



## 'Green procurement' of buildings: a study of Swedish clients' considerations

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# ‘Green procurement’ of buildings: a study of Swedish clients’ considerations

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The results of a survey show that both public and private building clients in Sweden, to varying extents, include environmental requirements in their procurement documents. The requirements identified have been classified into six categories primarily related to building and demolition waste, building material, contractors’ environmental work, ecological aspects, construction work and other. One conclusion is that requirements regarding the separation of waste and a contractor’s environmental policy are considered important, since they are stipulated in the majority of projects. Another finding is that requirements related to operation and especially to energy use are not considered sufficiently. Structured interviews were conducted with three of the clients who at that time of the survey had developed the most complete procurement documents with regard to environmental requirements. The aim of the interviews was to investigate how the stipulation of requirements, the evaluation of environmental aspects and the verification of environmental requirements were carried out. The conclusion drawn is that Swedish clients find the stipulation of requirements relatively uncomplicated, but find the evaluation of environmental impact, mainly related to selection of materials, problematic due to inadequate evaluation models.

*Keywords:* Construction, environmental requirement, sustainable construction, procurement

## Introduction

The environmental agenda has become increasingly important for the Government in Sweden, and is reflected in growing legislation to counter negative impacts on the environment. One of the primary targets is the building sector, where there is believed to be considerable scope for improvement. Environmental concern has broadened to include fundamental questions about sustainability, and so the concept of sustainable construction has evolved to cover ecological, economic, social and cultural responsibilities. Ecological sustainable construction implies a process that starts in the planning stage and continues after the construction team has left the site (Hill and Bowen, 1997). Responsibilities include managing the serviceability of a building during its lifetime, its possible deconstruction and the recycling of resources to reduce the waste stream associated with demolition. Choice of

material, technical solutions, construction methods, and types of services installation also affect total environmental impact, which is to be minimized. Clients and developers have a responsibility for the development of environmentally aware processes by stipulating the requirements under which projects are designed. The client’s proficiency in formulating, evaluating and verifying relevant environmental requirements to include these aspects is crucial to this development. The requirements must be stipulated in a way that enables them to be fulfilled by the contractor and verified by the client. Environmental considerations inevitably require clients to modify their project management practices.

This paper reviews a recent study and its results in the area of the environmental requirements for reducing environmental impact from building projects. The objective of the study, via a questionnaire survey, was to identify the environmental requirements that clients have stipulated in their procurement of building projects, and to examine some of those clients’ experiences

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of green procurement, i.e. procurement including environmental requirements.

### **Overview of environmental improvements by the Swedish building sector**

The building sector in Sweden suffered a recession throughout much of the 1990s. During that period the government vigorously pursued the environmental agenda and prepared a new code in which 15 environmental objectives were identified (Ministry of the Environment, 1998). The built environment in general and the construction sector in particular were seen to be in need of fundamental change aimed at improving environmental load, because of their impact on several of the environmental objectives. To stimulate investment in the environmental improvement of buildings the Swedish state will, over the 5-year period from 1997, have invested €109 million. The funds are used to subsidize job-creating investments in the ecological sustainable renovation of buildings and plant, and to stimulate investments in waste management, renovation, demolition, water supply and sewerage. However, compared with the annual cost of maintenance and repair of buildings, which in 1999 was estimated to be €5.8 billion (Swedish Building Industry, 2000), the investment programme is rather modest.

The Ecocycle Commission, appointed by the Swedish government in 1993, has examined producer responsibility for products. The Commission's remit was to develop a strategy for adapting the goods used in the community to the needs of a closed-loop system. This was done to determine the responsibility that should be borne by producers of different goods, namely those who produce, import or sell a product or item of packaging. Producers also include those whose work generates waste requiring special measures for disposal.

In response to the Ecocycle Commission's work, the Ecocycle Council for the Building Sector, which includes developers, property owners, architects, consultants to the building industry and the building materials industry, was established in 1994. One of its undertakings is to limit future environmental problems through taking action at the early stages of product development, planning and project design. The Ecocycle Commission's goals primarily included products/materials and waste streams, whereas little attention was devoted to problems associated with energy used for heating, ventilation or maintenance of buildings. This influenced the construction sector's approach to addressing the environmental agenda, focusing effort on waste streams and materials. As the

environmental work has progressed, additional priority areas have been included and both the Ecocycle Commission and the Ecocycle Council have had a significant bearing on the progress of environmentally aware construction in Sweden. The Ecocycle Council (2000) has ranked the most significant environmental aspects related to external impact from buildings, based on lifecycle assessment (LCA) analysis, as follows.

1. Energy use for space heating
2. Material use, including waste and transport
3. Hazardous substances

### **Energy use for heating**

In the reports from the Ecocycle Council (2000) and from the Ministry of the Environment (2000), energy use for heating, including domestic electricity, is targeted as the primary source of environmental impact by the construction sector. The building sector uses 155 TWh annually, representing 39% of the total energy use. In another study, Adalbert (2000) examined the total energy use during the lifecycle of a building from manufacture of constituent materials through to demolition, based on Swedish conditions. One conclusion is that 70–90% of the environmental impact arises from the occupation phase, if this phase is assumed to last for 50 years and today's techniques are used. Airborne emissions, like CO<sub>2</sub>, originate from the use of fossil fuels and are to be reduced on a national level. One approach is to replace the use of non-renewable resources, such as coal and oil products, by renewable energy sources like water, wind, sun power and biofuels. Even if the use of renewable energy is increased heavily it will not be enough to cover the total energy needs (Swedish Environmental Protection Agency, 1998). It is important, therefore, to reduce the use of primary energy. Producing buildings that are energy efficient is of primary importance.

### **Materials, waste and transport**

The environmental impact of materials, transport and construction work is minor in relation to the impact of energy use. Nevertheless, the construction sector is responsible for a considerable part of transport and materials usage. Forty-four percent or 75 Mtonnes of the total amount of material used is related to construction, making this an obvious target (Ecocycle Council, 2000). Choice of materials and construction methods has a significant and complex impact on the environment. The long term perspective involved and the large quantity of materials and components make the total impact on the environment difficult to assess. Heavy emphasis has been placed on research into the

environmental impact of building materials and assembly methods through the use of lifecycle assessment (LCA) models. LCA is a technique for analysing and assessing the environmental impact of a material, product or service throughout its lifecycle, usually from the acquisition of raw materials to waste disposal (Jönsson, 1998). It is used for the purposes of comparing the impact of different products or assessing the dominant environmental problems related to the production of goods (Tukker, 2000). The method has emerged as a legitimate means for evaluating the performance of buildings across a broad range of environmental considerations (Cole, 1999). Nevertheless, LCA has not been particularly successful in practice in the construction sector, principally because of problems concerning the availability of input data and the complexity of LCA analysis in its present form. So far, LCA has mainly been used on products (see e.g. Erlandsson, 1995; Björklund and Tillman, 1997; Gunter and Langowski, 1997). Currently there are over 40 000 products on the market, and it will take a considerable time before even a small percentage of these are assessed. Moreover, there is a need to develop instruments relevant to whole buildings for use in procurement.

Building and demolition in Sweden generate some 4–6 Mtonnes of waste annually, which represents roughly 5% of the total amount of waste generated by all sectors. During 1990 approximately 90% of the waste from building activities was deposited. Five percent was used for energy extraction and the remaining 5% was reused, mainly for landfill. The quantity of construction and demolition waste creates numerous problems (Peng *et al.*, 1997): it consumes valuable space, especially in larger cities; it generates traffic; and it might be a source of harmful leakage and other contamination. Demands from regulatory bodies, municipalities and the public have placed waste recycling operations under scrutiny, leading to pledges from Sweden's construction sector to reduce the amount of waste to municipal landfill sites by 50% between 1995 and 2000. Many construction and demolition materials have a high potential for recovery and reuse. To support this, most contractors in Sweden now separate waste. Also local markets have been established to sell secondary materials, but it is necessary that clients accept the reuse of materials and that guarantees can be given to make reuse successful. However, long term improvement is likely only if the problem can be tackled at source. In other words, waste elimination should be considered during the planning and design of new projects.

The primary arguments for clients and contractors reducing and recycling construction and demolition waste in most cases have been economic. Munici-

palities have increased tipping fees and applied stricter regulations regarding the kinds of waste that may be deposited, stimulating efforts to recycle. In Australia similar conditions are prevailing. McDonald and Smithers (1998) have investigated the economical aspects of waste management, and shown that implementing a waste management plan during the construction phase of a project reduces waste generated on site by 15%, with 43% less waste going to landfill because of recycling. Also, cost savings of 50% on waste handling were generated. Nevertheless the waste strategies implemented by municipalities in Sweden or Australia are not exceptional since several of EU member countries have adopted similar approaches.

The general perception of cost savings can differ between countries. In a study of the on-site sorting of construction waste in Hong Kong (Poon *et al.*, 2001) it was found that contractors had considerable reservations about adopting this approach. Their reasons, among others, were that the sorting interfered with normal construction activities, was labour intensive and, consequently, more costly. It was believed that only contract terms could set the bounds for the contractors in building waste management.

### **Hazardous substances**

Current information about the health and environmental effects caused by chemical substances is inadequate, and clearly the risks today are more complex and difficult to assess than ever. This complicates the identification of substances that are hazardous, confuses awareness of the risks involved with manufacturing and usage, and makes the actions needed to prevent or limit their impact more difficult to identify. Annually, the building sector uses 3.5 Mtonnes of material, including hazardous substances, representing 5% of the total use by all sectors. These occur in several of our commonly used building products as cast, cement, electrical materials, adhesives, etc. The National Chemicals Inspectorate has examined the presumed effects of some chemicals on health and the environment. Inventories of chemicals considered to involve risk in use are published and updated regularly (NCI, 1996, 1998). The purpose of these inventories is to identify hazardous substances in materials like asbestos, lead, mercury and formaldehyde, thereby restricting their use.

### **The study**

The study consisted of two parts: first, a questionnaire survey was undertaken to examine which environmental aspects clients have considered when procuring

buildings; and second, an interview study to examine the clients' experience of 'green procurement'.

### Questionnaire survey

A questionnaire survey was devised to determine which environmental requirements Swedish building clients consider when procuring buildings. The following questions were asked. Has your company considered environmental aspects in the procurement of construction projects? For what project size have environmental requirements been stated? Which environmental requirements do you usually consider? Are you, in the near future, planning to procure construction projects where environmental aspects will be considered? The clients were also requested to submit a procurement document for a construction project of their choice to confirm that such requirements had, in fact, been stipulated.

**Table 1** Sample groups and responses to the questionnaire

Sample groups	Group size	Clients contacted	Clients responding
Municipals	288	38	28 (74%)
SABO	300	11	10 (91%)
Government	16	11	9 (83%)
Private	83	9	6 (67%)
County councils	21	1	1 (100%)
Total	708	70	54 (77%)

### Sample design

Laws and regulations control clients to varied extents, depending on whether they operate as private concerns or are within the public sector. Therefore both public and private clients were included in the study, since differences in their achievements in, and attitudes towards, ecological sustainable construction was expected. In order to reach a large target group, a representative sample of 70 clients (Table 1) was selected, based on lists of private and public organizations supplied by the following.

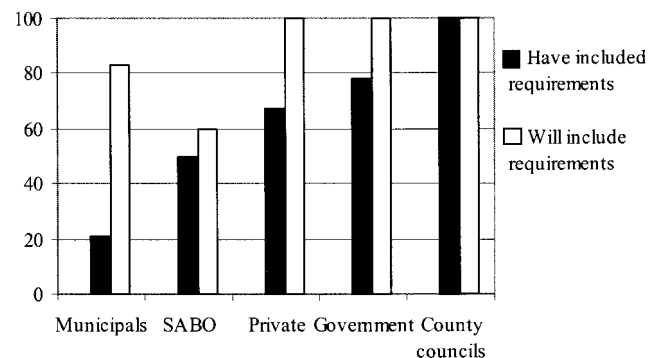
- Sekom, an organization for municipalities with an ecological outlook. There are 288 municipalities in Sweden, and those who are members of Sekom were considered to be more likely than others to have included environmental aspects in their procurement.
- SABO, an organization for clients involved in municipal housing, with 300 members. In a survey performed by SABO, their members were asked questions about how they worked with environmental aspects in general. Four questions from that study that related to

building activities were identified, and used as selection criteria, i.e. the client had to have considered all four questions to be selected for the study presented here.

- The Governmental Network for Quality and Construction, which includes 16 clients, departments and committees. Nine of these were selected. Excluded organizations were those committees not heavily concerned with the procurement of buildings.
- Byggherreföreningen, an organization for clients, with 83 member companies. The nine largest, according to business volume, were selected on the assumption that they have the financial wherewithal to develop and implement environmental strategies.
- The County Councils Federation, including the 21 county councils in Sweden. At the time of the study, building projects performed by county councils were rather concentrated in the Stockholm region, so only the Stockholm county council was included.

### Results from the questionnaire survey

From the responses to the questionnaire it was established that 46 of the 54 clients had included environmental requirements in their procurement documents. However, some of these clients did not indicate which requirements they had considered, or offered a very limited presentation of requirements. Therefore, an evaluation of the clients' answers had to be undertaken. Clients who had included at least four environmental requirements were included, and altogether 23 clients were identified. If less than four requirements were considered then it was suspected that environmental aspects were not to any great extent considered in procurement. Figure 1 shows the percentage of clients in each group, who have included environmental



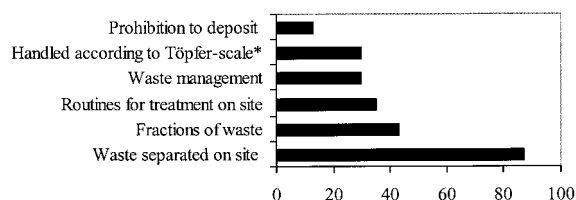
**Figure 1** Clients who have stipulated environmental requirements (after evaluation) and whether in the future they will stipulate requirements (in %)

aspects. Also shown is the number of these clients who, in the near future, expect to include environmental aspects as part of their procurement. Few clients (21%) within municipals stipulated environmental requirements as part of their procurement. A study of their documentation revealed a difference: governmental and private clients had developed much more rigorous conditions addressing environmental aspects than most of the municipal and SABO clients. Figure 1 indicates that most of the clients in the study who already have included environmental aspects in a project will do so again in the near future.

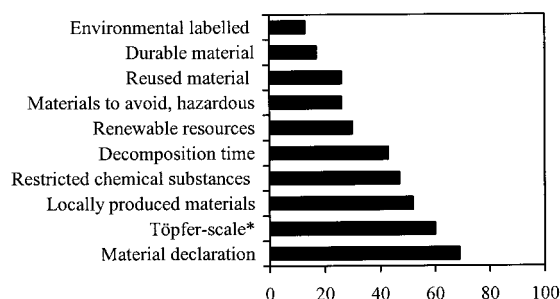
The information received in the procurement documents from the 23 clients who had considered environmental requirements was compiled, and the requirements with similar characteristics were classified into six categories:

- building and demolition waste;
- material;
- contractor's environmental work;
- construction;
- ecological aspects; and
- other requirements.

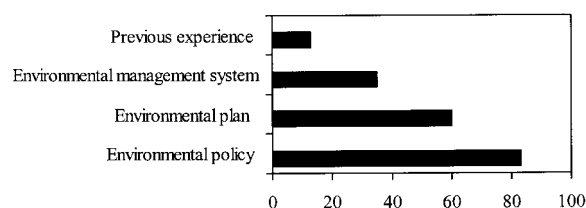
Figures 2–7 show the numbers of clients that considered each concept of the requirements, in terms of a percentage value. The two most commonly stipulated



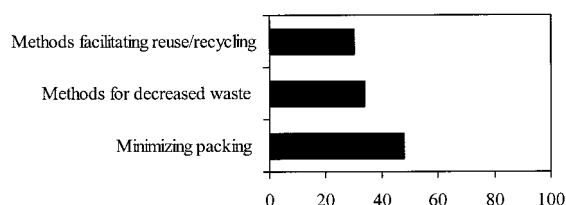
**Figure 2** Requirements on waste handling (in %). Note that the Topfer-scale can be used as one basis for selecting building materials from an environmental perspective. The scale includes the following seven steps, all with the purpose of reducing waste: 1, prevent waste occurring; 2, reuse; 3, recycle; 4, reuse for other purposes than the original; 5, extract energy; 6, handle in other ways than deposit; and 7, deposit.



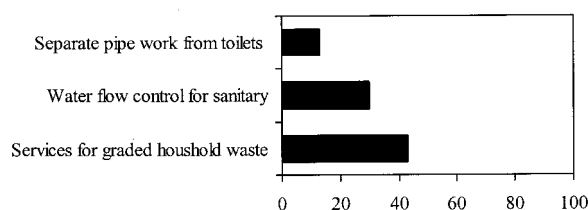
**Figure 3** Requirements on material selection (in %)



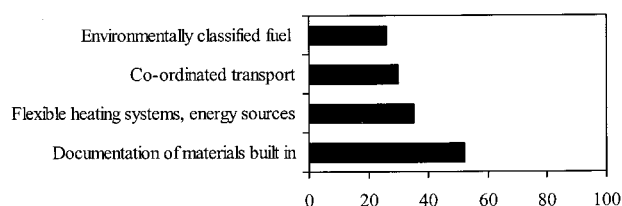
**Figure 4** Requirements on the contractors' environmental work (in %)



**Figure 5** Requirements on construction work (in %)



**Figure 6** Requirements related to ecological housing aspects (in %)



**Figure 7** Other requirements (in %)

requirements are separation of waste, stated in 87% of the projects and contractor's environmental policy, stated in 83% of the projects. Reasons can be: (a) that waste separation can be economically beneficial, is easy to follow up and is relatively simple for the contractor to carry out (also public opinion may be a driving force); and (b) that the contractor's environmental policies show his general goals for environmental work, providing an indication to the client as to how the contractor himself considers environmental aspects.

The least common stipulated requirements are: previous experience of environmental projects (13%); prohibition to deposit specific types of waste (13%); and

separate pipe works from toilets to collect urine (13%). Reasons can be: (i) that the building sector has faced a recession and few new projects have been carried out (several, especially small, contractors had not had the chance to participate in environmentally profiled projects); (ii) uncertainty about legislation (prohibition on the deposition of waste means simply that the contractor is not able to deposit hazardous waste; however, this is already included in legislation in Sweden and therefore makes the requirement redundant); and (iii) that installation costs for separate pipeworks are high.

Additionally the concepts of requirements have been compiled according to the Ecocycle Council’s prioritized areas (Table 2), to examine whether the clients cover those areas. From a long term perspective, most requirements have positive effects on reducing environmental impact. However, some requirements are targeting routines of environmental work, and do not have a direct effect on either of these areas; therefore these are not included in the table. Also the requirements in Figure 6, ecological aspects, target the occupation phase, taking them outside the area of Table 2.

Few requirements are related to energy use for heating. When stipulated in procurement documents, in most cases it concerns the use of flexible heating systems allowing a significant part of the supplied energy from renewable sources. However, there are several other requirements that may be stated within this area, e.g. system solutions providing energy savings, co-ordinated climate systems, increased insulation thickness, passive solar use, etc.

Reduced material use and amount of waste to tipping are better covered by several requirements, as are hazardous substances. This reflects that the Ecocycle Council’s work has been effective in focusing

on these areas. However, there is a danger that requirements intended to reduce environmental impact in one area could adversely affect another area. The requirement for locally produced material is an example where the aim is to reduce transport but where e.g. the effects of the manufacturing process could be neglected.

Interviews

To examine ‘green procurement’ at the practical experience level, structured interviews with three clients were undertaken. Structured interviews, i.e. questions prepared in advance and applied to all interviews, are often used when the intention is to compare and generalize the results (Patel and Tibelius, 1986). Some of the questions were structured to seek answers from the respondent only to clearly defined alternatives, while other questions allowed the respondent to answer freely (see Appendix).

Sample

The three clients that, at that time of the questionnaire study, had developed the most complete procurement documents with regard to environmental requirements were selected for interviews.

- Lunds Kommuns Fastighets AB (LKF), which is a municipally owned residential client mainly targeting construction and facility management of residential housing in the city of Lund.
- Akademiska Hus in Stockholm AB, which consists of the parent company Akademiska Hus AB and eight subsidiary companies targeting construction and management of university facilities.

Table 2 Requirements related to the Ecocycle Council’s prioritized areas

Energy use for heating	Material and waste	Transport	Hazardous substances
<ul style="list-style-type: none"><li>● Flexible heating systems</li></ul>	<ul style="list-style-type: none"><li>● Material selected according to Töpfer-scale</li><li>● Reuse material</li><li>● Durable material</li><li>● Waste separated on site/ fractions specified</li><li>● Waste handled according to Töpfer-scale</li><li>● Prefabrication of material and customized material</li><li>● Minimized packing</li><li>● Construction methods facilitating reuse/recycling</li></ul>	<ul style="list-style-type: none"><li>● Locally produced material</li><li>● Co-ordinated transport</li><li>● Environmentally classified fuel</li></ul>	<ul style="list-style-type: none"><li>● Chemical Inspectorate’s lists</li><li>● Materials to avoid</li><li>● Prohibition to deposit materials</li><li>● Environmentally labelled material</li></ul>

- Locum AB with Locum Bygg is the Stockholm County Council's facility management co-operation, targeting public health care facilities. Locum Bygg acts as a consultant within the company Locum AB.

The interviews were treated as cases. A case is a phenomenon of some sort occurring in a bounded context, and is the unit of analysis in this study. The cases are the three clients in the context of the environmental work they perform. Two aims in studying multiple cases are to increase the chances of generalization and to develop descriptors. A cross-case analysis has been performed, in accordance with the method advocated by Miles and Huberman (1994). Initially, the information obtained from the interviews was scanned in consecutive order using the interview questions as headings. Thereafter, a categorization, namely the themes in the information, was identified, and a structure was created. For the scope of the present paper, the relevant categories are environmental requirements. Beyond this, information has not been included, but is available in Sterner (1999).

### Results from the interviews

The cross-case analyses were performed to identify similarities and differences among the clients' answers (Table 3).

### Stipulating environmental requirements

The clients had all developed project specific requirements to reflect the environmental goals decided at the company level. To facilitate future work, two of the clients have included or will include general environmental requirements such as environmental plans and

environmental management systems in their administrative instructions (AFs). Stipulating the requirements is considered straightforward. The reason for this, expressed by the clients, was that once the prioritized areas for the project are decided, the problem with formulation is more or less resolved. It is considered to be relatively easy to formulate requirements for projects that have a well defined and specific theme for environmental work.

### Evaluating environmental aspects

If the selection of materials is not left to a consultant, the clients use their own evaluation models influenced by the LCA method. Presented here is LKF's model, where each material is assessed in six different categories: manufacturing; construction; occupation; cost; operation and maintenance; and recycling possibilities (together with their underlying assessment areas, see Table 4). Within each assessment area a scoring between one to four points is given, where a low point indicates a good choice.

Similar scoring is used in the Akademiska Hus model, where the assessment is performed within four categories: manufacturing; construction; occupation; and demolition. For each category an assessment of material use, energy consumption and emissions is made. The assessment is further related to a reference product, e.g. the most commonly used on the market. The environmental assessment is performed quantitatively. A product will be awarded a score of 1–5 points in each of the categories, where 1 indicates a case much worse than the reference material.

The interviews revealed the complexity of the client's problems in evaluating environmental impact. The difficulty in evaluation springs from the lack of relevant and operational models for evaluating the

**Table 3** Category: environmental requirements

	Stipulate	Evaluate	Verification
LKF	<ul style="list-style-type: none"> <li>● Based on environmental goals</li> <li>● Project specific</li> <li>● Based on environmental goals</li> </ul>	<ul style="list-style-type: none"> <li>● Tender evaluation</li> <li>● Own evaluation system for materials</li> <li>● Tender evaluation</li> </ul>	<ul style="list-style-type: none"> <li>● Evaluation of a specific project</li> <li>● Continuous follow up of all projects</li> </ul>
Akademiska Hus i Stockholm AB	<ul style="list-style-type: none"> <li>● Project specific</li> <li>● Will be included in AF<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>● Own evaluation system for materials</li> </ul>	
Locum Bygg	<ul style="list-style-type: none"> <li>● Based on environmental goals</li> <li>● Project specific</li> <li>● Is included in AF<sup>a</sup></li> </ul>	<ul style="list-style-type: none"> <li>● Tender evaluation</li> <li>● The Chemical Inspectorate's lists</li> </ul>	<ul style="list-style-type: none"> <li>● Continuous follow up of all projects</li> <li>● Environmental programme</li> </ul>

<sup>a</sup>Instead of legislating in favour of procedures for procurement, clients in Sweden use AF (administrative instructions), which are included in the tender document. AF controls the terms under which a contract is set up.



**Table 4** Assessment parameters for evaluation of construction material used by LKF

Manufacturing	Construction
<ul style="list-style-type: none"> <li>• Impact the environment as little as possible during its lifecycle</li> <li>• Has low energy consumption in manufacture</li> <li>• Is made of renewable resources</li> </ul>	<ul style="list-style-type: none"> <li>• Contribute to a good working environment during construction</li> <li>• Act well together with the completed structure</li> <li>• Do not contribute to high levels of moisture in the building</li> <li>• Do not extend the construction time through complicated construction methods</li> </ul>
Occupation	Operation and maintenance
<ul style="list-style-type: none"> <li>• Provide a healthy indoor environment</li> <li>• Is not a source of static electricity</li> </ul>	<ul style="list-style-type: none"> <li>• Have a long length of life</li> <li>• Contribute to a good operation and maintenance economy</li> </ul>
Recycling possibilities	Cost
<ul style="list-style-type: none"> <li>• After use the material can be reused, recycled or will naturally decompose</li> </ul>	<ul style="list-style-type: none"> <li>• Investment cost</li> </ul>

environmental impact of materials. An assessment based on the parameters shown in LKF's model, Table 4, undoubtedly will lead to subjective views, since a material might show good qualities in one category and be poorer in another. Furthermore, the categories will each have a different significance in their impact across the total environmental, making the assessment uncertain. Even LKF considers this evaluation to be misleading, since the result does not, with any greater certainty, verify that the best alternative has been selected. The model, however, offers a straightforward approach that hopefully will give some indication on which materials not to select.

#### *Verifying environmental requirements*

In an attempt to guarantee the contractor's fulfilment of the requirements, the contractor's environmental policy and environmental management system (EMS), e.g. ISO or EMAS, is requested. To follow up the environmental progress continuously, however, the client has to develop additions to traditional project management. Within an environmental programme the client describes the environmental goals for the project and provides a summary of the environmental aspects. Within the framework of the environmental programme, architects, consultants and contractors are required to develop their own environmental plans, which are followed up continuously. During the design phase, meetings with the project manager and client are held during which the environmental plan for the project is discussed. The project manager is also required to show how environmental work is progressing and how it is followed up. Using the same procedure, the contractor's work is evaluated. Since consultants and contractors then adopt similar work routines, and seek advice from each other and the client, a more continuous building process can be achieved.

## **Discussion**

The way in which environmental requirements are stipulated in procurement documents is significant for the development of a project's environmental features. If requirements are stipulated so that they prescribe technical solutions, then this can inhibit the development of new and more environmentally conscious methods. On the other hand, consultants and contractors must also be able to fulfil such requirements, answering affirmatively to the question of sufficiency of knowledge and skill in developing and implementing environmental strategies. Stipulation of relevant and achievable requirements is a further indication of the client's professionalism within this area. The majority of the requirements identified in this study target waste reduction or material use. For waste separation, financial incentives and the creation of a positive attitude within and about the company can be compelling reasons for clients to include this aspect in their contract conditions. Furthermore, the environmental agenda for the building sector has developed from this approach and must now be broadened.

Energy use during operation of buildings is considered to have the largest environmental impact because most buildings have a long life expectancy. However, few requirements related to the operation of the building are found. This might depend on Swedish building codes, which already regulate energy use in buildings, or on the budgets available at the time of investment. Usually, higher investment costs are difficult to accept, even though they will reduce the cost over time. Introducing lifecycle cost analysis into procurement, and basing tender evaluation on these costs, can be a stimulus for focusing on more energy-efficient buildings.

Tender evaluation including environmental parameters can also serve as an incentive for development

of ecological sustainable construction. Today, the parameters evaluated are the contractor's environmental policy and/or environmental management system (EMS), neither of which stimulates this development. Documented policies are often so similar as to make comparisons difficult. Facilitating an assessment that includes other environmental parameters requires the development of operational models. The clients in the study reported that the evaluation relating to the environmental impact of materials was the most challenging task when performing 'green procurement'. This factor arises from the lack of models that, in a rational way, could support impact assessment. Without an accepted model, or standard, it is difficult to conclude which is the best option, thus complicating the chances of including environmental impact evaluations within tender assessments.

## Conclusions

The state of environmental considerations among clients in the Swedish building sector is varied. Government and private clients have developed more rigorous procurement documents addressing environmental aspects than most municipal and SABO clients. The latter still have to make considerable efforts in order to develop the procurement process so that it properly addresses ecological sustainable construction. In general, when clients stipulate environmental requirements they do so by focusing on the selection of particular materials that limit the use of resources and quantity of waste. Few clients consider requirements relating to operational matters or, more specifically, to energy use. The latter is considered by the Ecocycle Council to be the most important environmental aspect, and in the future clients will need to improve in this area. Using lifecycle cost analysis in procurement and basing tender evaluation on such costs can be a stimulus for more energy-efficient buildings.

Clients found the evaluation of environmental impacts complicated due to the lack of operational models. Methods assisting clients in their assessments are needed in procurement, in tender evaluation and in the evaluation of the environmental impact of materials. Future work could usefully include pilot projects to demonstrate the economic effects of ecological sustainable construction in a lifecycle perspective. This is necessary if participants in the building sector are to be educated and stimulated towards genuine environmental concern and action.

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## Appendix: Interview manual

### Part 1: Questions concerning the company

1. Who have initiated the environmental work within the company?
2. Is there a person within the company who is responsible for environmental issues?
3. Do you use an environmental management system or are you planning to introduce such a system? What result has it given or are you expecting?

### Part 2: General questions concerning the project

4. In what phase of the project was it decided to include environmental aspects?
5. Why were environmental aspects considered?
6. How has the consideration of environmental aspects changed the cost of the project? What is this answer based on: own estimations or calculations and follow up?
7. Are there environmental aspects that you did not consider because costs were expected to be too high? State which aspects.
8. Has any subsidy been granted to the project? If so then from where?
9. What is the subsidy intended to cover and is the intended cost covered?
10. Was there any price reservation concerning environmental requirements in the procurement, and if so then how were those formulated?
11. Is this the first project the company has performed with an environmental profile?
12. If not which aspects were considered in that/those projects?

### Part 3: Project design and procurement

13. What is your perception of the concept of green procurement?

14. When did your company introduce environmental aspects in procurement?
15. What type of procurement method has been used in this project? Has this affected the environmental work?
16. Who have participated in the design of the project? Indicate on a scale from 1 (weakly) to 4 (strongly) how they have driven the environmental work.
17. Who have decided on the environmental aspects considered in the project?
18. Are there any environmental aspects that have a high priority, which are they and why have these been selected?
19. What are the complications when considering environmental aspects in procurement?
20. How complicated is formulation, evaluation, or verification of environmental requirements? Indicate on a scale from 1 (no difficulty) to 4 (great difficulty).
21. State which complications are present when formulating, evaluating, and verifying environmental requirements.
22. How is the environmental work followed up?
23. What parameters were included in the tender evaluation, what weight was each given?
24. Which environmental aspects have been evaluated in the tender assessment and how have these been evaluated?
25. Have you considered hazardous substances and components when selecting materials? What criteria were used for assessment and which products have been examined?
26. Have you considered health aspects when selecting material and how materials work together in the building and, if so, how is that done?
27. How is reduction of waste from building considered?
28. Have you prioritized reuse of materials and materials that are able to be recycled, and if so how is such a priority carried out?

The following information, related to the project, was requested from each company in advance of the interview.

- General presentation of the company, turnover, number of employees, etc.
- General description of the project.
- Administrative instructions and procurement documents.