Technology Procurement for Efficient Systems

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Abstract
Future-oriented buyers, who draw up challenging performance requirements and indicate a coming market, can stimulate manufacturers and contractors into developing and marketing new, and much more efficient, innovative solutions which meet customer satisfaction. In the construction and energy fields, there are already a number of examples with costs, or resource consumption, being halved by using the process co-operative or technology procurement. Creation of buyer groups, formulation of criteria and real purchasing, in combination with support and promotion activities, are important parts. After a tendering process, true collaborative work will take place, which, during the development, gives the suppliers and contractors access to early reactions from buyers and users in a kind of partnering arrangement. Examples of projects are lifts installed in existing buildings, housing appliances, ventilation, heating and lighting.

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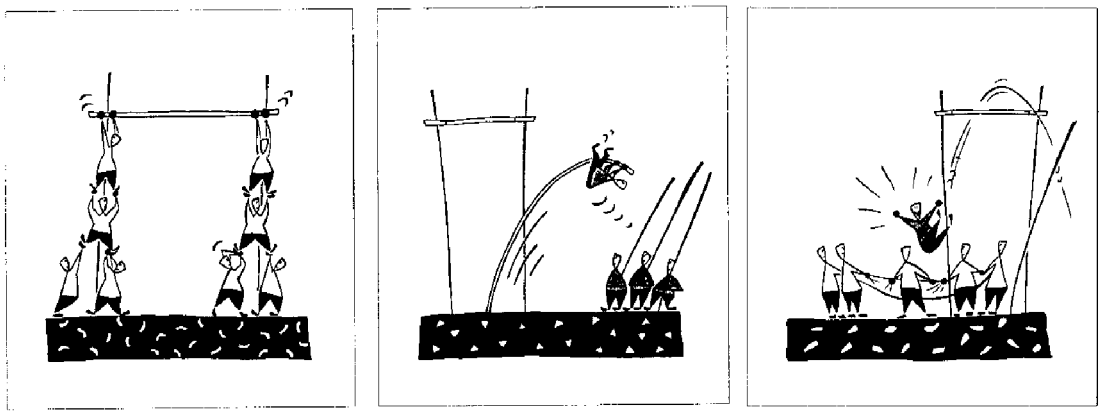
The importance of identifying key buyers, and the role of government (federal, regional and local) and other long-term customers as anchor buyers or intermediators, is stressed among the "lessons learned" from the process.

Keywords: Buyer needs, buyer groups, collaboration, innovation, LCC, performance criteria, technology procurement.

1 Introduction

1.1 Possibilities

Reduction of energy use by half, reduction of total costs almost by half, and/or speeding-up the development process and the realisation of individual projects are results achieved by using co-operative or technology procurement. With this process major buyers and users articulate their needs in functional terms, aggregate their purchasing power, and accelerate the innovation and diffusion process. Through parallel work and early involvement of leading buyers and users, the risks are reduced for contractors and manufacturers, Fig. 1.



Setting higher goals
Purchasers and buyers collaborating in innovative buyer groups can create new criteria for energy efficiency.

Selecting through competition
Common criteria for environmental performance allow producers to compete for orders and ranking.

Landing safely
For producers, strong buyer groups mean lower investment risks.

Fig. 1. Technology procurement - some aspects [1]

1.2 General construction problems

Many low-efficient, existing technical solutions, consuming large resources of energy, capital and time, are the results of the rather split-up building process which is characterised by fragmentation into phases and branches, see Fig. 2. Manufacturers or contractors do not really know the final and total cost or energy use, and they very seldom meet the end users - being facility managers, maintenance personnel or consumers. Real needs are not articulated in functional terms and the requirements are not specified in order of priority. There is a gap between buyers and users on the one hand, and manufacturers, contractors or sellers on the other, and the latter cannot be sure about the users' real problems and needs, nor whether or not they will actually buy the newly developed products and systems.

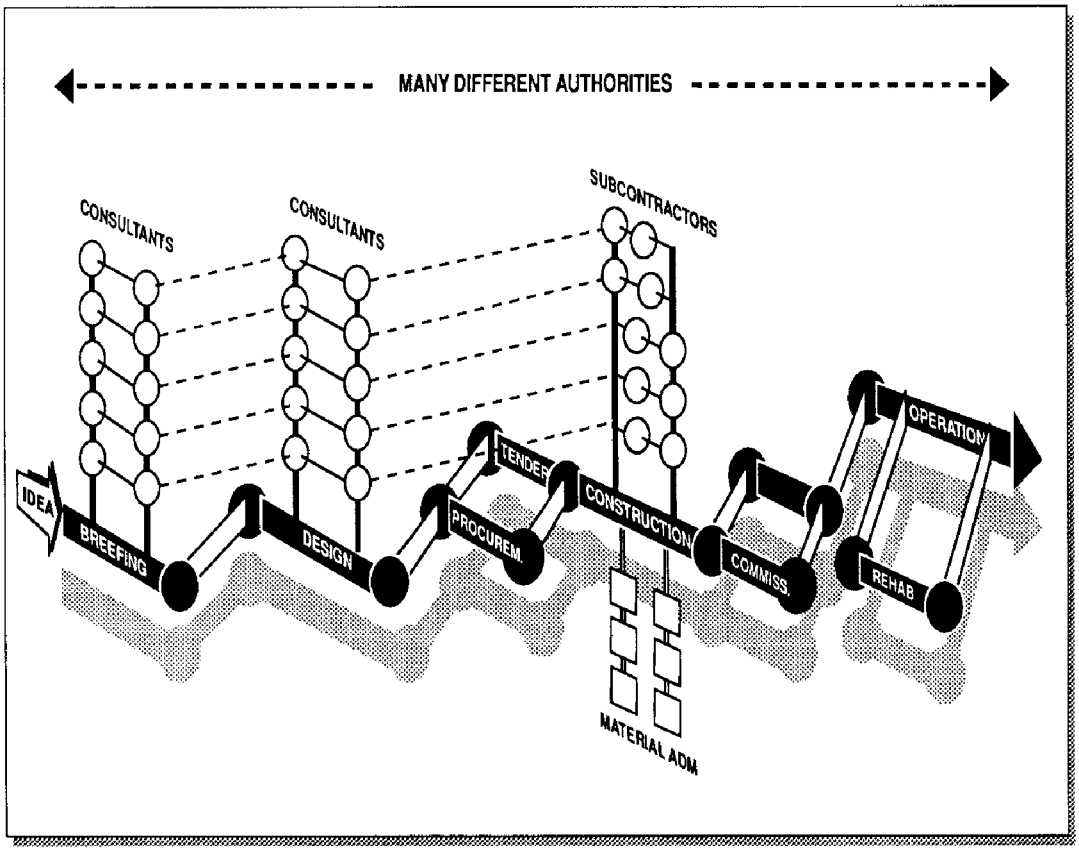


Fig. 2. Fragmentation of the construction process - Division into stages and occupational groups (circles and squares symbolise limits of responsibility) [2]

The problematic general situation in the construction sector and future changes in the construction process required for accelerated, yet reliable innovation, have been treated in the Atkins reports about different European countries [3].

1.3 Project Earth and operating costs

The impact of energy production and CO_2 emission on the possibilities of a sustainable situation in the world and the risks of a climate change has come into focus more during recent years.

The part of the total operating costs which relate to space, heating, ventilation and cooling has increased. In some systems, the operating cost is the largest by far of the total life cycle cost (LCC). As far as components such as electric motors are concerned - and there are large numbers of them in buildings - the *energy cost* can account for as much as **90 per cent of the total life cycle cost**. The right choice of more energy-efficient components and systems with consideration of life-time costs will be crucial for the total project economy and also for the environment. Innovation in the construction sector is really important and new, efficient procedures have to be introduced. The inspiration of innovation by the real buyers, or property owners, is essential.

The International Energy Agency, IEA, has set up a special programme in order to facilitate the development and diffusion of more energy-efficient solutions. In the project "Co-operative Procurement of Innovative Technologies for Demand-Side Management",

a process has been developed, and different pilot projects will be fulfilled, using technology and co-operative procurement.

2 Theories and definitions

2.1 Theories

The great importance of the involvement of buyers in the innovation process in general has been pointed out for instance by Erik von Hippel, MIT, [4] and was mentioned already in the SAPPHO studies [5]. The technology procurement process aims at stimulating innovation and creating new, non-existent products or systems. This method has been used on some occasions throughout history, see further below.

In many areas, the market is out of balance. There are many buyers, but they are not united. They may have valuable ideas but have difficulties imagining new products. Sellers and manufacturers are not well-informed about what their customers really want.

Interaction between users and producers and the organisation of the market for innovation have been stressed by Lundvall [6 and 7] and the importance of a central co-ordinating agency by Teubal [8]. The creation of networks has been treated by Håkansson [9].

2.2 Definitions

Technology procurement is an entire acquisition process, which has the pronounced aim of promoting **innovation**. Its use is intended to produce products, systems and processes that are better adapted to the buyers' requirements than those on the market at the outset of the work.

It is not exclusively associated with any particular form of contract, though it is closest to design/build contracting with requirements in functional terms.

Co-operative procurement includes both

- technology procurement (of something not yet existing on the market), and
- acquisition of existing products/systems in some organised ways (for instance among the 25 per cent "best", most energy-efficient, or best in some other aspects).

In both cases, a number of **buyers combine** their efforts and, to a varying extent, work jointly with the formulation of requirements, invitation for tenders, evaluation and actual buying.

In many cases, the buyers may only represent public organisations, but they may also be private companies, individuals, or combinations of public and private organisations.

3 The technology procurement process

Important activities in the preparation for technology and co-operative procurement as a result within the above-mentioned IEA Annex III project are illustrated in Fig. 3 below.

The most important part is to **create groups of buyers**. It is especially important to inspire the more dominant, future-oriented buyers or users to join the groups. In the construction sector, as in some other sectors, there is a lack of good communication links between different actors in the process, including links between buyers and suppliers. An important part of successful co-operative work is to **create a network** and strengthen it. Apart from networks between future-oriented buyers, good communication channels should

be created with manufacturers, users - if separated from buyers -, different authorities, testing laboratories, utilities, etc.

The group of buyers should use a large amount of time at the beginning of a project to study problems and agree on common goals and objectives.

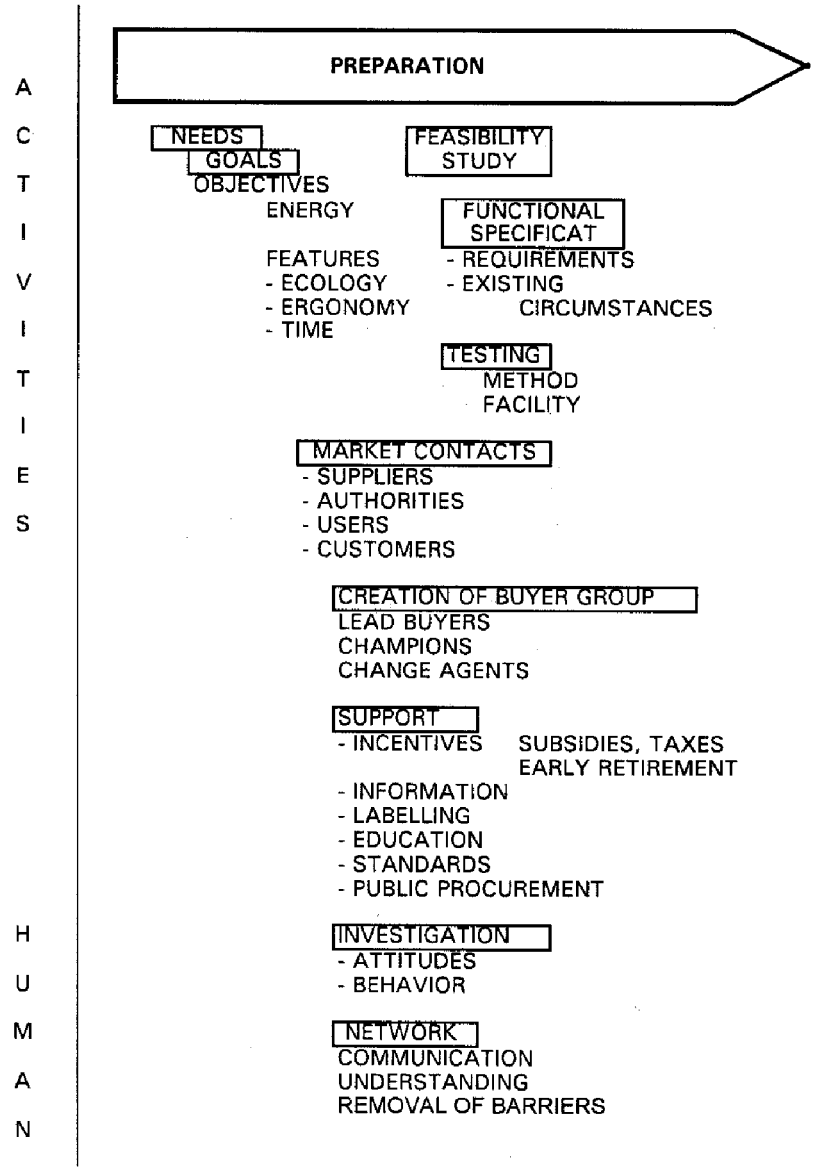


Fig. 3. Co-operative procurement - Preparatory activities [1]

The specifications should be formulated as **functional requirements**. It is important to find very knowledgeable drafters for the specification. They should not get caught up in limitations implied by present-day technology or by conventional design solutions. Openness for new ideas and solutions is very essential.

The requirements can refer to a primary goal, for instance primarily in the **energy field**, but also to **other features** which will facilitate acceptance and penetration of the new product or system. These **features** can, for instance, include ergonomic aspects, environ-

mental requirements, data on noise, emissions, etc. This will then contribute to greater customer satisfaction and acceptance of new solutions.

4 Earlier experience

4.1 Historical examples

Contests have often inspired significant innovations. There are some wellknown historical contests and challenges in which clear goals were established. The development of a new clock for ship navigation is one example. By the discovery of new continents and the efforts to improve the sea routes, many nations, e.g. Spain, France and Britain, had offered, since the end of the 16th century, large sums of money to the inventor of a practicable solution of the longitudinal problem - to determine the exact degree of longitude at sea. A ruling committee, The Board of Longitude, was established in Britain in the beginning of the 18th century. The functional requirements stipulated an accuracy of determination of position between 1 degree and 30 minutes, which had to be tested on a voyage to the West Indies during six weeks. The prize amount set up was £10-20,000. It was not until in the 1760s, after 30 years and 4 prototypes, that John Harrison managed to meet the requirements. He had to prove the function of his prototype chronometer, H4, during two voyages, and the error after the voyages was only 6 seconds. In the 1770s, during his second expedition to the Pacific, Captain James Cook had a copy of Harrison's chronometer onboard his ship.

Another classic instance where technology procurement was used is the Rainhill Trials in 1829 that brought a breakthrough in development of the railway locomotive. Functional requirements were laid down, including minimum speed and traction capacity. The buyers had guaranteed a small first order of 5 locomotives to the successful winner. But, of course, to acquire fame was the most important factor for the winner. Of the five entries, Robert Stephenson´s Rocket won and he subsequently also supplied 5 locomotives at a fixed price.

4.2 Earlier projects in Sweden

Technology procurement has been used in developing the most extensive railway electrification scheme of its time - the iron ore line between the Norwegian port of Narvik and Riksgränsen on the Swedish border - to development of Asea Brown Boveri's X 2000 high-speed train as a result of requirements specified by the Swedish State Railways, SJ. Strict functional requirements have been laid down by buyers as the introduction to extensive development work undertaken together with suppliers also in the energy and telecommunications fields. The solutions that emerge must however always be highly competitive in an international market.

4.2.1 Lifts for existing buildings

The Swedish Council for Building Research project "Lifts for existing buildings" in the 1980s resulted in solutions that were clearly more cost-efficient in total, cutting the original overall cost of **construction and lift** by half (Fig. 4). At the same time, it was possible to reduce the disruption to residents, installation taking a few days instead of several weeks or months as before. The project also resulted in one of the main suppliers, KONE, receiving very large international orders through its subsidiaries, e.g. 250 lifts in one project in Holland.

Fig. 4. Rapid lift installation - Completely prefabricated lift shaft [2]

4.3 Energy examples in Sweden

Technology procurement has been used in Sweden in the field of energy-efficiency, and very promising results have been obtained by NUTEK, the Swedish National Board for Industrial and Technical Development, in Sweden, see Fig. 5 below.

The same procedure with formation of buyer groups, consisting of major buyers both from Government - central and local - and private companies and organisations, has been used. Competitive international tenders were requested from suppliers, and NUTEK supported with seedmoney for preparing performance specifications and information activities.

The first project within the Swedish programme to use this procurement method was a refrigerator/freezer project which started in 1989. A group was created, consisting of leading buyers - public, co-operative and commercial housing companies. They represented about 40 per cent of the market for combined refrigerators/freezers. A symbolic first series of 500-1,000 units of a frequently used model was guaranteed. It combined an incentive of about USD 130 per unit to the first housing companies to buy this product. The goal was formulated in the functional term of kWh per equivalent volume in litre and year. Five bids were received and three of them could fulfil the compulsory/mandatory requirements.

Project area	Result	Energy reduction
Refrigerator/Freezer	From 1.2 kWh/litre comparable volume per year to 0.8	by 33%
Clothes washers & dryers for laundry rooms	From 2.6 kWh/kg of laundry to 1.2	by 50%
Ventilation. Replacement of fans in residential area	From 750 kWh/apartment and year to 380	by 50%
Windows	From 5,900 MWh/year to 3,300 MWh in one project	by 44%
Heat pumps	Two suppliers chosen for development and deliveries	by 30 %

Fig. 5. Results of some Swedish technology procurement projects in the energy field [1]

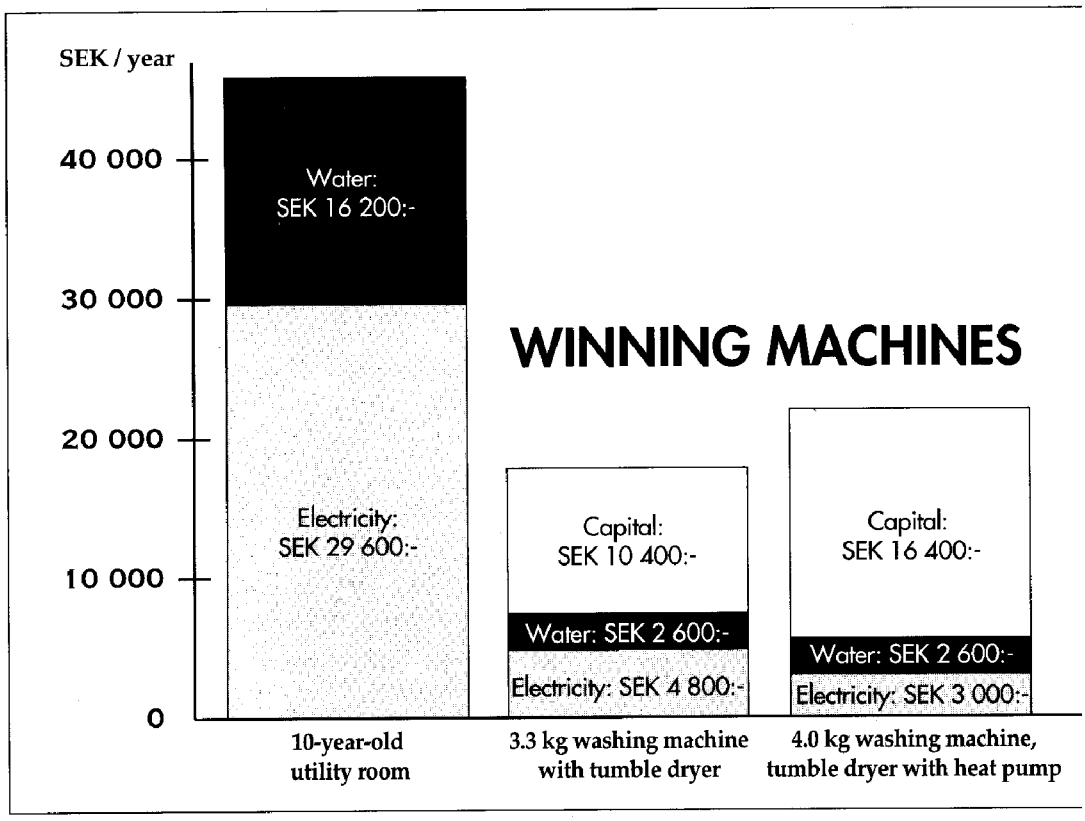


Fig. 6. Life Cycle Costs for clothes washers and dryers in laundry rooms. Example. [10]

Similar results have been achieved in a project in New York City in collaboration with major housing companies and the Consortium for Energy Efficiency.

In the project clothes washers and dryers for laundry rooms (a responsibility for the property owner in multi-family houses), essential reductions of energy and water resulted in lower total operating costs, see Fig. 6 above. Lower noise emissions also made it possible to extend the hours of use without disturbing the neighbours. Major progress on export markets followed.

5 Lessons learned

Some preliminary findings:

- It is much easier to concentrate the technology procurement work on single components and systems than on more complicated systems and whole facilities, see Fig. 7.
- Establishing common goals is very important.
- Formation of buyer groups and new networks is time-consuming.
- Formulation of performance requirements and testing procedures requires availability of experienced specialists.
- Long-standing high-level support is important.
- Multi-level requirements are an advantage.
- The risks involved for buyers and manufacturers are reduced.

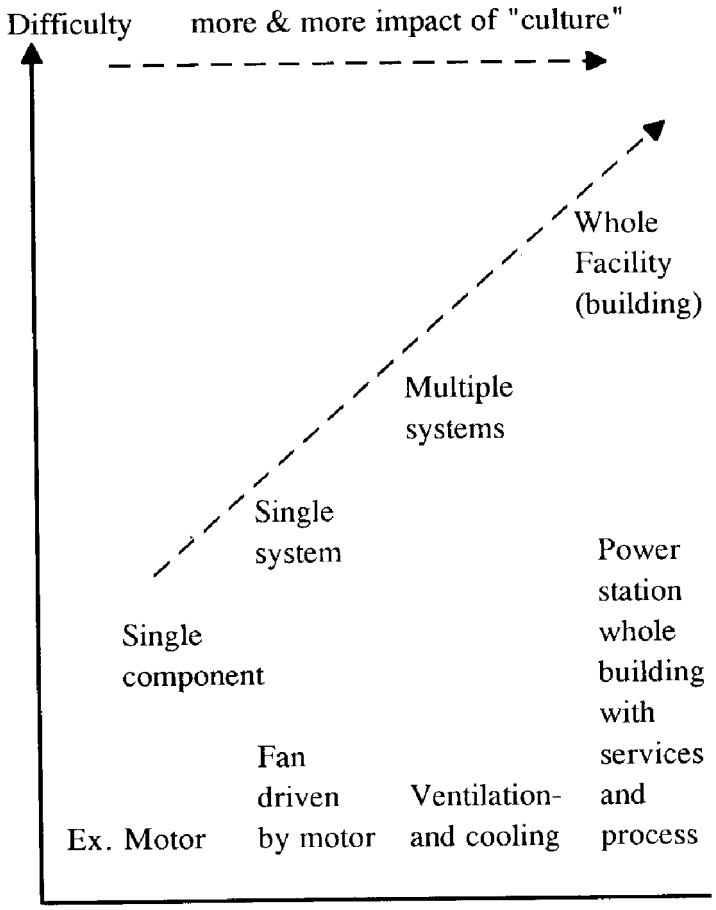


Fig. 7. Product complexity “ladder” [1]

The countries participating in ongoing IEA projects, for instance the “Co-operative Procurement” Task, are collecting experience from a number of pilot projects. A workshop on lessons learned has taken place in February 1999 in London.

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