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**MAKING USE OF BUILDING RESEARCH FOR INDUSTRIAL
DEVELOPMENT**

by A.H. Wilson

ANALYZED



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Title of the paper MAKING USE OF BUILDING RESEARCH FOR INDUSTRIAL DEVELOPMENT

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Organization/Enterprise Division of Building Research, National Research
Council Canada

Key words building research, industrial development, codes and regulations

Summary

This paper explores the proposition that there is a need for the effective monitoring of the resources devoted to new buildings and to the care of existing ones because the resources available are limited. In particular, it examines a number of important and principally economic relationships that exist between research, industrial development, and codes and regulations in the building environment in Canada. It concludes that the complex nature of these relationships makes control over the resources devoted to better building and building care a very difficult task.

Titre du texte EXPLOITATION DES RESULTATS DE LA RECHERCHE DU BATIMENT DANS
LE DEVELOPPEMENT INDUSTRIEL

Auteur Andrew H. Wilson

Organisation/Entreprise Division des recherches en bâtiment, Conseil
national de recherches Canada

Mots-clés recherche en bâtiment, développement industriel, codes et
règlements

Sommaire

Le mémoire traite de la nécessité d'exercer un contrôle efficace des ressources affectées à l'érection de nouveaux immeubles et à l'entretien des édifices existants parce qu'elles sont bornées. L'auteur examine en particulier un certain nombre d'importantes relations, de caractère économique principalement, qui s'exercent dans le domaine du bâtiment entre la recherche, le développement industriel, les codes et les règlements. Il conclut que la nature complexe des relations précitées rend très difficile le contrôle des ressources employées à une construction et à un entretien meilleurs.

MAKING USE OF BUILDING RESEARCH FOR INDUSTRIAL DEVELOPMENT

Andrew H. Wilson, Canada

INTRODUCTION

A number of important relationships exist between research, industrial development and codes and regulations in the building environment in Canada. The overriding factor in these relationships is economic. It influences the answers to questions such as: Why must we do scientific and engineering research in building? How much should be spent on it? What is the payoff in industrial development from investment in building research? What are the costs of applying building codes and standards? What are the costs of regulating new buildings and operating existing ones? Because of restrictions in length, this paper cannot fully explore the answers to all these questions, but it can suggest where the answers might be found.

Economics, as a discipline, makes use of the notion of scarcity, or limitation, in the availability of resources. But this notion is difficult to handle because there are different kinds of limitations: those that are physical; those that are human; and those that have to do with elements such as time and attributes such as enterprise, management, imagination, and invention, which have both physical and human dimensions. Again, these can only be briefly touched upon in this paper. But even when resources are in short supply, the use of research, the encouragement of industrial development and the application of codes and regulations can usually be made more effective by carefully allocating those that are actually available.

The built environment in Canada has a number of characteristics not shared by most countries. For example, there is not one but many built environments across the country, each with its own seasonal variations. Winter is normally the season that influences how a building will be designed and built.

BUILDING RESEARCH

In Canada, as elsewhere, it is relatively easy to identify the research inputs and outputs of institutions, agencies, and firms directly involved with the business of building. It is more difficult to identify the building-related research inputs and outputs for organizations indirectly involved; for example, companies in the manufacturing sector or university departments of civil engineering.

Nevertheless, it is possible to say with some confidence that in 1980 aggregate expenditures in Canada for construction-related research and development were about \$50 million, of which federal agencies provided about one half and industry provided one third. If it is assumed that that the building

sector R & D accounts for 60% of all construction R & D (and the engineering sector for the remaining 40%), then it can be assumed that the value of all building-related R & D in 1980 was about \$30 million. This is a tiny figure when compared with the \$26 billion spent on building activities during the year - just over one tenth of one percent of it. It is below the industry average for Canada, and well below the average for sectors such as electronics and aerospace that are heavily research-dependent. This figure has changed little over the past 15 years.

The proportions of Canadian building-related research devoted to materials, techniques and equipment have not yet been studied. A qualitative examination of the outputs, however, shows the majority of Canadian activity to be in materials and techniques.

Research and development are two of the prime sources of innovation in the building sector, as they are in other sectors. Since Canadian R & D activity is limited in its coverage, a proportion of the innovations made in this country are of foreign origin, and of American origin in particular. On the other hand, Canada has a network of agencies able to provide technical information for building and engineering construction to all parts of the country. As one report has noted:

"There is a loosely connected technology transfer network of private and public institutions, associations and companies within, or associated with, the construction industry in Canada. The activities of the members of the network may include the performance or encouragement of research, development, design, testing and inspection as well as actual construction. This network functions quite effectively when the mutual interests of its members are involved. It is also well connected to sources of technology abroad, especially in the United States."(1)

Perhaps the fundamental question to be asked about building research in Canada is: Why continue? There are perhaps four answers. First, the building sector needs sources of new and digested technical information. Second, it needs laboratories able to solve building problems which are growing more complex with time. Third, there are some problems unique to Canadian buildings that require domestic solutions. Fourth, new materials, techniques and equipment are being made and marketed all the time, but the manufacturers are not always prepared to do the necessary research before selling it to the building sector.

INDUSTRIAL DEVELOPMENT

Although industrial development can be defined in various ways, for the purposes of this paper it may be considered to have two principal components: growth in national output, and increasing quality of the final built product. Industrial development must also be related to the potential market which, in the case of

buildings, is predominantly domestic. It must be related to the levels of technical, financial, managerial and other skills available within the corps of designers, developers, contractors, owners, operators and others associated with building. It must take into account the effectiveness of technology transfer and education networks, must include the repair, renovation, etc., of existing buildings as well as the construction of new ones, and must recognize safe practices for both the construction and operation of buildings. Thus one can say that linkages exist between industrial development and building research, between building research and codes and regulations, and between codes and regulations and industrial development.

Canadians pride themselves on having a first-class building construction sector, and if it is compared to those in other countries, they may be right. Yet from the point of view of recent industrial development, this pride may have to be modified somewhat.

For example, in recent years the value of newly-constructed and repaired buildings has been providing a steadily decreasing share of the Canadian GNP, down from 10.6 per cent in 1976 to 8.8 per cent in 1981. In the residential sector, the number of housing starts has declined from 273,000 in 1976 to 178,000 in 1981, and a further decline to 130,000 is expected in 1982. At the same time, the price index for all types of residential construction rose from 188 to 322 (based on 1971=100), an increase of 71% over 5 years. In the non-residential sector, the index rose from 163 to 245 over the same period, an increase of 50%.⁽²⁾

Rising price indices may reflect, among other things, improvement in the quality of built products; however, they may also reflect deterioration in the quality of some building components which has been offset by improvement in others.

The unemployment rate for the building construction sector varied between 1976 and 1981 but stood at around 16% in 1981. During 1982, this figure has risen to over 20%. Again, the impact of this on national growth is negative. But some of the unemployment may be due to improvements in manpower utilization techniques, equipment, materials and design, and to changes in specifications.

From the numbers of papers, books and articles currently published or available in Canada, it is clear that a great deal of building-related information is accessible. The Division of Building Research of the National Research Council, for example, has distributed about one million copies of its publications in each of the past several years. But publication does not in itself guarantee that proven technology is being put into practice. Similarly, improving the quality of building-related training courses does not ensure that the graduates of these courses will have opportunities to put their learning to work.

While one can quantify the growth component of industrial development resulting from building (whether positive or negative), one cannot yet do so for changes in the quality of buildings, either at the time of construction or during their lifetimes. For example, there is very little information available on building maintenance costs and their adequacy. Intuition, on the other hand, tends to suggest that building quality has been improving, on average.

CODES AND REGULATIONS

In 1978, in response to the widespread view that increasing government regulation of industry might be having serious adverse effects on the efficiency of Canadian firms and industries, the Prime Minister wrote on behalf of all the Provincial Premiers to invite the Economic Council of Canada to evaluate the situation and develop a set of practical guidelines for improving the process of government regulation.

The Council, in its two reports, made no specific evaluation of building regulations and, consequently, offered no guidelines or recommendations with regard to them. However, in one of these reports it said:

"Regulation is a political-administrative process specifically designed to replace or modify the operation of economic markets or, in some cases, to fill gaps where no markets exist. Both the decision to regulate and the decision to change regulatory processes significantly are made in the political arena."(3)

In Canada, the Constitution permits the federal and provincial levels of government to regulate business, markets and so on in accordance with their assigned responsibilities. It also allows municipalities to regulate activities within rules laid down for them by their respective provincial governments. Thus, a province may permit its municipalities to adopt a building code of their own, or it may adopt a single code for application in all municipalities.

The federal government has no jurisdiction with regard to building codes except in the two northern territories, but one of its agencies, the National Research Council, provides facilities for compiling and publishing the National Building and Fire Codes (NBC, NFC). The NRC does not write these Codes. This is done by independent technical committees under the guidance of the NRC Associate Committees for the two Codes. The Codes are revised and reissued every few years, and are constantly being updated. The NBC and NFC have been developed as complementary and coordinated documents to reduce the possibility of conflict in their respective requirements. The NBC is essentially a model code containing only minimum regulations for the safety of new buildings with respect to public health, fire protection and structural sufficiency, among other things. The NFC, on the other hand, establishes the standards for fire protection, firefighting provisions and life safety within existing buildings,

including standards for the conduct of activities causing fire hazards, the maintenance of fire safety equipment, and egress facilities. This Code also establishes the standards for the prevention, containment and fighting of potentially hazardous fires originating outside buildings.

The adoption and application of the NBC and NFC vary across the country. The province of Newfoundland, for example, has not officially adopted the NBC although several of its municipalities have done so on their own, as has the provincial Department of Public Works for the buildings under its jurisdiction. The province has, however, adopted the 1980 edition of the NFC under its Fire Prevention Act.

The business of building in Canada is regulated in a wide variety of ways by the three levels of government, in addition to the NBC, NFC and other building-related codes. Governments regulate property standards and zoning, the fate of heritage buildings, land use, building site safety, the use or prohibition of materials, and labour union activities. They regulate the financial activities of private enterprises engaged in new construction or the repair of older buildings. They administer thousands of buildings of their own. They are concerned with taxation, subsidies and grants to encourage new building construction, patents of invention, and so on.

Government regulations have economic costs that are borne by buyers and sellers, owners, developers, operators, financiers, taxpayers and others. Only some of these costs can be determined, so that the total regulatory cost burden related to buildings cannot be estimated. Regulations may also have economic benefits, some of which are measurable in monetary terms, while others are not since they are enjoyed to different degrees by different people. Shopping malls, for example, can provide significant economic benefits to storeowners and customers, but the problems caused by the resulting vehicular traffic may annoy those who live in the same neighbourhood.

Building-related research provides some of the technical foundation for developing codes, standards and regulations, although the role played by experience is also significant. The search for a sound technical basis for new codes, standards and regulations may, in turn, stimulate research in the fields of building science and engineering.

The growing scarcity of certain resources, such as energy, has led to code-related activity in Canada. In 1978, for example, the Associate Committee on the National Building Code published a document covering measures for energy conservation in new buildings. It was written in a format that permitted its use either as a guide or as a basis for new regulatory requirements. The provinces were encouraged to consider enacting these measures but, to date, relatively little action has been taken.

The Associate Committee on the National Building Code, several provinces, and many municipalities have considered, and some have enacted, bylaws with regard to the care of older buildings, especially of those undergoing renovation or designated for heritage purposes. The objective in the case of renovation is the same as for new buildings. Heritage bylaws are farther reaching and are not infrequently implemented by municipalities in order to boost assessments on their tax rolls. The costs and benefits of these activities are not yet well-established in Canada.

It is clear that codes and regulations influence the quality of the final built product, but the extent to which this happens in practice has not been measured. They may also influence the growth, or decline in the contribution of building to national output. Again, there are no figures available to indicate the size of this influence. Even if there were, the influence of market forces on the decision to proceed with a particular building project is probably stronger.

As this paper is being written, the level of resources being devoted to new buildings and to the care of older ones is lower than it could be since many potential owners are waiting for interest rates to fall farther than they have over the six months since July 1982. In other words, savings are currently high in Canada, and are not being moved out into building and other industrial projects.

QUESTIONS AND ANSWERS

The question, Why continue to do building research?, has been answered already. The question of how much should be spent on it in Canada has not been answered, although a study initiated by the federal Ministry of State for Science and Technology may provide some partial solutions.

What is the payoff in industrial development from investment in building research? No general answers to this question have so far been proposed and, when they are, the influence of the market, the money supply and the general economic climate are likely to be seen as more important than building research in influencing industrial development. Yet the life-cycle costs of a building are dependent on the quality of the product and the way in which it is cared for, and both of these require assistance from building research.

The costs and benefits of applying codes and regulations to building and to buildings are difficult to examine since they include both technical and nontechnical elements, not all of which are measurable in cost or benefit terms unless the measurement is applied to a single and relatively simple situation. Also, some regulations negate others or cause a misallocation of resources as a result of the strength of the incentive or the disincentive involved. There is a limit, for example, to the number of shopping malls any one city can absorb,

so that a financial or a regulatory incentive to build more than this number could be a counter-productive use of economic resources.

One of the principal difficulties in assessing the relationships between building research, industrial development and codes and regulations is the lack of available data, especially of a nontechnical kind. Another is the complex nature of these relationships, which involve economic and human, as well as technical, elements and several levels of jurisdiction. Another is the lack of a basis on which to optimize these relationships. Yet, if they are not monitored continuously, a difficult task, the effective use of the available resources may be considerably less than might be achieved.

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