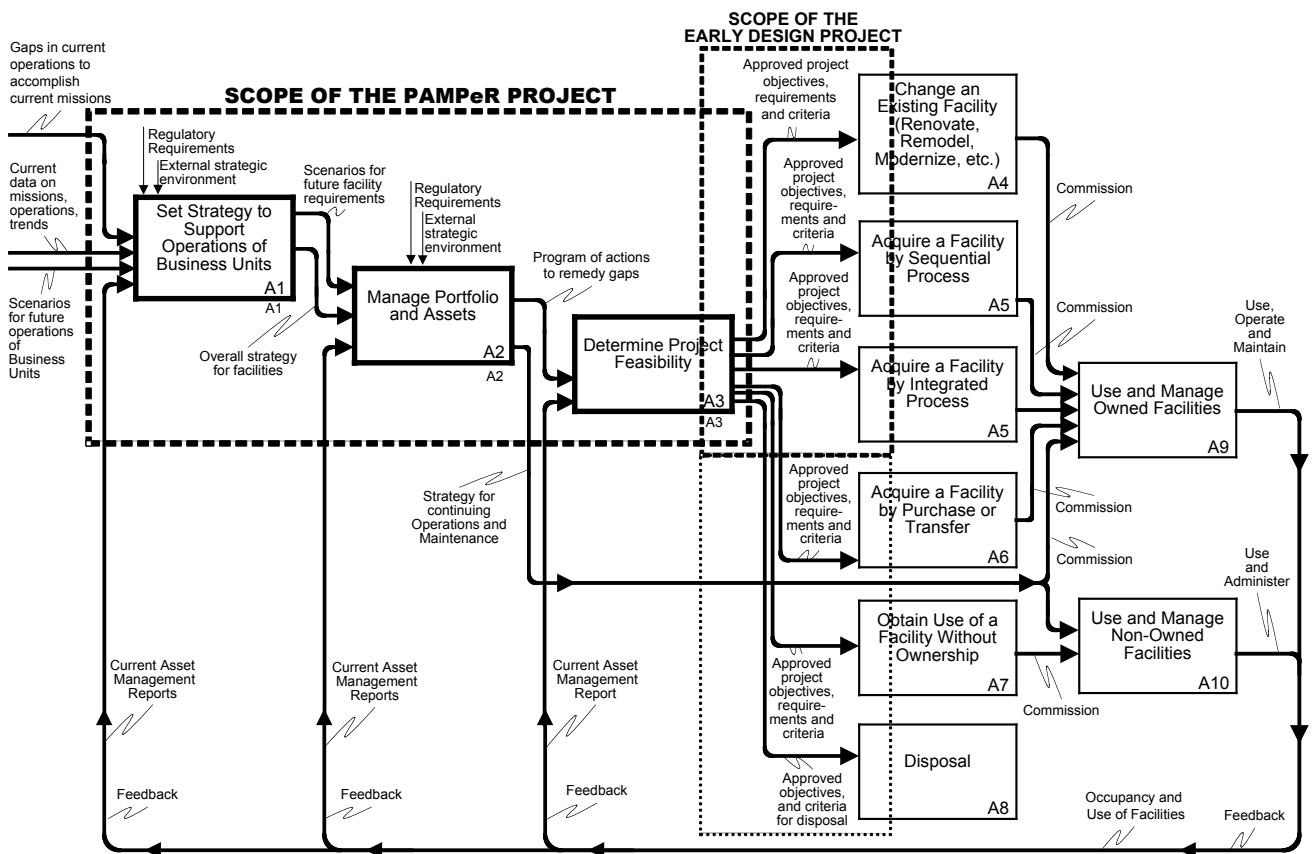


Figure 17. Portfolio and Asset Management: Performance Requirements – IAI PAMPeR Project

Diagram by Gerald Davis and Francoise Szigeti -- 2005 © International Centre for Facilities

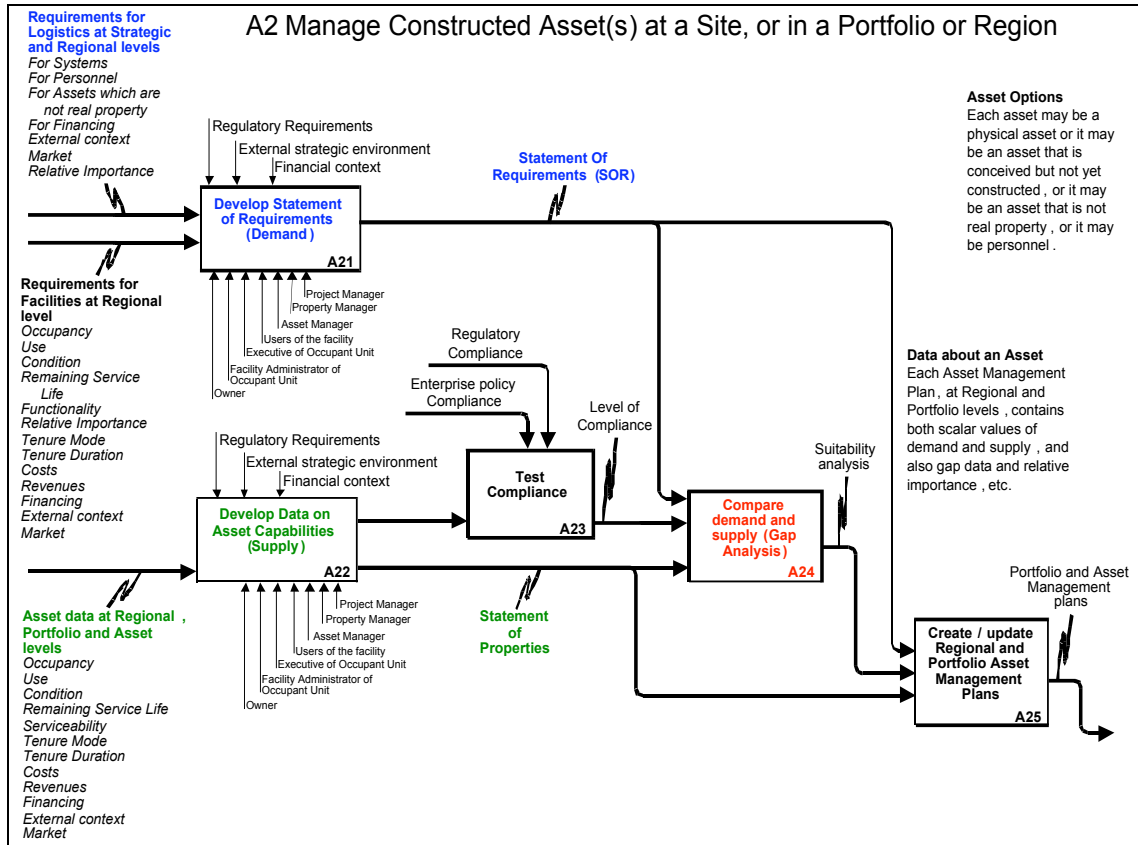


Figure 18. Flow of Information into Regional and Portfolio Asset Management Plans

Source: Diagrams by Gerald Davis and Francoise Szigeti -- 2005 © International Centre for Facilities

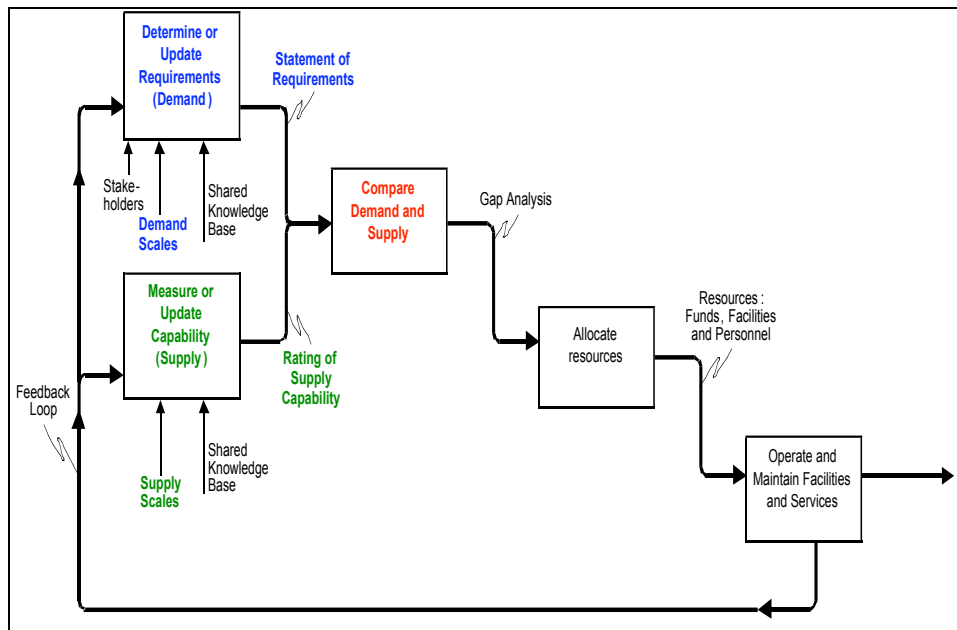


Figure 19. Life Cycle Loop

Source: Diagrams by Gerald Davis and Francoise Szigeti -- 2005 © International Centre for Facilities

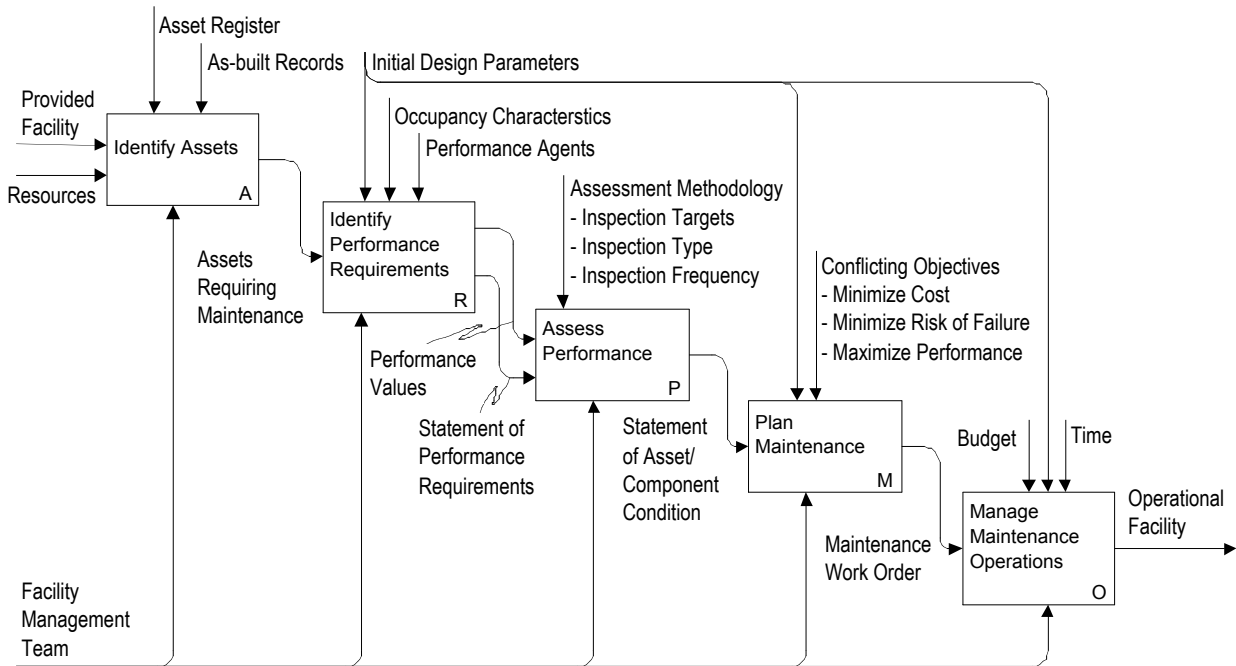


Figure 20 - Example: diagram of PB approach for Asset Maintenance (Hassanain 2003)

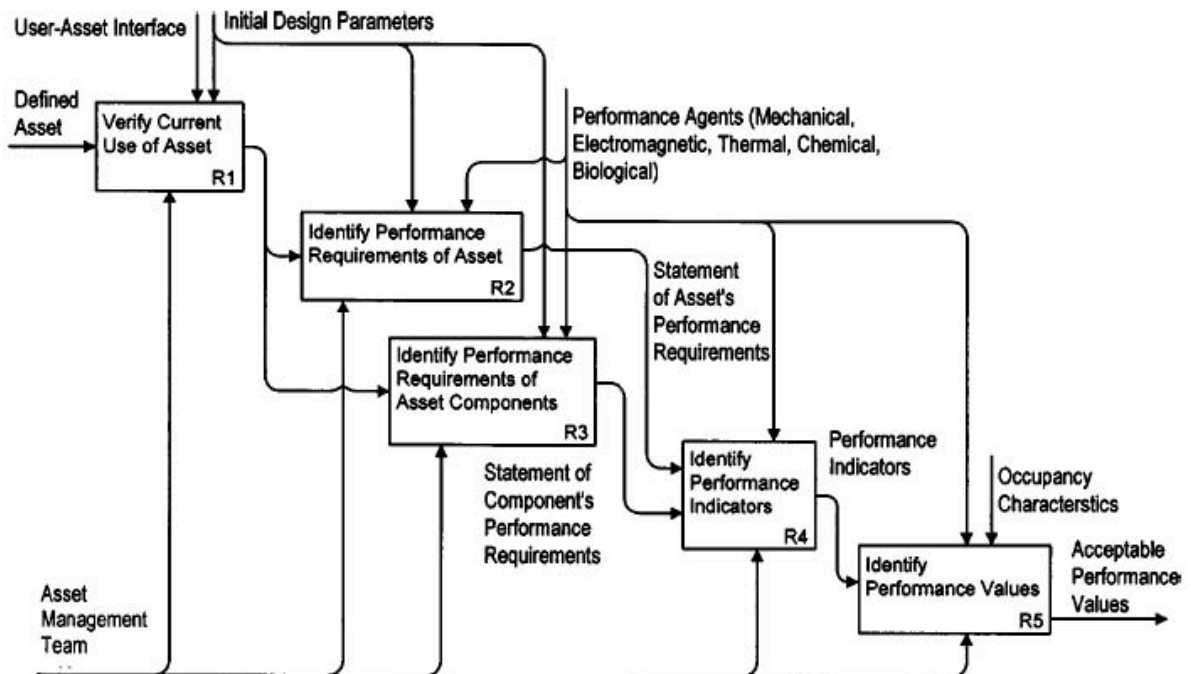


Figure 21. Node R, Identify Performance Requirements (Hassanain 2003)

Table I provides a context summary of the key elements and dimensions in the whole process. SoRs for a constructed asset, whole building or facility are positioned in relation to these other dimensions.

In effect, one could say that this table presents the insides of the Hamburger.

- The top part illustrates the Functional Concept (FC).
- The bottom part illustrated the Solution Concept (SC), and
- The middles gives further details about the verification / validation that links the two halves.

Only when clients really know and understand why they require what they are about to procure and can state their requirements clearly, explicitly and comprehensively, can they make informed decisions, and expect the provider team to do the same. Clients also need to take the time to spell it out, or be vulnerable to misunderstandings and disappointments. Keeping track of budgets, costs and schedules is not sufficient.

Knowing and making explicit the objectives and purposes for each transaction is important at every step of the Life Cycle Management of a constructed asset. The more unique the project, the longer the time horizon, and the more numerous the stakeholders, then the more complex will be the process for stating the requirements for the project. The first challenge is how to hand over the information and make decisions from one level of hierarchy in Table I to the next, and from one phase of project delivery to the next. The high-level SoR, which defines the launch of a project in the first place, will be deepened and made more precise in the course of that project. Keeping subsequent documentation and transactions true to the essence of that high-level SoR can be a challenge. It is this implementation along the supply chain that still requires much more research, experience and verification in practice.

On the other hand, as the project moves forward, is commissioned and used, there will be changes to its use. If there exist well documented, explicit, sets of statements of requirements to support each stage of decisions then it will be possible to adjust those statements easily to the changes in use, and to fine-tune the asset in a manner that is responsive to the changed objectives of the users.

Table 1: WHY AND WHAT <compare> HOW: Context for Statements of Requirements

HIERARCHY	WHY + WHAT	COMPLIANCE	APPLICATIONS
Society levels •global •international •national •regional •municipal •local	Requirements levels •Objectives / Goals / Targets •Functional Statements and other Requirements in user language •Performance Requirements in technical language •Operational Requirements	CODES & STANDARDS (external) •Mandatory •have legal authority •Minimum required (e.g. for fire, health, safety, etc.) NORMS •Not mandatory •have legal authority ONLY if included in regulations	Regulations, at different levels of application, such as: Environmental/green topics, clean air, accessibility, hazardous waste, water, etc.) Building regulations Planning regulations Environmental Regulations Occupational Health and Safety Standardized Aspects - Topics - Attributes
•Customers & stakeholders, •Groups of 'users' (inclusive of visitors and surrounding community)	Same as above	STANDARDS (internal) •Voluntary •internal to the organization or group •Either higher level of performance than Codes or additional attributes not covered by Codes and Regulations + Indicators of capability CLIENT CONTRACTS and subcontracts – Serial or integrated – Including verification / validation methods and Tools – Including Key Performance Indicators (KPIs) – Including Characteristics	Statements of Requirements (SoR) (Project brief / Program) •Description of “user group/individual” / Mission(s) / Operations / Logistics support / resources, etc. •Environmental context •Time / Project milestones •Cost / Financial /Economics •Procurement route •Quantity •Functionality / Serviceability (Equivalent indicators of capability) •FM / O&M •Service Life / Required condition •Security / Protection •Accessibility, Sustainability •Other attributes, etc.
Individual/specific users (e.g. home owners, shopkeepers, hotel managers, etc.)	Same as above		

Evaluation, validation, verification

Compare / Match Gap Analysis

Performance Test Methods (PTM), calculations, measurements, etc.

Key Performance Indicators Customer Satisfaction surveys, assessments, metrics, etc.

	HOW		
•Infrastructure of Countries, Municipalities, and Whole sites •Constructed Assets •Whole Buildings, Building Systems, and Sub-systems •Components and Elements •Products, Services	•→ From project and design analysis To constituent parts •To whole constructed asset from constituent parts ←	•Prescriptive & PB Technical Specifications used on projects •Occupants' manual, O&M manuals, Building Systems Commissioning documentation, testing and controls software applications, etc.	•Acceptable solutions / Deemed to satisfy solutions •Specific solutions in given situations



and Materials			
Szigeti, F. & Davis, G., International Centre for Facilities (ICF) © 2001rev 2005. Based on a sketch by Foliente, G., CSIRO			

1.5 Performance Requirements

Criteria link indicators of performance to objectives and goals

Professionals have dealt with technical requirements and with the physical objects and solutions for many years. What is changing is the growing emphasis on the links to business objectives and goals, to support for business processes, and to business results.

There is no limit to the number of performance requirements which could be defined. In practice, client groups prefer to consider only a short set of requirements and criteria. If there is no source of defined criteria for a given situation, then it is useful to define the requirements for a limited count of topics. Keeping the number of topics to about 15 to 20 “high level” questions in each group of topics works best. More detailed subtopic questions can then be invoked if the answer to a “high level” question triggers a flag or concern.

Setting levels of requirements

Levels of required performance are usually set as part of the preparation of SoRs, as part of project programs (or briefs), or as part of requests for proposals and procurement contracts.

“[] In some cases better performance will bring useful benefits, while in others, once certain thresholds have been reached, there is little advantage in further improvements in performance. [] There are a variety of [] reasons for adopting a flexible approach to the expression and comparison of performance levels. In general, therefore, it is preferable to express both required and achieved performance not as single values but as bands between upper and lower limits.[] In consequence, the criteria in performance specifications can with advantage be expressed as graduated scales, divided into fairly broad bands.” (Gibson 1982, p18)

When, instead of describing the solution and how it should be constructed (prescriptive approach), a client team prepares a document that includes, objectives and goals, performance requirements and criteria, it is important to include “indicators of performance” so that the results can be measured against explicit, up-front metrics, whether qualitative or quantitative. These performance indicators need to be easily understood by the users and the evaluators. Appropriate methods and tools can then be used to validate the indicators, and verify that required performance-in-use has been achieved. The choice of solution, including the implementation details, would then be worked out by the “supply” team responding to the client’s request.

Blythe and Worthington explain why it can be effective to prepare an SoR that is prescriptive in whole or in part, and why the balance between performance and prescriptive based content can vary. (Figure 22)

[Briefs:] “Clients which build regularly, such as large retail chains, will specify solutions that have worked well in the past. The brief will be largely prescriptive, focusing the project team’s innovative abilities on the elements where performance can be improved and costs reduced. Clients who build infrequently or require to fulfill a specialized need, will tend to produce briefs with a higher proportion of performance specification. Briefs that are completely performance related, with no reference to past experience, can be risky. On the other hand, a brief which is totally prescriptive will stifle innovation. The best briefs have a mixture of innovation and past experience.” (Blyth and Worthington 2001 p64)

[Performance requirements and measures] “The brief should set performance requirements which are statements about the ‘measurable level of function that must be provided for an objective to be met.’

There can be more than one performance requirement for each objective.” (Blyth and Worthington 2001 p64)

Levels of performance are usually set as part of the preparation of SoRs, as part of project programs (or briefs), or as part of requests for proposals and procurement contracts.

“[] In some cases better performance will bring useful benefits, while in others, once certain thresholds have been reached, there is little advantage in further improvements in performance. [] There are a variety of [] reasons for adopting a flexible approach to the expression and comparison of performance levels. In general, therefore, it is preferable to express both required and achieved performance not as single values but as bands between upper and lower limits.[] In consequence, the criteria in performance specifications can with advantage be expressed as graduated scales, divided into fairly broad bands.” (Gibson 1982, p18)

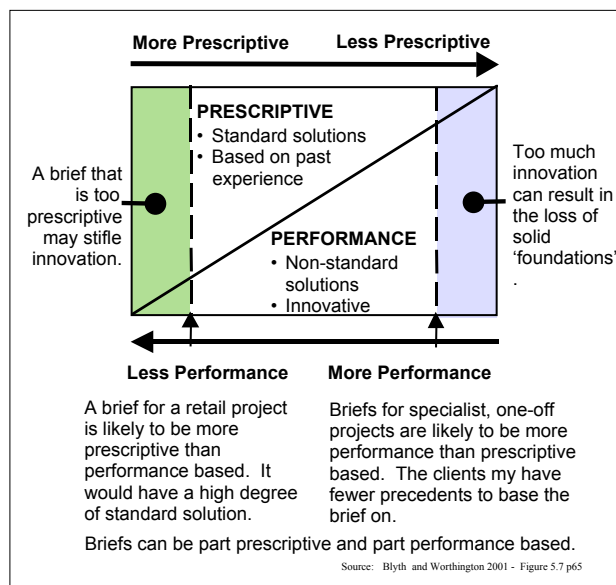


Figure 22. Balancing Performance and Prescriptive based elements in SoRs

User and performance requirements need to be stated so that they can be measured and compared. Donna Duerk explains how a performance requirement should be written:

- address the outcome of an objective;
- be precise and unambiguous;
- be measurable
- be operational – be capable of being met;
- be positive and not negative;
- be capable of being used as a yardstick. (Duerk 1993)

Program documents (SoRs) should be prepared at different levels of granularity, from whole building to building products & materials, so that functional requirements can be matched to specific solutions. (See Figure 8)

Whether all the documents throughout the supply chain will be Performance-based on any one project is unlikely for the foreseeable future.

Also, it is not necessarily appropriate for all projects ... it is not all one or the other. (See Figure 22)

Assessing results

Evaluation can come up with very different assessments, depending on the requirements being considered. For example, whether the Guggenheim Museum in Bilbao, designed by Frank O. Gehry, is performing well, can be reviewed from different angles.

If evaluated as a “museum”, then this building might or might not be rated a success, depending on what the expectations are for a museum. If rated as a contemporary work of art in itself, then it might be highly rated. It could also be evaluated against the performance priorities of the city of Bilbao, as stated in the museum’s brochure:

- “Tool for PR -- Change our image, and generate interest” ...
Result: The building generated a huge amount of articles, photos in the press. Everyone – world-wide -- with the slightest interest in art and architecture read about it. It could not be escaped. It was the talk of the international town. Bilbao’s was recognized around the world. People would come specifically to see the museum from.
- “Anchor project -- Help us attract others to the urban rehabilitation project we are embarking on” ...
Result: A whole new development is planned nearby, thanks to the role of the museum as a key point of interest to attract prospective tourists and workers.
- “Return on Investment -- Generate cash from tourism and museum entry fees”.
Result: Entry receipts to the museum repaid the project and construction first costs within two years.

So, again, the point is to be clear and explicit about the purpose and criteria for an evaluation in Performance Based Building. Gehry’s building has been a resounding success when rated against the City’s criteria.

Evaluations can be performed at any time during the Whole Life Cycle of the asset. (Preiser and Vischer 2005) If done with a fast, easy and inexpensive method, then they may be performed during each budget cycle to adjust the allocation of funds to those assets that require renovation, repairs or alterations. Such evaluations are not “in-depth” but can provide crucial information in support of budget decisions.

At minimum, evaluations should include a Condition Assessment, to ensure that the level of degradation is known, an assessment of the capability of the asset to perform at the functional level required, to ensure that the level of obsolescence is known, and an assessment of utilization.

PBB evaluations can and should be done in a routine manner. In practice, evaluations are often done only as part of Commissioning or shortly thereafter, or when there is a problem. Regardless of how they are done, or when, in order to be really meaningful, they should refer to explicit levels of requirements, against which they can be measured.

Performance evaluations are not the same as Occupant Satisfaction Surveys. Performance evaluations rate the physical asset according to a set of existing criteria and indicators of capability, and then match the results against the required levels of performance. The Occupant Satisfaction Surveys record the perceptions of the occupants, usually using a scale of 1-5 from very dissatisfied to very satisfied. Both types of evaluations are useful and they complement each other.

Gap analysis – match and compare

The ability to match and compare demand and supply is essential to the PBB approach. Whatever method and tools are used, they should permit some form of measurement of the requirements, and the corresponding measurement of the capability of assets to perform. (See Figures 4, 5, 6, 7 and 8) (Spekkink et al 2005, Szigeti and Davis 2001)

There are many types of in-depth specialized technical evaluations and audits. These generally require time, a major effort by the customer group, and a high level of funding, therefore they occur relatively seldom. For routine purposes, the most valuable methods and tools are comprehensive scans that can flag the need for further investigations, are performance based and include metrics that can easily be measured without lab-type instruments.

A recent paper discusses “the general criteria and system which can be used to structure building performance in such a way that performance requirements, criteria and results can be more easily aggregated and dis-aggregated. In addition, the various ways of viewing the concept and developments surrounding the performance approach in North America, Europe and Japan are presented, examined and compared based on selected examples.” (Lutzkendorf et al 2005)

That paper reviews “selected methods, tools and instruments used to define requirements and assess the capability of facilities to meet those requirements, including codes, regulations and standards. They are examined according to type and time-point. Some of the selected tools are analyzed against a comprehensive list of the criteria considered in each category. Very few apply across the whole structure proposed.” (Lutzkendorf et al 2005) Nonetheless, the point of the paper is that more and more tools are being created, tested and implemented world-wide.

Adding performance considerations in support of funding decisions

Although matching and comparing demand and supply can be used at any time in the whole life cycle, it is particularly useful when the information about the “gap”, if any, can be presented in support of funding decisions and actions.

In the past, facility related funding decisions were all too often based on subjective considerations, particularly when dealing with large portfolios of properties. When dollars are in short supply, the squeaky wheel usually gets the grease. For instance, recently, facility condition assessments (FCA) have been used to bring structure and consistency to the problem of allocating limited Repair and Alteration (R&A) dollars among competing projects. However, FCAs are still of limited value to the facility manager—they generate long lists of candidate R&A projects, but provide little, if any, useful information about whether or not a project should really be funded. Should a new roof project be approved for a facility that is not functionally sound any longer, as happened to one organization? What is an “excellent” versus an “appropriate” condition, and how should this distinction influence budgeting decisions across a portfolio?

Innovative decision-support tools are starting to emerge. Some tools are explicitly based on the demand and supply concepts. Such tools employ standardized performance metrics that for the first time link facility condition to the functional requirements of organizations and their customers, and to other performance requirements such as critical aspects of the mission of the organization. Projects can be planned, prioritize, and budgeted using a multi-criteria, demand and supply approach, that is transparent, comprehensive and auditable, and in a way that is faster, easier and less costly than in the past.

1.6 Looking to the future

In summary, for providers to be able to meet the requirements of the client, it is essential that the client really know and understand why they require what they are about to procure and can state their requirements clearly, explicitly and comprehensively. This applies whether the client is society via the codes and regulations, the buyer of concrete to renovate the steps of a building, a family looking for a larger home, the board of a hospital, or the owner / occupier / manager of government owned and leased properties. Clients also need to state how they are going to judge which method of procurement will suit their purpose, assess which offering will best meet their requirements and verify that at the end they are getting what they defined as required.

The down side of any prescriptive documents is that, unless such documents are regularly updated and take into account feedback from the field, they run the risk of codifying misunderstandings and mistakes, stifling change and innovation, freezing solutions and keeping the customer from benefiting from the knowledge of the provider ... which is why performance based documents that spell out the WHY and the WHAT rather than the HOW are to be preferred.

A study of UK government projects presents a comprehensive set of about 40 metrics (method and measurements) which, if used consistently, would give clients the necessary tools to improve the way they procure and manage projects. (Graves and Rowe 1999)

Only when clients really know and understand why they require what they are about to procure and can state their requirements clearly, explicitly and comprehensively, can they make informed decisions, and expect the provider team to do the same. Clients also need to take the time to spell it out, or be vulnerable to misunderstandings and disappointments. Keeping track of budgets, costs and schedules is not sufficient.

PBB is not easy to implement, but more and more interest in this approach is happening around the world. In Australia, Canada, Finland, the European Community as a whole, Hong Kong, the Nordic Countries, Singapore, South Africa, Spain, The Netherlands, and the United Kingdom, large-scale programs of one kind or another are under way, often spurred by governments, to reform the way that building and construction is regulated and / or managed. (Ang, Courtney, and Spekkink 2004)

Although the industry is keen to capitalize upon the desired changes, this will only be possible through effective collaboration with clients and government bodies. These challenges are being discussed at conferences such as “*Revaluing Construction*” and “*Clients Driving Innovation*”, and meetings such the series of “*AIA Building Performance Symposia*” and the recent gathering of the “*International Construction Clients Forum (ICCF)*”. Once clients who pay for the assets provided and governments who regulate the industry, get together with industry to discuss change, then it is likely that change will indeed happen. Thematic Networks like PeBBu are important because they accelerate the rate of diffusion of ideas, best practice, and lessons learned among the members of the network.

Because Performance as such is a concept that has more and more prominence in business management, Performance Based Building will continue to be part of a sharper focus by a performance based culture. Procurement will be the key to improved performance when clients learn to be more explicit in their demands and to participate more aggressively in the management and delivery process of their most significant investment and resource.

As a closing statement for this report, it is fitting to quote from a recent article in the October issue of the Harvard Business Review titled (Thurm 2005). In that article, titled “*Master of the House – Why a Company Should Take Control of its Building Projects*”, Thurm makes the case for clients to become more involved with

their building projects. Although he is not using the term Performance Based Building, that is at the root of what he is urging. By being involved, clients make explicit their values, the mission of their organizations, and their expectations from the building project. Thurm does not urge clients to prescribe solutions but to participate in the translation of their well articulated values into the built solution:

“The New York Times expects real business benefits from its new headquarters building because the company is taking an aggressively active role at every stage of its design and construction.

“[...] if you want to avoid squandering what is probably your company’s largest capital investment, keep in mind that meeting your schedule and your budget is just the starting point. It’s important to create something that truly propels your business forward. A building that dynamically reflects your company’s mission – brand instead of bland. A building with innovations that, combined, produce an energizing work environment instead of enervating clusters of cubicles.

“[...] Unless your voice is in the mix, you will get, at best, well-intentioned guesses by others as to what you want. At worst, you’ll get something that is incongruous with your goals.

“[...] It’s a giant mistake, though, to be a passive consumer when it comes to one of your most important assets. The deadening combination of a hidebound construction industry and risk-averse building owners has resulted in a shameful number of soulless, mediocre buildings that miss two opportunities – to say externally what the business is about and to say internally what the company aspires to be.

“[...] It is also important that you pay careful attention to your relationship with the executive committee of your company. For instance, educate the committee about the avoidable evils of change orders, which can destroy your budget and wreak havoc on your schedule, and establish formal processes to preclude them. Given the complexity of our headquarters project and the cumulative nature of basic decisions about its design and construction, we created a request-for-guidance form. The RFG presents the company’s executive committee with an issue to settle, includes the information necessary to do so, and records the committee’s decision. By documenting such decisions and creating an institutional memory, the form not only prevents confusion but helps instill a discipline about keeping changes to a minimum.

“[...] Even in this age of rampant outsourcing, a business doesn’t cede control of its core marketing, sales, and strategic decisions. Similarly, there is no reason to divorce yourself from the process of creating the environment for your business. Buildings are simply too large an investment to ignore. Push your organization to articulate its values. Convey those guiding principles to your consultants. Then work to ensure that those values are translated into a wonderfully designed and innovative structure that is a productive place to work. Whether or not you make these efforts, the financial investment is the same; the effect on your company will be remarkably different.”

As explained at several points in this report, the client has the responsibility to express the WHY and the WHAT with the “voice of the customer” when procuring and managing the assets that are needed to support the organization’s mission. This is true whether the client is a public, private or not-for-profit sector organization, whether it is big or small, whether it owns or leases such assets, and whether these assets are for its own use or for use by others. It is true for all types of constructed assets.

PBB is most likely to be implemented when clients demand it because they understand that such an approach best serves their interests. David Thurm makes clear that an active, informed, involved client is essential to the delivery of successful results in response to clients’ needs.



1.7 References

(For more references, see the bibliography included with the *Compendium of Statements of Requirements*)

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