Seventy years of forest products research

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Summary

In seventy years, timber use, at first governed by craft practices, has been transformed to a technology determined by scientific principles, made possible by the research on wood undertaken during the period. The pattern of this research, those undertaking it, the factors determining it and its funding in the United Kingdom are considered. Today, forest products research is at a low ebb, compared with that in earlier decades, but it is suggested that with a rapidly expanding UK resource, a continuing national dependence on timber and timber products and the environmental benefits from growing and using wood, the need for an effective forest products research capability remains as important as ever.

Introduction

When F.M. Oliphant wrote in *Forestry* in 1927 he did so when forest products research in the UK was in its establishment phase. Now, after 70 years, it must be asked if it has run its course.

The need for research on timber in the 1920s came about for the same reasons that decisions were taken to establish the Forestry Commission and create a national forest resource. The country had come through a devastating war when the key role of timber in sustaining the war effort, in getting coal from the mines, in moving munitions, in the construction of aircraft and in many other ways, had demonstrated a national dependence on wood. The national forest had contributed much and was severely depleted but, even so, Britain had largely depended on timber from overseas and many thousands of lives were lost in shipping it to these shores.

The need to create a strategic national forest resource was recognized but this would not meet normal peace-time needs and, in any event, would not be available for decades. The UK would continue to import most of its timber but economy in use was sought and a policy to utilize the largely unexploited resources of the Empire was foreseen. It was this rationale that determined the administration of timber research in Britain. Elsewhere, countries with a large national timber resource, such as the United States, Canada and India, had established forest products laboratories as part of the forest service; for Britain, largely dependent on timber from elsewhere, this was not considered appropriate and forest products research was one of a number of research activities administered by the Department of Scientific and Industrial Research (DSIR).
Background of forest products research in Britain

Timber research was not established in the UK by the DSIR but it was supported or initiated by a Board created by the Department. At first, research was at a number of university and other research centres, at the Imperial Forestry Institute, Oxford, Imperial College, London, the Royal Aircraft Establishment, Farnborough and the National Physical Laboratory among others, but in 1927 the Forest Products Research Laboratory (FPRL or simply Princes Risborough, as it came to be known widely round the world) was established and, over time, the various timber research activities moved there.

From its outset, the role of FPRL was to undertake research and not to promote timber. But in the harsh economic climate of the 1930s, the timber trade recognized the commercial threat to timber from other materials and to counter this the Timber Development Association Ltd (TDA) was created in 1934. TDA was a trade-promoting organization but from the outset there were uncertainties as to the boundaries between its activities and those of FPRL. This might have been resolved in 1959, when there was a proposal to integrate the two organizations at Princes Risborough but this came to nothing and, in 1962, TDA, then at Tyldes Green in Buckinghamshire but shortly after to move to Hughenden Valley, became the Timber Research and Development Association (TRADA). In the late 1980s and thereafter, TRADA created a number of separate companies, including TRADA Technology Ltd (TTL), TRADA Certification Ltd (TCL), and, in 1996, on amalgamation with the Furniture Industry Research Association, FIRA International Ltd. In 1994, in changing commercial and financial circumstances, TRADA was subject to a management buy-out and acquired a wider brief for funding and commissioning work. Wood research went on elsewhere, most notably at University departments at Oxford, Imperial College, and Leeds, and somewhat later at Aberystwyth and Bangor; today, Imperial College has a significant research capability in wood protection and Bangor in fibre technology and wood composites. But it was at the FPRL and TDA, or the organizations they became, that the main research and development activities on wood were centred.

However, like the TDA, FPRL was to undergo significant changes. In 1965, the DSIR, a pattern for similar organizations in other Commonwealth countries, which continue to this day, was dissolved. FPRL became part of a new Ministry of Technology and the Wilson era of ‘white hot technology’ was promoted. Work on timber was to be of direct benefit to industry with a corresponding reduction in basic research; accountability and cost-benefit techniques were introduced to determine the relative value of projects. With a change of government and abolition of the Ministry of Technology, FPRL went briefly to the Department of Trade and Industry and, in 1971, to the Department of the Environment (DOE). Shortly afterwards, FPRL was merged administratively with the Building Research Station and the Fire Research Station to form the Building Research Establishment (BRE). FPRL was renamed the Princes Risborough Laboratory (PRL) but remained on the site at Princes Risborough until, following a review which foresaw financial and administrative benefits in amalgamation and consolidation, staff and facilities were moved to mainly new buildings on the main BRE site at Garston, near Watford, in 1987. On 28 February, 1997, the DOE ‘sold’ BRE to a management buy-out group so timber research, from being almost wholly managed by government in 1927, became independent of government in 1997, though expecting to attract funding for work needed by government. Soon after Oliphant wrote in 1927, staff numbers at FPRL were 133. At their peak, in the 1960s, they reached around 220 of whom perhaps two-thirds were scientists and technicians; today the number working on timber at BRE is in the mid-thirties. TRADA in the mid-1960s employed somewhat over 100 of whom rather less than half were involved in timber research, from being almost wholly managed by government in 1927, became independent of government in 1997, though expecting to attract funding for work needed by government. Soon after Oliphant wrote in 1927, the number working on timber at FPRL were 133. At their peak, in the 1960s, they reached around 220 of whom perhaps two-thirds were scientists and technicians; today the number working on timber at BRE is in the mid-thirties. TRADA in the mid-1960s employed somewhat over 100 of whom rather less than half were involved in timber research and development; today those working on timber number 28. Numbers alone do not measure effectively research output and influence; however, for timber research, where there is a need for a multidisciplinary input, substantial reductions mean work on some aspects of the technology ceases or is much reduced and the maintenance of spe-
cialized and costly facilities is put at risk. Sustained reductions in numbers, with no or few replacements, means that experience is lost and expertise for the future prejudiced and this must be a cause for concern.

Seventy years of research

What have 70 years of timber research given the timber industry and timber user? Any answers must necessarily be subjective and highly selective. What must be recalled is that in 1927 wood use was guided by rule of thumb, for example, strength data for the design of structures scarcely existed, kiln drying was in its infancy and air drying was based on a principle of a year per inch of wood thickness, preservation technology was based on creosote with the limitations this imposed, and panels—plywood and fibre board—were of poor reliability. The first need was for objective and accurate data on all aspects of the properties of timber and an explanation for these in terms of its anatomical, physical and chemical composition. Such studies contributed to a better understanding of the shrinkage and movement of wood, its more efficient drying, improvements in the preservative treatment of wood and in its surfacing and machine finishing.

A particularly significant decision was taken in 1929 to put in hand a programme of test work on Empire timbers, made possible by funding from the Empire Marketing Board. Some 80 unused or little used timbers were tested in the period to 1939 and, in doing so, standard procedures for determining the properties and performance of timbers were established; quite as important was the close working relationship established between many overseas forest services and FPRL. The results of this early work appeared in *Empire Timbers*, published in 1945 (*FPR, 1945*), just in time for an industry which, in post-war austerity Britain, was severely constrained by a licensing system on softwood purchases and a ban, except for strategic use, of any timber from ‘dollar’ countries (before 1939, some 70 per cent of the UK hardwood import had come from North America). Many timbers were traded for the first time, often from countries that had not sent wood to Britain before, light hardwoods in place of softwoods and tropical hardwoods in place of temperate hardwoods. This quite dramatic change in the pattern of the hardwood trade, in particular, led to a further programme of timber assessments, in co-operation with and often at the request of colonial forest services. Nowadays familiar woods, such as afrormosia, ramin, utile, etc. were seen for the first time and, aided by the test data, quickly found favour for industrial use. Around 200 timbers were tested at Princes Risborough and reported on in *A Handbook of Softwoods* (*BRE, 1977*) and *A Handbook of Hardwoods* (*BRE, 1972*), the latter among the most comprehensive publications of original test data on world timbers.

Work on British-grown timber had, from the outset, been undertaken at Princes Risborough but, as the resource assumed greater commercial importance, the need for a more co-ordinated policy for research on and development of British-grown timber became evident. A joint Forestry Commission/FPRL committee, the Home Grown Timber Research Committee (HGTRC), was set up in 1958 with senior research scientists from both organizations. In the 30 years of its existence, the HGTRC initiated work on all the common UK-grown softwoods, which was reported in a series of booklets, and, in all, produced some 370 reports. The range of work undertaken was wide, from studies of the patterns of within-tree structural variation to the use of British timber for plywood. Many aspects of special significance might be cited but two warrant special mention. The design of a timber structure requires a knowledge of the strength of the timber used but the basis on which this was obtained, a visual assessment of growth features, was unfavourable for British-grown timber, in particular the requirements with respect to growth rate. An alternative assessment method is based on stiffness, which can be determined by non-destructive means, as it has a close relationship to strength. A machine to do this was developed at FPRL in 1962. This prototype was improved on by machines from elsewhere, but the introduction of machine stress grading and the great amount of work done to demonstrate its acceptable structural performance has meant that today British timber is
not only accepted but sought after by the market. A very different study examined the effect of forest practice, in particular planting distance, on timber quality. On silvicultural and economic grounds, planting distances on windthrow hazard sites had widened to as much as 2.7 m but the adverse effects on timber quality, log straightness and yields of structurally acceptable timber, were not foreseen until demonstrated in a comprehensive study. The need to consider how forest management options affect timber quality, especially where there is a need to maintain or improve this, was clearly demonstrated by this work.

A particularly significant contribution has been made by both the major research centres to the use of timber in building. The introduction and update of design data has been critical for the maintenance of timber as a foremost structural material in building. Much of the data in the building codes, in the first place CP112, later BS5268, Part 2 and more recently Eurocode 5, were derived from tests at Princes Risborough, with tables for permissible spans for carcassing first produced in 1962. The TDA and later TRADA had a very significant role in the promotion of timber in construction. Soon after its formation TDA, in 1936 and 1938, organized competitions for timber house designs. In 1951 it designed for the Festival of Britain, it later designed for and promoted, through Tradafarm, the use of timber in agricultural buildings and the Association was particularly active in the 1960s. This was the time for the introduction, or more correctly re-introduction, of timber frame housing and TRADA undertook much design work, including the Mactrad homes at Penkridge and four-storey houses at Glory Hill.

Like all other technologies, that concerned with timber is international and many developments derive from advances made both scientifically and commercially elsewhere. Outstanding examples are improved methods for joining wood, both mechanically—punched metal plate fasteners made prefabrication of trussed rafters and other building components feasible—and by adhesives; glues now in use can have exceptional durability so that, in complete contrast to 1927, plywood today can be a long lasting, engineered product. Advances in adhesive technology and the need to use wood residues resulted, in the 1960s, in the introduction of chipboard and, following it, panel products such as oriented strand board, cement-bonded particle board, medium density fibreboard (MDF), with properties appropriate to particular uses. However, confidence in and long-term acceptance of these products depends on a critical evaluation and statement of their performance, in national codes and standards, and the contribution of the research establishments has been essential for this.

Communications

From the outset, it was recognized there was a need to communicate the results of research; this was done by means of courses and by the issue of many hundreds of different scientific and technical papers and information notes from both FPRL/PRL/BRE and TDA/TRADA. Training needs in wood technology were recognized in 1956 with the formation of the Institute of Wood Science and in wood science with degree courses at Imperial College, at Bangor and, most recently, at High Wycombe. An understanding of timber, its properties, processing and use, has become a sophisticated technology which makes it all the more surprising that not one of the universities cited can attract a sufficient number of students to run a full-time course devoted only to wood.

Does this mean we know all we need to know about wood? After 70 years has the need for research run its course? It would be remarkable if this were so.

The future

Despite the near total loss of some markets, e.g. mining and railway sleepers, and the perceived threat to timber as a building material, from steel and concrete in construction, and UPVC for joinery, the annual UK use of sawn softwood has remained remarkably constant for decades, averaging around 8 million m$^3$ a$^{-1}$ though varying between 6 and 10 million m$^3$ a$^{-1}$ according to the state of the economy. Hardwood use has declined by about 50 per cent from 3 million m$^3$ a$^{-1}$ in the 1950s but this
has been more than offset by the use of panels (plywood, chipboard, MDF) for many of the purposes for which hardwood was formerly used.

That timber continues to be an important commodity derives from its being used as a cost-effective material of known and predictable performance, based largely on the scientific, technical and commercial investment of past decades. If it is to continue to be used successfully alongside new and competing products then this investment must continue. But what is the case for doing so?

Many reasons might be given, but three are cited. The first is a national case which rests on the fact that the UK has a rapidly expanding softwood timber resource, and how best to use this is both a national and industrial concern. Though much of the work done so far has resulted in successful marketing, there are challenges in seeking further market share, in efficiencies in production and processing, in seeking added value and in obtaining an improved product for the future. How, too, to use and improve the native hardwood resource presents a major challenge if only part is to approach the quality of out-turn obtained from some of our European neighbours' forests.

Second, despite the increasing contribution from its own forests, the UK will remain dependent on overseas supply for most of its timber. How to obtain and make the best use of the world’s timber resource must be both a national and international concern. Over recent decades, world use of wood has increased at a rate of 1.6 per cent per year, marginally faster than the rate of world population increase, and today amounts to just over 3 billion m$^3$ a$^{-1}$. Globally, though not necessarily locally, this figure is believed to be within the annual increment of the world’s forests but, as their area diminishes and populations increase, it will cease to be. How to respond is a challenge to both forester and wood technologist. There is great scope for more effective use of the timber currently available and especially for the production of wood on the shortest rotation possible and having the characteristics sought by the user. It is this emphasis on user need, whether by the industrialist or the rural worker that is critical. From seeking to use a resource, the technologist must manage and create a resource for a need. How to do so and how best to use the resource requires national investment and international co-operation.

Third, the environmental benefits from the production and use of timber require much more attention. Timber is perceived to be more environmentally benign than steel, concrete, aluminium or UPVC when there is a choice in use but the true environmental, let alone social and economic benefits, in this choice have yet to be demonstrated. Life cycle assessments are only now being made for the comparative evaluation of materials in use; it is in the interests of timber that they are pursued with vigour to demonstrate its favourable environmental impact and counter some of the adverse and often ill-informed comment made about its use.

**Funding**

Finally, who pays? When Oliphant wrote, practically all timber research was funded by government. Today, government agencies are still important funders of wood science with an annual contribution of around £3 million. The main contributor to this is the DOE and it was this Department which, in 1996, produced *Timber 2005, A Research and Innovation Strategy for Timber in Construction* (DOE, 1996), one of a number of similar strategies being developed by DOE. *Timber 2005* applies to wood in construction and not to all wood uses but, with somewhat more than half the UK sawnwood and approaching that proportion of the panels, used in the UK for construction and joinery, it must have a significant effect for timber research. It supports the UK Sustainable Development Strategy and has its key objectives: a more efficient utilization of timber and timber-based products, targeted dissemination of unambiguous technical and environmental data, and better utilization of the UK forest resource. A Timber Industry Alliance (TIA), with representatives from associations concerned with timber, has been formed to give guidance on needs and priorities. DOE continues to fund work relevant to statutory and regulatory needs of government but other submissions are assessed under a Partners in Technology programme.
This, as its name implies, is a partnership, with an industry input, though not necessarily in cash, to match that from government. A similar requirement applies with funding from the European Union (EU). Some 42 million ecus (about £30 million) are available for all 14 EU countries under the current 5-year programme for forestry, pulp and paper and wood processing research. But with contractors only receiving up to 50 per cent of their budgeted costs, often a high preparatory cost and, at best, only a modest chance for a successful application, the EU is an uncertain source of funding. The Forestry Authority supports selected areas of timber research and other forestry research, tree improvement, silviculture, site studies, which have a consequence for timber quality; though the sums available for work on timber are modest, they are particularly significant for work on British timber. Thus government or government agencies fund a substantial proportion of timber research but, increasingly, industry is expected to contribute.

However, how to do so on a significant scale has yet to be resolved. Unlike other industries, such as steel, concrete and brick, with only a few major players, the timber industry comprises a large number of small to medium sized companies, often with different interests (e.g. pulp, panels, sawnwood) and having different functions (e.g. production, distribution, use, etc.). A co-ordinated industry-wide approach to research needs clearly presents problems, which may be resolved by the TIA, but it appears more likely that sectorial interests will support and develop activities of special interest. There must be concern, too, that current policies favour short- and medium-term investment and yet for both the national forest resource and Britain’s use of the international resource there is a need for a long-term commitment to research. This should, perhaps, be the responsibility of government, as industry assumes responsibility for those research activities with an expected commercial investment, but in the current economic climate there can be little expectation, let alone optimism, about this.

So has timber research run its course? In terms of current activities, it is at a low ebb. With limited funding it will remain so but, if wood and wood products are to retain their markets against aggressive competition from other materials, there must be investment in technical research and development. It is likely that timber stands to gain in comparison with other materials in assessments of environmental impact and from being the butt of environmental critics it could become an acceptable and favoured material. But to do so and retain this support requires innovation in production, processing and use. The nature of the research and who funds it may change, but while timber is a major commodity, the need for research and the maintenance of a research capability remain as important as ever.

For a more detailed account of timber research up to 1975 at Princes Risborough, reference should be made to Rendle (1976). The history of TDA and TRADA from 1934 to 1974 is given in Latham (1974).

References and further reading


