

UNIVERSITY of DUNDEE

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**DEVELOPING A PROCESS TO IMPROVE PRODUCTIVITY and COMPETITIVENESS**

The feasibility study undertaken in collaboration with the University of Dundee has enabled the management of Pert Bruce Construction Ltd to objectively assess our efforts to improve our efficiency and productivity. We have developed a number of systems over recent years to allow us to improve our competitiveness and this study has given us the opportunity to obtain an external review of those systems. This has demonstrated that our processes are sufficiently advanced and that the optimum course of action in the short term is to embed these systems.

The recommendations contained within the report have provided us with some immediate actions that can be taken to improve our systems without significant impact or adverse effects along with some direction for future long-term development.

Hopefully this will allow us to improve our productivity and consequently our competitiveness with the result that we survive this economic downturn and emerge as a leaner and efficient Construction Company when the commercial environment improves.

We would like to thank Dr Mohamed El-Haram, Professor Malcolm Horner and Doug Forbes for their expertise and commitment in developing this report

Jamie Pert  
Joint MD



**Teamwork • Commitment • Success**

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# Developing a process to improve productivity and competitiveness

## SUMMARY

This report outlines a feasibility study undertaken with Pert Bruce Construction Limited to explore means of improving productivity and competitiveness. It outlines the scope of the study and provides recommendations on the feasibility of further developing their processes and systems.

An final report for CIC Start Online  
prepared by

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*Improving the Performance of the Construction Industry*

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## 1 EXECUTIVE SUMMARY

This feasibility study was a collaboration between the University of Dundee and Pert Bruce Construction Limited. The study explored the opportunities to develop a process to improve productivity and competitiveness.

Pert Bruce Construction Ltd is a North East of Scotland Construction Company based in Montrose, Angus with an annual turnover of around £6 million. The Company was formed in 2005 from the merger between James Bruce and Son (est. 1871) and WWP (est. 1965). Their principal area of operations extends from Dundee to Aberdeen.

Professor Horner heads up the Construction Management Research Unit. The CMRU is part of the Department of Civil Engineering which has consistently ranked top in Scotland and in the top dozen departments in the UK in successive Research Assessment Exercises. Since its formation it has studied productivity in construction and has recently developed a Productivity Benchmarking Tool which allows contractors to record, control and benchmark their productivity.

The staff of the University of Dundee worked alongside the directors of Pert Bruce Construction to understand the systems that they currently have and how these might be more closely aligned to measure productivity at the task level. One of the key challenges associated with the work that Pert Bruce undertake is that it is highly specialised and bespoke. As a result there are very few standard processes which can be measured and benchmarked as would be the standard approach using the Productivity Benchmarking Tool (PBT) and the principles of cost-significance. We have therefore undertaken a study of the existing processes used within Pert Bruce to determine how these are aligned with our background research and opportunities which might exist for improving these.

The study concluded that the existing procedures and systems within the company are very advanced and that implementing further change at this stage may be counter-productive. In addition to this it was concluded that the use of the PBT would not be appropriate because of the measures of productivity being used by Pert Bruce.

The following recommendations arose:

- If buy in to change is difficult, involve an external facilitator to obtain widespread recognition of the importance of productivity improvement
- Programme and data collections sheets should be electronically linked.
- One of the key markets for the productivity improvement process will be with the existing and future supply chains of Pert Bruce. If the company is to remain competitive it is vital that their sub-contractors also remain competitive.
- Focus on the causes of delays and ways of improving them.

This feasibility study has highlighted that the University of Dundee's Productivity Benchmarking Tool could be further developed to ensure that it is more appropriate to the needs to the construction industry. The following recommendations have been made in this respect:

- A hierarchical breakdown of project should be developed.
- The development of the PBT to deal with productivity in terms of earned value.

## 2 INTRODUCTION

This feasibility study was a collaboration between the University of Dundee and Pert Bruce Construction Limited. The study explored the opportunities to develop a process to improve productivity and competitiveness.

Pert Bruce Construction Ltd is a North East of Scotland Construction Company based in Montrose, Angus with an annual turnover of around £6 million. The Company was formed in 2005 from the merger between James Bruce and Son (est. 1871) and WWP (est. 1965). Their principal area of operations extends from Dundee to Aberdeen.

Professor Horner heads up the Construction Management Research Unit. The CMRU is part of the Department of Civil Engineering which has consistently ranked top in Scotland and in the top dozen departments in the UK in successive Research Assessment Exercises.

Since its formation in 1981 the CMRU has been researching labour productivity in the construction industry. Seven PhDs have been completed in the specific field of productivity under the supervision of Professor Horner. The work of the Unit in this field has been captured in the seminal work "More for Less – a contractors' guide to improving productivity in construction" published by CIRIA in 2004. The monogram has proved so popular that it is now out of print. Professor Horner is also joint author of "The Effects of Accelerated Working, Delays and Disruptions on Labour Productivity" published by the CIOB in 1995, which has been used extensively in quantifying claims for delays and disruption. He has acted as productivity consultant to many major companies including Balfour Beatty, Masons Solicitors, Drake and Scull, John Mowlem and the International Labour Organisation.

## 3 BACKGROUND & SCOPE OF THE STUDY

### 3.1 Previous research and why labour productivity is important

This study sought to determine the feasibility of developing processes within Pert Bruce and their supply chain to improve labour productivity. Labour accounts for some 30% of typical construction costs. An increase in productivity of 30% would therefore reduce construction costs by 10%. In days when contractors' margins were 4%, this would represent a 250% increase in profits. Equally, it could represent an 8% cut in costs to the client and a 50% increase in profit to the contractor. In an environment where contractors' margins are zero or even negative, improvements of this magnitude potentially represent the difference between survival and extinction.

The UK Government has recognised that one of the keys to economic recovery is to increase productivity. This recognition is reflected in many publications for example, the Department of Business Innovation and Skills' Economics Paper No 12 (March 2011). Additionally, the Scottish Government's second purpose target after economic growth is to rank in the top quartile for productivity against key trading partners in the OECD by 2017. Improvements in productivity will assist both Scotland and the UK to meet these targets.

Labour productivity is central to the successful delivery of construction projects. It has a major impact on both time and cost. Improvements in labour productivity offer the greatest potential for reduction in costs. And yet, few contractors collect productivity data, and even fewer analyse it in a way which is designed to improve performance. There are some very good reasons for this: first, traditional cost models and contract documents such as the bill of quantities do not readily lend themselves to the isolation of labour productivity; second, items in the bill of quantities are not activity based and are not designed to measure labour productivity: rather, they focus on the materials required for a project; and third, there are far too many activities on a construction site to contemplate measuring productivity in them all. Previous research undertaken at the University of Dundee has developed approaches to help contractors overcome these challenges. This has been supplemented by the development of a Productivity Benchmarking Tool as outlined in the next section. Any improvement in labour

productivity would have a significant impact on the competitiveness of the company.

The panel asked that reference be made in this final report to how the proposed approach differs from the use of CLIP. BRE's CLIP (Construction Lean Improvement Programme) seeks to create improvement by applying various tools and techniques from lean construction. Our approach differs from this by focussing on productivity at the task level and seeking to make improvements in productivity through measurement and benchmarking. When it comes to improvement approaches, there is some overlap between the tools we use and those of lean (for instance, collaborative planning). However, our emphasis on real time productivity measurement at the task level differentiates our approach from that of CLIP. Professor Horner was an early mentor to the staff engaged in the CLIP programme.

### **3.2 Use of the Productivity Benchmarking Tool (PBT)**

Funded by a grant from the ERDF and on behalf of the University of Dundee in support of the Scottish Construction Centre, WLC Ltd have developed a benchmarking tool that prompts contractors to collect inputs, outputs, and delays in significant activities either weekly or monthly in a consistent way. The tool plots productivity in real time in each significant activity week by week, month by month or cumulatively (see figures below). It also plots the duration and cause of each delay in a similar way. Because productivity is measured in a consistent way, this provides the following valuable information.

- A running record of productivity and delays.
- The relative importance of delays due to different causes.
- The relationship between productivity and delays.
- Trends of changes in productivity and delays over time.
- Differences in productivity between one project and another.
- The productivity on a given project compared with average productivity on other projects either in the same organisation, or anonymously and with the necessary permissions, with other organisations. Thus it is possible to see at a glance whether the productivity on one site is above or below average, or in the top or bottom decile or quartile.
- Real data for use in estimating and planning.
- Reliable data for the settlement of claims for delay and disruption.



#### 4 THE STUDY

The staff of the University of Dundee worked alongside the directors of Pert Bruce Construction to understand the systems that they currently have and how these might be more closely aligned to measure productivity at the task level. The study explored the applicability of tailoring the PBT to Pert Bruce's requirements and the alignment with their existing systems.

One of the key challenges associated with the work that Pert Bruce undertake is that it is highly specialised and bespoke. As a result there are very few standard processes which can be measured and benchmarked as would be the standard approach using the Productivity Benchmarking Tool and the principles of cost-significance. We have

therefore undertaken a study of the existing processes used within Pert Bruce to determine how these are aligned with our background research and opportunities which might exist for improving these.

#### **4.1 Review of current practices within Pert Bruce Construction**

Pert Bruce have been refining their internal systems over recent years to be able to better capture data and identify areas where productivity degradation occurs. This has included better monitoring of activities on site and use of vehicles and journeys. These refinements have been implemented incrementally to ensure that each stage has been adequately embedded and is functioning. This has resulted in better buy in from the operatives and site managers. Indeed, the provision of hard data to verify management assertions has improved relations between the management and operatives.

Pert Bruce's process of monitoring projects revolves around the bill of quantities, created to price the project. The following process for monitoring projects therefore exists.

- 1) If a bill of quantities is not available for the job, one is generated by the estimating department during the tendering process. For each item in the bill a build up of labour, plant and materials is created. For each of the labour rates a build-up is created for each of the grades of tradesmen involved.
- 2) Once a project has started a programme is created. This is generated directly from the items in the bill and the allocated hours for each of the items. The hours allocated to bill items are aggregated to create key activities.
- 3) On a weekly basis the site manager records the percentage complete and the hours spent for each of the activities. Comments are added to allow the site manager to identify the causes of delays.
- 4) The director determines the number of hours that ought to have been spent on a project by using the percentage of work completed as estimated by the site manager. This is then compared with the number of hours that have actually been spent on that particular task
- 5) The activities are then assessed as being behind or ahead of expected productivity levels and the site manager is informed accordingly.

This process has been fully implemented now for around 6-9 months and the results are starting to be seen by the directors. There has been some reluctance to change and record information from management and operatives.

#### **4.2 Modifications proposed to improve productivity**

The review that has been undertaken of the process currently in use in Pert Bruce has identified over recent years that there are opportunities to improve their productivity and steps have been taken to realise those opportunities. There is a feeling within the company that the system has been developed to a stage at which it is now able to realise real benefits. Having reviewed the current systems we are of a similar opinion. It would not be of benefit to the company in the short term to make further significant modifications to the process or outcomes. It is our opinion that the company is significantly more advanced than many other contractors.

However, we have noted that there are some key areas which could be explored in more detail and should be considered by the company in the medium to long terms. The current processes could be adapted and refined to allow them to improve their productivity and competitiveness further.

- 1) There is no feedback loop between what happens on site with the monitoring of the programme and the estimating process. As everything that is undertaken is dependent upon the bill of quantities and the hours that are allocated by the estimator, this needs to be influenced by the actual production rates that are taking place on site.
- 2) The focus on the implementation to date has been within the directly employed staff of Pert Bruce. Whilst controlling the productivity of sub-contractors is not the immediate requirement of the company there would be significant benefits to the

company in engaging their supply-chain in this process.

- 3) There is a focus on recording what has happened and the reasons for less than expected productivity. However, this does not necessarily explain the root cause of the delays. We would therefore suggest that the causes of delays are explored in more detail. One way of improving this would be collaborative planning (involving all the supply chain and designers) on a weekly basis to outline exactly what tasks will be undertaken and what will be required from whom to make it happen. It would also include a detailed review of the previous week's activities. We would recommend that this approach is explored.
- 4) One of the challenges in measuring productivity on projects is when the tasks are very specialised and bespoke. One approach to overcoming this – which is closely aligned with the approach which is used by Pert Bruce is Earned Value. Earned value is a technique commonly found in the petro-chemical industry, but relatively rarely found in construction. It relies on the existence of a set of norms, or standard times per unit of output. In its simplest form, earned value is a way of combining performance across a range of activities. For example, if a gang of 3 steelfixers fixes 160t of 40mm rebar and 60t of 20mm rebar in 40 hours, and if the “norm” for 40mm rebar is 0.8t/mh and for 20mm rebar 0.5t/mh, the “hours earned” are  $160 \times 0.8 + 60 \times 0.5 = 158$ hrs. Actual hours worked =  $3 \times 40 = 120$ hrs. The productivity index, defined as earned hours/actual hours =  $158/120 = 1.31$ . Earned value avoids the need to assign hours to activities. However, it can work only if robust and reliable norms are established. We would suggest that Pert Bruce should seek to develop these norms to allow them to create a measure of productivity across their sites.

There are three key elements which have been identified which could also be changed to improve the process.

- There appears to be duplication between the productivity recording sheets and the time sheets. These are used for different purposes but contain a significant amount of the same information. These could be rationalised to avoid unnecessary recording.
- The project programmes which are developed in Microsoft Project could be automatically linked to the site manager's weekly return sheet to avoid the need to manually input data for each project on a weekly basis.
- It was reported during the review that there were some difficulties obtaining buy in from staff and operatives as this is seen as a director led initiative. We would suggest that an external facilitator might be used to allow the process to become better embedded.

### 4.3 Conclusions

The process of productivity improvement explored in this feasibility study relate directly to internal systems within Pert Bruce. At a time when margins are tighter than they have been for the last 20 years there is an imperative to make improvements to remain competitive. Pert Bruce have been making active attempts in recent years to be able to combat this and implement improvements within their company.

The study sought to review the existing procedures within Pert Bruce and has concluded that these are very advanced and that implementing further change at this stage may be counter-productive. In addition to this the use of the PBT would not necessarily be appropriate because of the measures of productivity being used by Pert Bruce. To overcome this and to afford future opportunities for improvement recommendations have been suggested in the next section.

## 5 FEASIBILITY OF FUTURE WORK

### 5.1 Recommendations

The feasibility study has concluded that Pert Bruce's systems are significantly further advanced than the vast majority of the construction industry. Nevertheless, there are further steps which could be implemented to ensure that the company stays at the forefront of improving productivity and competitiveness. As a number of the processes that the company has introduced are relatively recent it would be advisable that these are allowed to bed-in and be fully tested prior to undertaking any of the further recommendations outlined below.

- If buy in is difficult, involve an external facilitator to obtain widespread recognition of the importance of productivity improvement
- Programme and data collections sheets should be electronically linked.
- One of the key markets for the productivity improvement process will be with the existing and future supply chains of Pert Bruce. If the company is to remain competitive it is vital that their sub-contractors also remain competitive. Should the project prove feasible, we would therefore envisage the work undertaken with Pert Bruce's directly employed operatives to be transferred to further members of their supply chain.
- Focus on the causes of delays and ways of improving them.

The above recommendations will allow the productivity and competitiveness of Pert Bruce Construction Limited to improve further. This feasibility study has highlighted that the University of Dundee's Productivity Benchmarking Tool could be further developed to ensure that it is more appropriate to the needs to the construction industry. The following recommendations have emerged in relation to the PBT. It is recommended that these should be implemented for future releases of the tool.

- The PBT currently allows comparisons to be made on a site-by-site basis for selected activities on similar projects. However the facility does not exist to create a hierarchical breakdown of projects. Such a development would allow contractors to benchmark productivity between gangs on a similar activity or between projects managed by the same manager for instance.
- The PBT is not currently configured to measure productivity in terms of earned value. However, it is entirely feasible to do so and the mechanisms of doing so should be explored in future releases. This would then make it more applicable to the types of problems being faced by Pert Bruce and other contractors.

### 5.2 Sources of funding for implementation

To facilitate the implementation of the recommendations in the previous section it ought to be possible to access sources of funding. To implement the recommendations for Pert Bruce Construction, the most likely source of funding would be through CITB-ConstructionSkills, the Sector Skills Council for Construction. Productivity is one of the key drivers for ConstructionSkills and through initiatives such as their Growth Fund, levy payers can access funding.