Benchmarking Civil Engineering

Author

David Madigan, Senior Industrial Fellow, University of Bath
Martin Print, Construction Specialist, Innovation Unit, Department of Trade and Industry

Notes:
1. At the time of writing this paper Martin Print was Business Improvement Manager of Balfour Beatty Civil Engineering Limited.
2. This report is based on a paper delivered to the Innovative Manufacturing Initiative/Construction Productivity Network forum on benchmarking held in July 1996.

Document control information:
Date of issue: date completed
Document number: ACI/CNU/97/038
Circulation: Public
Version: 1.00

To obtain a copy of this document contact ACI at:
School of Management
University of Bath
Bath, BA2 7AY
United Kingdom
Tel: + 44 (0) 1225 826641
Fax: + 44 (0) 1225 826135
E-Mail: A.P.Graves@bath.ac.uk
Web: http://www.bath.ac.uk/Departments/Management/research/agile/home.htm

Copyright © University of Bath, 1997
All rights reserved. No part of this publication may be reproduced, stored in a retrieval system or transmitted in any form or by any means electronic, mechanical, photocopying, recording or otherwise without the prior written permission of the copyright holder.
What is the Agile Construction Initiative?

The Agile Construction Initiative (ACI) is a research programme funded under the Construction as a Manufacturing Process sector of the Innovative Manufacturing Initiative (IMI). The programme has been put together jointly by Balfour Beatty Civil Engineering Limited and the University of Bath. The programme is being managed by Brian May, who is the business improvement manager of Balfour Beatty Civil Engineering Limited (BBCEL). The programme is being supported at the Bath by three professors; Andrew Graves and Cyril Tomkins in the School of Management and Geoff Hammond in the School of Mechanical Engineering.

Professor Andrew Graves is the European Director of the International Motor Vehicle Programme (IMVP); this is the programme that led to the book “The Machine that Changed the World” and the coining of the phrase Lean Production. ACI is being modelled on this programme. The aim of the ACI is to benchmark performance in civil engineering worldwide and then to derive some conclusions on what constitutes best practice in civil engineering. The programme will also carry out some pilot implementations of best practice in industry.

The research programme has three research areas; international best practice, appropriate methods of financial control and construction activity and life-cycle assessment. The international best practice research will carry out a SWOT analysis of the UK civil engineering industry to inform the remainder of the research work, ensuring that it concentrates on the areas that will yield the biggest improvements in performance. It will then go on to benchmark the civil engineering industry worldwide and to describe best practice. The financial control research will look at the application of activity based costing and the cost of quality to civil engineering. The construction activity and life cycle assessment research will look at the whole life costs and environmental impacts of civil engineering projects.

The remainder of this paper will concentrate on the international best practice research and in particular the benchmarking method that will be used.

What does ACI mean by benchmarking?

Many companies and research projects are benchmarking the construction industry. However, most of these are looking at specific business processes. ACI aims to look at the performance of the civil engineering industry at a project level. The performance measures are designed to capture to effectiveness of civil engineering projects from the viewpoint of the client or sponsor of the project. The other key element is that the benchmarking is set in the context of wider industry changes and the participating companies own continuous improvement efforts.
The benchmarking process is well described by Camp. He defines ten benchmarking process steps (Figure 1).

<table>
<thead>
<tr>
<th>1. Identify what to benchmark</th>
<th>6. Communicate findings</th>
</tr>
</thead>
<tbody>
<tr>
<td>2. Identify comparative companies</td>
<td>7. Establish goals</td>
</tr>
<tr>
<td>3. Collect data</td>
<td>8. Develop action plans</td>
</tr>
<tr>
<td>5. Project future performance levels</td>
<td>10. Recalibrate benchmarks</td>
</tr>
</tbody>
</table>

- Figure 1 Benchmarking Process Steps

The steps will be examined separately.

**Identify what to benchmark**

Building on the work of the IMVP, we have identified four principles for choosing benchmarks.

1. Define a standard product.
2. Define a limited set of measures of performance.
3. Define a wider set of indicators of construction practice.
4. Ensure anonymity of data.

**Define a standard product**

The problem that we must solve was well summed up by John Krafcik and James Womack of MIT:

‘The problem in comparing assembly plants is one of “apples to apples” to insure that the activities being compared and the products being produced are comparable.’

The first standard product being developed is a highways project. The activities associated with constructing a typical trunk road have been divided into standard and non-standard activities. The non-standard activities have been excluded. This has resulted in a list of around fifty standard activities about which projects will be asked to submit data.
Define as set of measures of performance

The measure of performance are related to the project outcome and attempt to look at that outcome from the client’s perspective. The measures of performance are as follows:

1. Productivity (Gang hours and utilisation of major plant items)
2. Delivery (Final programme / original programme)
3. Wastage (Material delivered / material incorporate in permanent works)
4. Quality (Cost at completion/ Cost at completion plus 12 months)

Define a wide set of indicators of construction practice

The benchmarking is intended to lead to the development of best practice guidelines. Steps 5 to 9 of the benchmarking process require an understanding of how the performance gaps observed in step 4 come about. The indicators of best practice are used as the first step in the development and implementation of best practice. Statistical analysis will be used to determine the association between different construction practices and levels of performance. In order to derive best practice guidelines these associations will be investigated in order to determine causality.

Ensure anonymity of data

In order to get companies to submit data freely, it is essential to ensure anonymity. Because of the measures of construction practice it is essential that a large database of projects is built up that will hide individual company and project results.

Identify comparative companies

The ACI benchmark method is being developed by Bath and BBCEL. However, as indicated above, it is essential that a large number of projects submit data. This means that the benchmarking will have to scale up rapidly. This will be done in a methodical and measured way. The method will be developed and prototyped within BBCEL. The method will be scaled up by adding other UK, European and world companies. ACI will concentrate on companies of a similar size and capability as BBCEL.

Collect data

The data will be collected by the companies themselves. They will be given detailed questionnaires covering the elements of the standard product and also more general information of the projects themselves. The information will be collated using a database. Researchers will then visit the projects to audit the
data that has been submitted to ensure uniformity in the way that the data is collected.

**Determine the performance gap**

The data will be analysed. The first aim will be to look at the performance gaps that exist. The data will be analysed to ensure that external factors, such as weather and ground conditions that may vary from country to country are not responsible for the performance gaps. If genuine gaps in performance are seen to exist these will then be analysed in terms of the association between the observed performance gaps and the differences in the construction practice between projects.

**Project future performance gaps**

This is where the best practice guidelines will be developed. Based on further analysis of the association between performance gaps and differences in construction practice, implications will be drawn about what constitutes best practice and whether or not this best practice is transferable to the UK civil engineering industry (if it lagging behind). If the UK civil engineering industry is ahead, then strategies for further improvement will need to be developed.

**Communicate the findings**

The findings will be communicated at two levels; the data and the analysis. The data will be published in the form of the Agile Construction Database. This will summarise the findings about the associations between observed construction practice and performance. The analysis will be published in the form of the Agile Construction Model. This will contain the implications drawn about best practice and how to move towards it.

**The remaining stages**

The remaining stages are for industry to carry out. ACI will carry out a limited number of best practice pilots with participating companies. However, implementation is a matter for industry itself. ACI will monitor changes in construction practice and their effect on performance and publish these results, but change management can only be done effectively by the companies themselves.