FOSTERING SUSTAINABILITY AND ENHANCING QUALITY IN CONSTRUCTION WITH BUILDING SUSTAINABILITY ASSESSMENT

Ewelina Kaatz[1], David S. Root[1], Richard C. Hill[2] and Paul A. Bowen[1]

[1]*Department of Construction Economics and Management, University of Cape Town, Private Bag, Rondebosch 7701, Cape Town, RSA*
[2]*Department of Environmental and Geographical Science, University of Cape Town, Private Bag, Rondebosch 7701, Cape Town, RSA*

Research reported in this paper advocates the need for a more widespread use of building assessment methods in building practice to enhance the quality of building design, construction and management, and to stimulate broader stakeholder participation. Lessons learnt from Environmental Assessment (EA) and the Process Protocol (PP) informed the development of a functional specification for a building sustainability assessment model with the aim to improve the effectiveness of building assessment in fostering sustainable construction. The most important test of effectiveness of any building assessment method in fostering sustainability is the extent to which it influences decision-making throughout the building process. Arguably, building assessment methods need to become more interactive and dynamically integrated with building project activities, introducing building assessment into the domain of project management. As a result, new core functionalities of a building sustainability assessment method come to the fore, including integration, transparency and accessibility, and collaborative learning. A brief discussion of one potential use scenario for the application of the proposed model is presented; that of a building performance audit, which illustrates the advocated integration of building assessment with an actual building project. The main conclusion of the research is that the future evolution of building assessment will most likely be focused on enhancing the building process and empowering stakeholders through their direct participation in sustainability-orientated decision-making. This focus should be the guiding principle in the development and application of building assessment methods.

Keywords: building performance audit, building sustainability assessment, process map, stakeholder participation.

INTRODUCTION

This paper outlines a potential use scenario for the application of a building sustainability model using its functional specification. The use scenario refers to a very common application of building assessment methods to evaluate building performance, namely, to a building performance audit.

Environmental audits of building performance are probably the most common application of building assessment methods. Such audits usually involve evaluations of resource consumption, waste generation and indoor air quality during building

[1] droot@ebe.uct.ac.za

Kaatz, E, Root, D S , Hill, R C and Bowen, P A (2006) Fostering sustainability and enhancing quality in construction with building sustainability assessment. *In:* Boyd, D (Ed) *Procs 22nd Annual ARCOM Conference,* 4-6 September 2006, Birmingham, UK, Association of Researchers in Construction Management, 349-359.

operation, (Cole, 2000). Since, building performance is also influenced by management practice, management issues form an integral part of a building performance audit. Such assessments typically result in an overall score that provides a basis for building performance rating and/or labelling for marketing purposes. Introducing sustainability as an objective of construction practice requires an expansion of the scope of building performance audits to address the socio-economic contexts in which buildings operate.

The aim of this paper is to emphasise the need for a closer integration of building sustainability assessment with the building process, or the building project's cycle. Such an approach ensures a timely provision of relevant information for informed decision-making on building sustainability issues. In this way, building sustainability assessment can be considered in terms of a dynamic and inter-active process rather than an *ad hoc* activity. In turn, this allows suggesting desired properties and process-related aspects of any building sustainability assessment method.

A functional specification for a building sustainability assessment model

The purpose of this research was not to produce an operational building sustainability assessment method, but to focus on the underlying philosophy that informs building sustainability assessment practice. Thus, in developing a functional specification for an assessment model, the focus is on the context in which a model would operate rather than the model's technical characteristics.

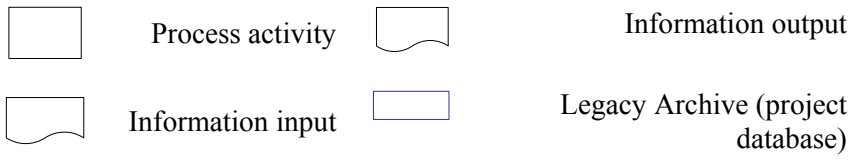
The research approach was informed largely by a review of the field of Environmental Assessment and the development of the Process Protocol (Kagioglou *et al*., 1998). Environmental Assessment (EA) refers to the Environmental Impact Assessment (EIA) of projects and the Strategic Environmental Assessment (SEA) of policies, plans and programmes (Hill, 2004). The EA process focuses on the identification, prediction, evaluation and mitigation of biophysical, social and other relevant effects of proposals, seeking to maximise their benefits before major decisions and commitments are made (Sadler, 1996).

In common with EA, any building assessment method should focus on the collection, analysis and presentation of adequate information to enable decision-makers to make better-informed decisions (Kørnøv and Thissen, 2000). Hence, the process for feeding information obtained from building assessment into the project cycle is central and building assessment should be viewed as a *process* rather than an activity, dynamically integrated with the building project cycle.

The Generic Design and Construction Process Protocol (Process Protocol), which represented the second source of expertise informing this research, provides a framework to achieve this integration. It represents a common set of definitions, documentation and procedures to facilitate more effective co-operation between organisations involved in the building process (Kagioglou *et al*., 1998). The Process Protocol uses process mapping as a valuable management tool to illustrate flows of information through the project cycle.

Examination of the Process Protocol indicates the criticality of transparency and accessibility for any building sustainability assessment method in terms of the communication strategy (i.e. exchange of information among participants) and the process itself (i.e. methodology). Ideally, the process should facilitate the provision of relevant information on sustainability to building stakeholders, facilitating decision-making and assisting in knowledge generation and sharing among the stakeholders.

Figure 1: Basic Shapes of the Process Map for the Model's Use Scenario



Lessons learnt from the review of EA and the Process Protocol were used in the development of a potential scenario for the model's application as a method for a building performance audit. A process map illustrates this particular use scenario and its basic shapes are shown above in Figure 1.

Process activities in the scenario of a building performance audit are represented as white boxes connected by arrows (see Process Map 1). These activities comprise those that are inherent to building assessment and those of the building process/project (e.g. building refurbishment). Information inputs for process activities are presented as pink boxes, hence the arrows connecting them with appropriate activities point downwards. Information outputs from activities are presented as green boxes. The outputs are captured in the project database, i.e. the Legacy Archive, from where they are sourced as inputs into subsequent project activities (as indicated by blue arrows). However, before this particular use scenario is explored further, it is important to understand what factors influence the quality and perception of building performance.

Factors to be considered in a building performance audit

Arguably, an evaluation of building performance using a building assessment method should be concerned with the quality of the stream of services a building provides to end-users and the building's impact on, and interaction with, its surroundings. As quality is closely associated with value, its comprehension can be facilitated by the interpretation of value in construction. Dell'Isola (1997), cited in Thomson *et al*. (2003), derives value in the building context from building function, quality and costs:

$$\text{Value} = (\text{Function} + \text{Quality})/\text{Cost}$$

Function may encompass aspects of building use, access and space. Quality entails aspects of building performance, engineering systems and construction (Gann *et al*., 2003). Cost may be expressed in terms of environmental loadings, resource consumption and financial burdens of building production/use. This definition brings into the scope considerations of building performance issues of functionality and project value, beyond that of quality and financial cost.

Furthermore, building performance can be established through the relationship between building form and function in a particular context (Kalay, 1999). Performance is therefore determined through an interpretive judgmental evaluation which "*considers the form and other physical attributes of the proposed solution, the functional objectives and goals it attempts to achieve, and the circumstances under which the two come together*" (*ibid*.:396). To evaluate the quality of building performance, it is necessary to identify the most desirable function(s) that can be supported by a particular building within its specific context (e.g. physical settings and stakeholder needs). Subsequently, one could examine how effectively and efficiently the building is managed and operated to provide the required services. Using this information, building performance could be improved simply by changing operational and management practices. However, it may also be necessary to alter a building's

form in order to optimally meet its existing or more desirable functions. In this instance, the building's refurbishment or modification would require the setting of strategic goals based on the users' needs defining the desired building function(s), and taking into account the sensitivity of the receiving natural environment, and the interactions with an existing socio-economic context. This information would then guide the subsequent development of suitable design and building management solutions. The following section presents how such a building audit can be structured using the proposed building sustainability assessment model.

APPLYING THE BUILDING SUSTAINABILITY ASSESSMENT MODEL IN BUILDING PERFORMANCE AUDIT

During the performance audit the proposed model would provide stakeholders with a strategy to establish their essential needs regarding a given building, with mechanisms to review the continuous improvement of the stream of services the building provides. It is important that this process addresses the quality of a building (i.e. its form and structure). However, emphasis would inevitably be placed on the benefits that this building brings to its users, as well as on what it demands of them in terms of its operation (Bordass *et al*., 2001). This brings to the fore important issues of building manageability, usability and responsiveness. Through their direct involvement in the audit, building users and the facility management staff can develop and implement *demand management* strategies to, for example, reduce resource consumption. They can also learn how to operate with the building to improve the effectiveness and efficiency of its services. Furthermore, if a building is considered as a means to the users' ends (individual and organisational), then more attention can be paid to the time dimension (short- and long-term goals) and performance attributes, such as comfort, health and safety (*ibid*.).

Once a decision to undertake the performance audit has been reached, the building performance audit would require that relevant stakeholders be identified (refer to Process Map 1). If the purpose of the audit is to evaluate and benchmark current performance of the building with a potential need to change existing management practices to improve its performance, then the participants might include the building owner, occupiers, a facility manager, as well as relevant service providers, specialists in certain assessment areas (e.g. an energy auditor), and neighbours who are affected by the building. If the audit is aimed to identify areas of building performance to be addressed during refurbishment works, then the process might also involve relevant building professionals.

Conducting the audit using the model would entail the introduction of sustainability thinking and principles to inform the establishment of project values. Consequently, the context in which the building operates should be deliberated by all stakeholders so that a common understanding of the biophysical, social and economic implications of current building performance, and of the opportunities for potential improvement is established. After the context has been established, process participants can define desired performance quality, preferably stated as performance targets for the audit and/or project goals and objectives for refurbishment. The project vision developed in this way should address the quality of building services expected by end-users and other affected stakeholders in relation to the required building functions, form and project values.

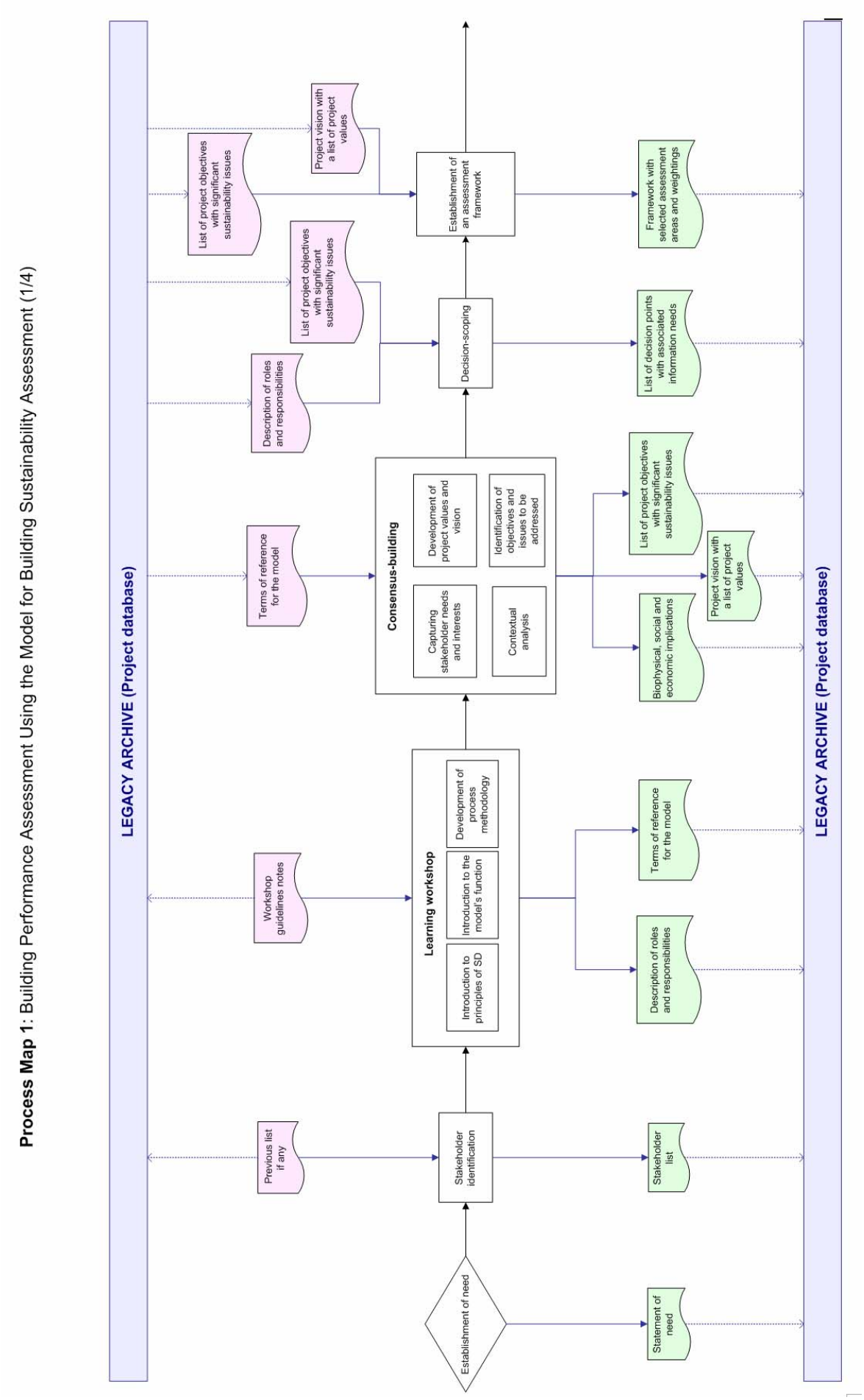
Furthermore, for the purposes of building refurbishment it will be necessary to review aspects of building functionality to extend the building's useful lifespan. Therefore, the scoping stage of the audit ought to foster a longer term outlook, so that stakeholders will not focus solely on immediate and short-term user needs, as building occupants and occupant requirements may change over time (Whyte and Gann, 2001). This would entail the identification of how a given building is to be used, how its use might change and the factors that affect these changes (Ryd, 2004). Moreover, the issues of resource consumption and environmental impacts in terms of building operation, maintenance, renewal and deconstruction should also be taken into account at this stage.

Through scoping, stakeholders would select significant assessment issues, identify assessment areas and establish an assessment framework. Subsequently, indicators can be selected or developed and benchmarks collated. Stakeholders will decide together upon performance targets for indicators in accordance with the project values and vision. This would be followed by the actual performance assessment and evaluation stage.

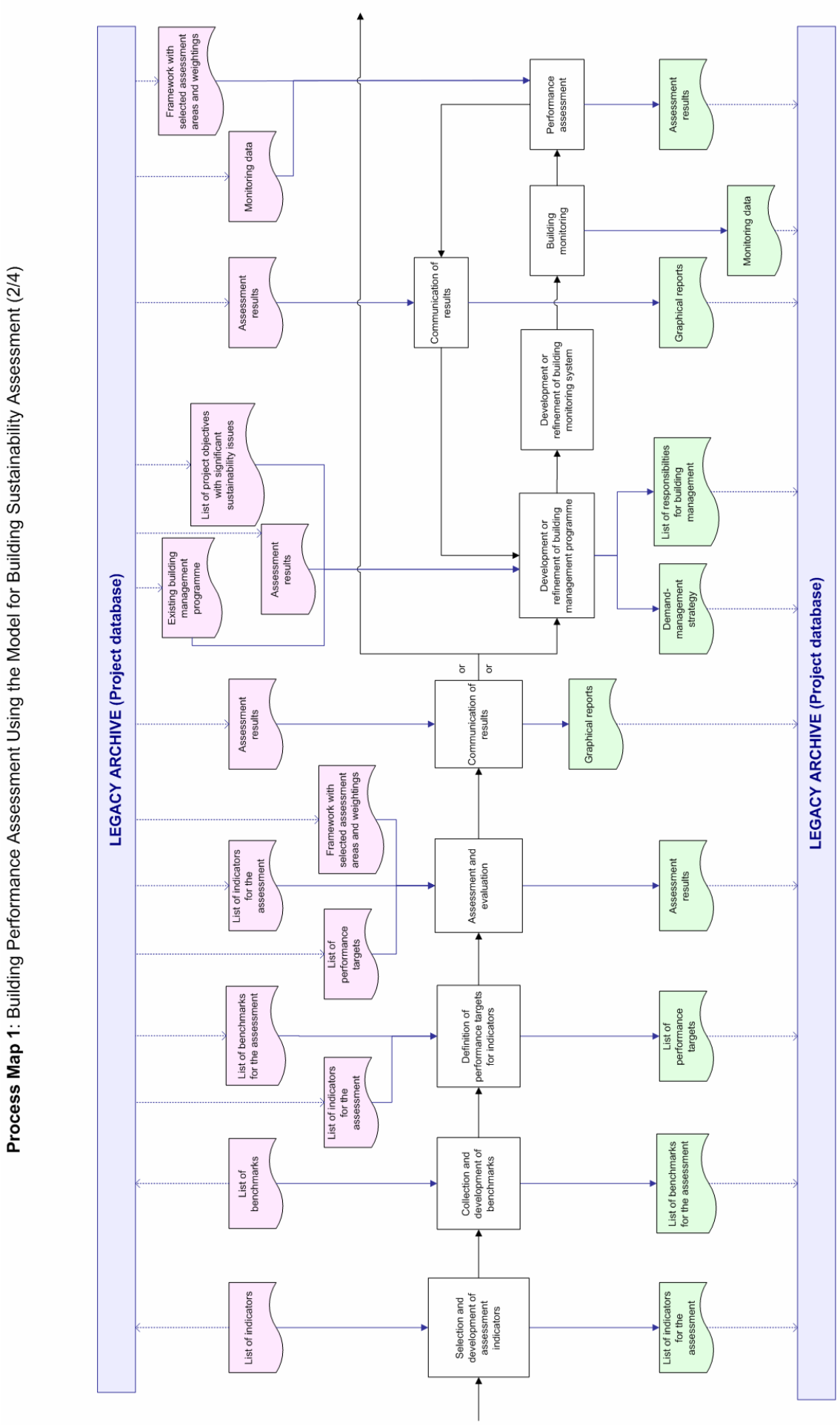
The communication of assessment results to various stakeholders should not be limited to a simple presentation of data. Instead, stakeholders would be encouraged to participate in the interpretation of measurements and in the identification of the most satisfactory practical solutions that can enhance the quality of building performance. Hence, there is a need to ensure that the model provides different formats of presenting information, and that it offers a forum for stakeholder dialogue and mutual problem-solving, i.e. effective communication for the attainment of shared meaning.

After the results have been communicated, decisions can be made regarding the potential needs in building performance improvement. Process participants would establish building management strategies to support desired building functions. Results of the audit can at this stage inform strategic planning and the development of the project brief for any refurbishment works. The transition from the audit into the refurbishment process would require the revision, and possibly refinement, of the project vision and values as well as the assessment framework by stakeholders.

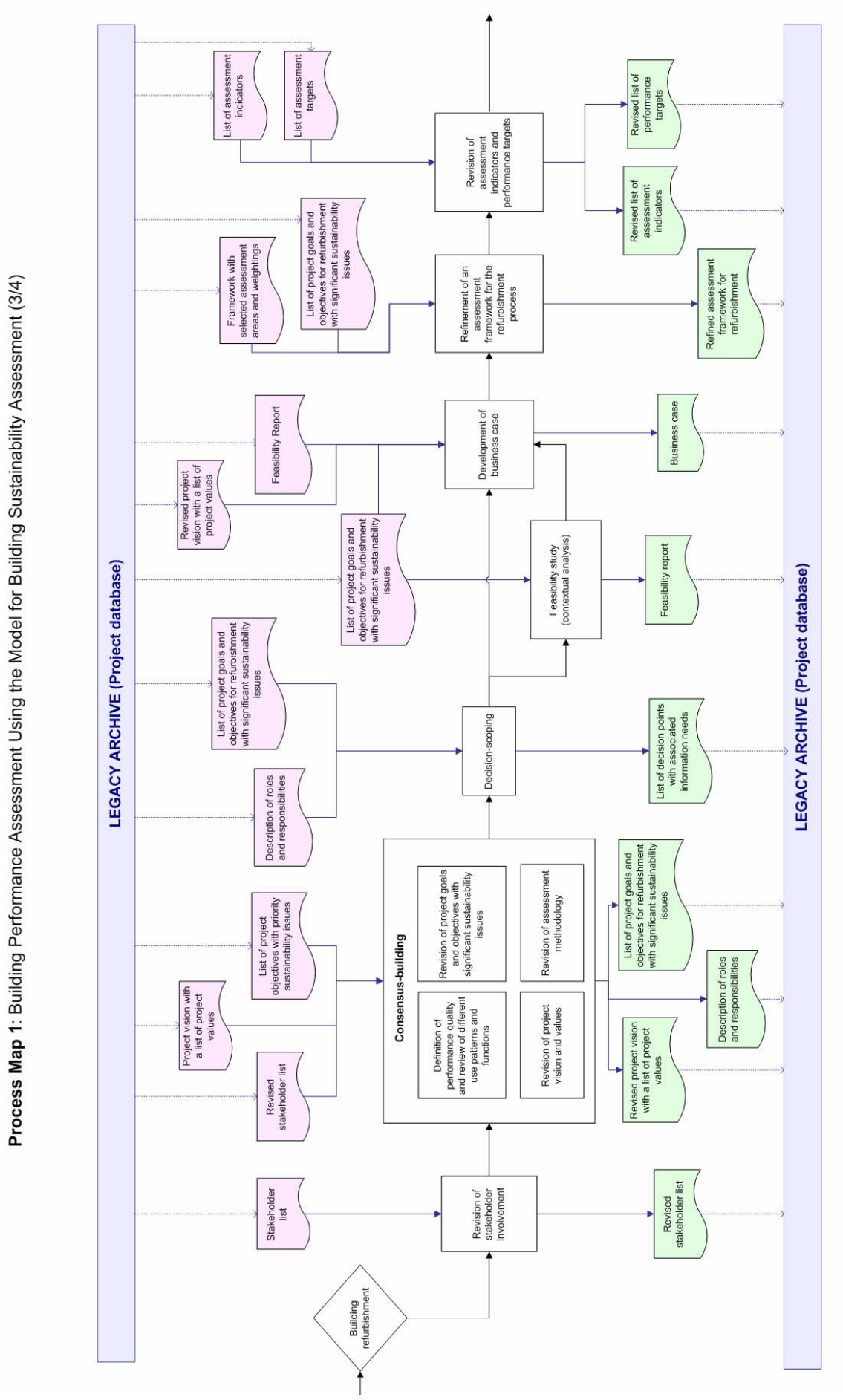
Process Map 1: Building Performance Assessment Using the Model for Building Sustainability Assessment (1/4)



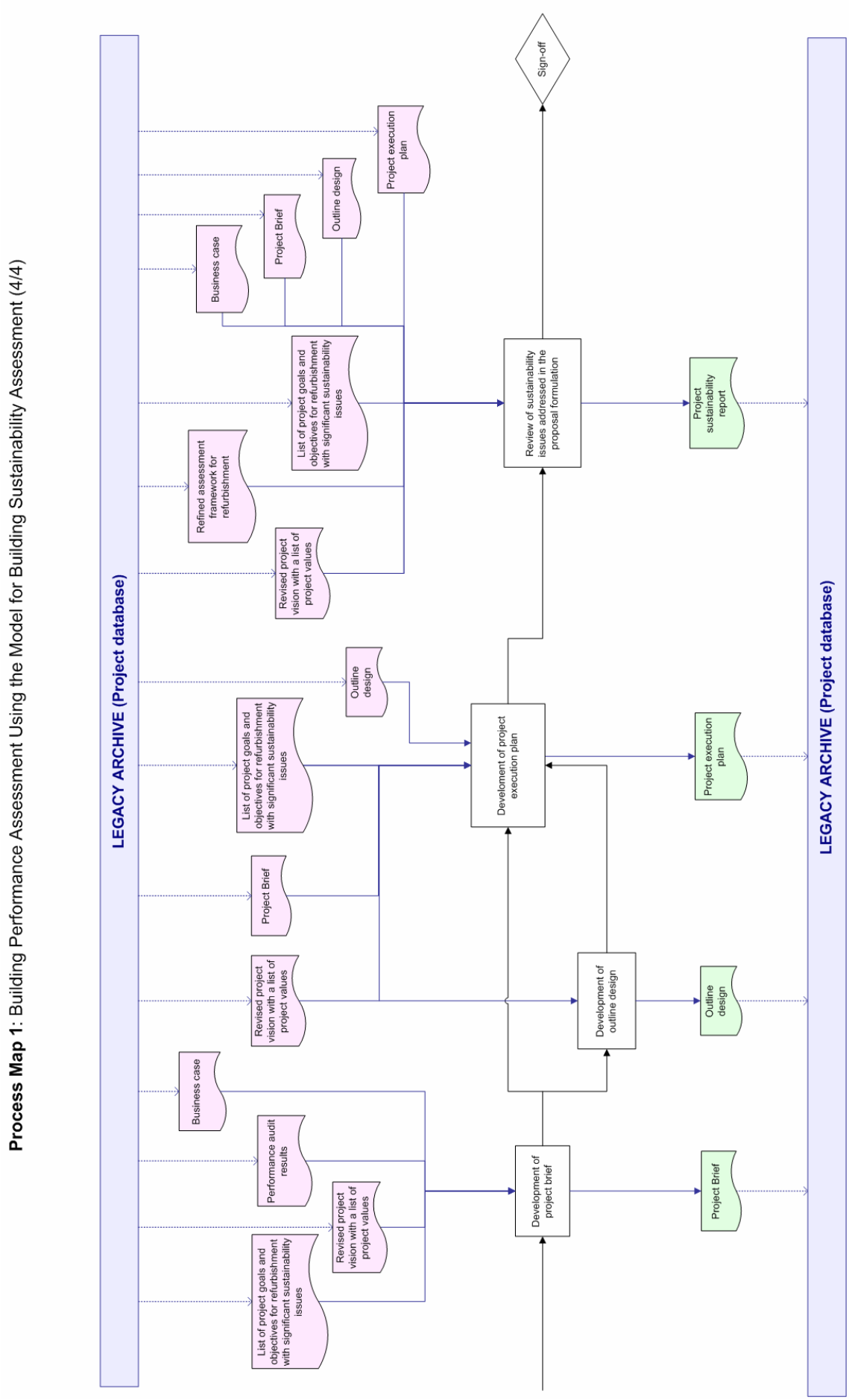
Process Map 1: Building Performance Assessment Using the Model for Building Sustainability Assessment (2/4)



Process Map 1: Building Performance Assessment Using the Model for Building Sustainability Assessment (3/4)



Process Map 1: Building Performance Assessment Using the Model for Building Sustainability Assessment (4/4)



It is important that the model facilitates information exchange and sustains dialogue among process participants (e.g. by establishing lines of communication between building occupants and facility managers) during project planning and execution of the building audit or refurbishment. Through application of the model, the process of service delivery and the associated allocation of responsibilities for performance quality should become transparent to all stakeholders. Moreover, all process information and outputs are stored in the Legacy Archive. Information and data captured in such a database will not only help to document the building's history and help address any management issues but they can also be used for a number of other purposes. For instance, the results of performance monitoring may form the basis for obtaining eco-labelling in terms of resource consumption. The information can also be used in the development of an Environmental Management System (EMS) (e.g. in the development of an environmental policy, action plan with targets and timescales) and provide benchmarks for continuous performance improvement over time. Most importantly, the information introduced in the Legacy Archive will be drawn upon in the various stages of the project process such as the pre-project and pre-construction stages where the decisions would inform the development of design solutions.

CONCLUSIONS

Whilst this paper has concentrated on the scenario of a building performance audit, it is clear that the presented should also facilitate any refurbishment process that may result from, or follow, the audit. Therefore, the model could be used for the purpose of formulating a refurbishment proposal at a variety of stages in the PP project process from establishment of need through building operation. In doing so it closes the cycle between operation of a building and the initiation of a project. Since major refurbishments and building modifications often involve significant construction works, the model cannot be limited to the use of a standard checklist, but rather would need to be dynamic and responsive to the application needs. Although the interdependencies with other project activities described within the project process have not been discussed here, the role of the building sustainability assessment model to other potential scenarios can be inferred from the building performance audit scenario together with its impact on the improving project decision making processes.

REFERENCES

Bordass, B., Leaman, A. And Ruyssevelt, P. (2001) Assessing building performance in use 5: Conclusions and implications, *Building Research and Information*, **29**(2), 144-157.

Cole, R.J. (2000) Building environmental assessment methods: Assessing construction practices, *Construction Management and Economics*, **18**(8), 949-957.

Hill, R.C. (2004) *Theory for the Practice of Environmental Assessment: Mutual Adjustment, Critical Rationality and Power in Planning and Decision Making*, Unpublished PhD Thesis, University of Cape Town, March 2004.

Sadler, B. (1996) *Environmental Assessment in a Changing World: Evaluating Practice to Improve Performance*, International Study of the Effectiveness of Environmental Assessment, Final Report, Canadian Environmental Assessment Agency and International Association for Impact Assessment, Ottawa, Canada (available at: www.iaia.org/ Non_Members/EIA/EAE/EAE_10E.PDF) [accessed on 21 July 2004].

Kørnøv, L. and Thissen, W.A.H. (2000) Rationality in decision- and policy-making: implications for strategic environmental assessment, *Impact Assessment and Project Appraisal*, **18**(3), 191-200.

Kagioglou, M., Cooper, R., Aouad, G., Hinks, J., Sexton, M. and Sheath, D.M. (1998) *A Generic Guide to the Design and Construction Process Protocol*, Salford University.

Dell'Isola, A. (1997) *Value Engineering: Practical Applications for Design, Construction, Maintenance and Operations*, RS Means, Kingston, MA.

Gann, D.M., Salter, A.J. and Whyte, J.K. (2003) Design Quality Indicator as a tool for thinking, *Building Research and Information*, **31**(5), 318-333.

Kalay, Y.E. (1999) Performance-based design, *Automation in Construction*, **8**(4), 395-409.

Ryd, N. (2004) Facilitating construction briefing – From the client's perspective, *Nording Journal of Surveying and Real Estate Research*, **1**(1), 86-101.

Thomson, D.S., Austin, S.A., Devine-Wright, H. and Mills, G.R. (2003) Managing value and quality in design, *Building Research and Information*, **31**(5), 334-345.

Winch, G., Usmani, A. and Edkins, A. (1998) Towards total project quality: a gap analysis approach, *Construction Management and Economics*, **16**(2), 193-207.

Whyte, J. and Gann, D.M. (2001) Forum: Closing the loop between design and use: Post-Occupancy Evaluation, *Building Research and Information*, **29**(6), 460-462.