

CASE STUDY

Activity-based costing, sensitivity analysis and management for *Brick Co* in a carbon constrained world

The Australian brick-making industry and its global context

Climate change is having a significant impact on businesses, society, and individuals, and it is increasingly understood that a shift towards a low-carbon economy is needed. The building and construction sector plays a central role in this shift, with greenhouse gas emissions from building and construction activities accounting for around 40% of global GHG emissions (WBCSD 2018).

Bricks are a common material used in the building of Australian homes. The process of manufacturing bricks requires, however, a considerable amount of energy, mostly through electricity used in the grinding, pressing, forming and cooling of bricks, as well as natural gas used in firing them. Energy consumption is consequently one of the most significant overhead items accounted for.

With recent and significant investment in distribution and transmission lines along Australia's east coast, and natural gas prices reaching parity with international prices since the Liquefied Natural Gas terminals started production in Gladstone, Queensland, *Brick Co* have observed a significant increase in their electricity and natural gas bills over the past year and are considering ways in which they can reduce their current electricity and natural gas consumption, as well as future-proof against rising costs.

Brick Co management currently uses a traditional method of allocating overhead costs such as electricity and natural gas, depreciation, admin, rent, repairs and maintenance and management/supervisor salaries, using a predetermined rate based on the number of units sold. Budgeted revenues and costs are based on prices and costs for 2020 and are as illustrated in Table 1.

	Total
Bricks (units) produced & sold	21,200,000
Revenues	\$ 33,600,000
Direct materials	5,104,000
Direct labour	9,780,000
Manufacturing overhead	
- Gas	4,310,000
- Electricity	621,000
- Rent	464,000
- Repairs and maintenance	352,000
- Manager and supervisor salaries	168,000
- Depreciation	96,000
- Admin	65,000

Table 1: Budgeted sales, direct and indirect costs for 2021

Brick Co uses SAP for their accounting and other processes and wants to allocate its rental costs to various departments in its *Brick* cost centre group (BG####) using the area occupied by each of its departments every month. Currently, Administration (A####), Production (P####), Marketing (M####) and Technical services (T####) departments,

mapped in SAP as service cost centres, are occupying 200, 2000, 400 and 600 square metres respectively. As the departments have no control over rental costs, management would like to allocate these costs using a method that would ensure the identity of the rental cost is not shown in the receiving cost centre reports.

For controlling purposes, your management has decided to allocate actual direct labour costs to various activities – Crushing (C####), Setup (S####), Forming (F####), Drying (D####), Firing (F####) and Logistics (L####) (Logistics include packing, distribution and admin activities) in its Factory cost centre group (BF####), based on the actual number of casual employees engaged for each activity, i.e. 20, 8, 12, 6, 14 and 40 respectively for these activities. Budgeted (planned) number of employees for each of the activity are 18, 7, 10, 5, 12 and 36 respectively. While doing the allocation, management wants to make sure these costs are shown clearly in the receiving cost centre's performance reports.

As a policy, your management would like to allocate actual salaries (for managers and supervisors) to individual cost centres in the Brick cost centre group (BG####) and would like these costs to be shown in the receiving cost centre's performance report. As per the current policy, 10%, 50%, 15% and 25% for Administration (A####), Production (P####), Marketing (M####) and Technical services (T####) departments respectively.

Actual rent, gas and electricity costs are paid through an invoice submitted by a Real Estate agent called ####RayWhite realty for the rent, and, Energy Australia (####Energy Aust) for Electricity and Gas for the current month. All the remaining actual costs are posted directly in the General Ledger every month. While posting, direct materials, direct labour, gas and electricity costs are charged to Production (P####) cost centre; Depreciation, Salaries, Rent and Admin costs are charged to Administration (A####) department; and Repairs & maintenance costs are charged to Technical services (T####) cost centre.

Management would like to control the costs of Technical Services and measure its service performance. It therefore would like to measure the service rendered by the Technical services (T####) cost centre to other cost centres and allocate the cost of providing technical support service (SS####) to those departments in the company's Brick cost centre group (BG####). In the current month, the Technical services department (T####) has provided 920, 100 and 180 hours to the Production (P####), Administration (A####) and Marketing (M####) cost centres respectively. The total planned hours for the Technical services department are 1000 in the current month and the service rate is \$200 per hour. It is important for Brick Co to see these costs mapped and allocated in SAP and shown in the SAP reports for controlling purposes.

While Brick Co allocates the above costs to its departments through SAP, it is nevertheless concerned that opportunities to reduce those costs may be missed due to the complexity of the processes involved in the manufacture of bricks as illustrated in Figure 1. For this reason, Brick Co have recently hired your team as their Management Accountants to assess the activities that most affect energy consumption, with a view to potentially investing in technologies to reduce both electricity and natural gas used.

Brick Co specialise in providing two types of brick: Aus Bricks and Artisan Bricks. Aus Bricks are the most used type of brick for family homes, and it is expected that sales for the year will be 20,000,000 units. Artisan Bricks are special orders or designs that are made for one-off architectural homes and buildings. Artisan Bricks often come in unusual shapes, which affects setup and forming costs. They also often require finer crushing & grinding and more complex firing processes.

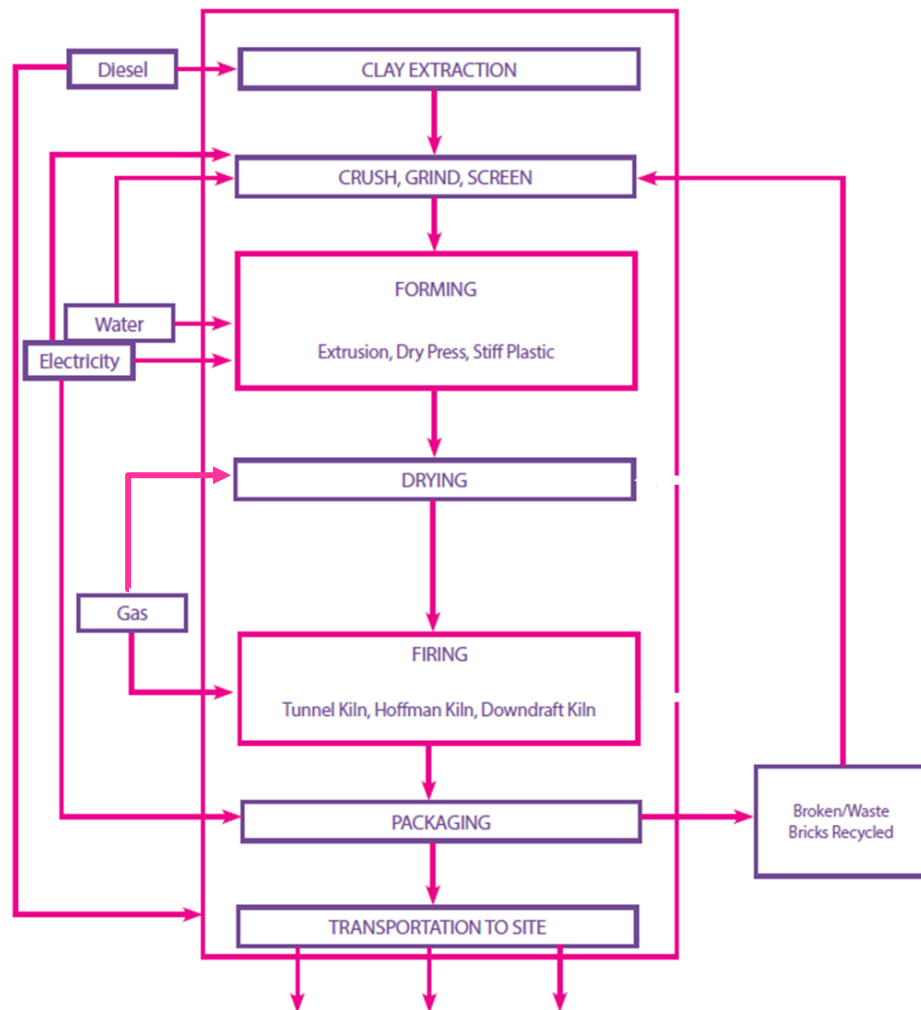


Figure 1: Activities at Brick Co's production site (adapted from Think Brick, 2014)

To conduct your assessment, you and your team spend some time at the brick production plant, observing the operations and interviewing staff as they go about their work to understand the different types of activities they undertake, and the different types of machines involved.

Activity 1: Crushing, Grinding and Screening

Unlike Figure 1: Activities at Brick Co's production site (adapted from Think Brick, 2014), production activities at Brick Co commence with crushing, grinding and screening activities, because their production facility in Victoria is located right next to a clay quarry owned and operated by a separate entity. Once the raw materials have been mined at the quarry, they are first crushed to break up large clay lumps and stones, after which the clay lumps are transported through size reducing grinders and screens and then mixed with water in what is called an



Figure 2: Grinding of rocks to form clay

agitator to produce a homogenous clay mass. Electricity consumption (megawatt hours - MWh) is the primary cost driver for the crushing, grinding, screening and mixing activity, with the wholesale market price for electricity forecast to be \$74.55/MWh. Budgeted consumption for 2021 is expected at 8,330 MWh, with activity levels for Artisan Bricks being higher at 2,080 MWh due to the finer grinding required.

Activity 2: Setup

Once mixed with water, the clay is shaped in machines that force the clay through a tube into a column, where the bricks are formed. Prior to the forming of bricks, however, the forming machine needs to be set up with the specifications required, including the correct dimensions of the bricks, any external designs, and the number of coreholes shaped into the centre of the bricks. Setups change for every type of brick manufactured, so the more bricks manufactured in a particular batch, the less the setup costs will be. It is expected there will be 510 setups needed throughout the year, of which 450 will be for Aus Bricks.

Activity 3: Forming

Once the forming machine has been set up, clay is pushed through into a brick column, and then cut into individual bricks with a wire. The cost driver for forming is the number of bricks produced and sold.



Figure 3: Forming or shaping of brick column

Activity 4: Drying

Wet bricks contain 7-30% moisture and, if fired when wet will crack. For this reason, they need to be dried in drying chambers for 24-48 hour at between 30°C and 200°C. Natural gas is used to warm the drying chambers. Drying time for Artisan bricks is longer, given the products tend to be considerably denser. Accordingly, consumption in 2021 is expected at around 90,650 GJ (gigajoules) for Artisan Bricks, with current prices in the east-coast gas wholesale market of \$5.85/GJ used as the forecast rate.



Figure 4: Drying of wet bricks

Activity 5: Firing

Once the bricks are dried, they need to be fired in a gas-fired kiln to develop the hardness and strength needed for them to become durable building materials. This is a really important stage and, if over-burnt, will lead to breakage, while if under-burnt the bricks will be too soft to carry the loads needed in building. Kilns are typically in a tunnel shape, with the bricks moving in and out on tracks.



Figure 5: Firing of bricks in tunnel kiln

Firing is the most energy intensive part of the brick production process, Aus Bricks are accordingly forecast to consume 288,000 GJ of natural gas across the 2021 period.

Activity 6: Packing, distribution and admin (logistics)

Once the bricks have cooled, they are de-hacked or automatically stacked on pallets and particleboard ready for shipping. Packaging, distribution and administrative costs are dependent on the number of orders, with 800 orders expected in the coming year, of which the bulk of them (710) will be for Aus Bricks.

As a consequence of the interviews undertaken and the observations made, you estimate budgeted indirect costs according to the different types of activity described in the above brick manufacturing process as follows:

Activity	Total budgeted indirect costs
1. Crushing, grinding, screening & mixing	\$ 621,000
2. Setup	215,000
3. Forming	495,000
4. Drying	1,510,000
5. Firing	2,800,000
6. Packing, distribution & admin	435,000
Total	\$ 6,076,000

Table 2: Budgeted indirect costs for 2021

Requirements 1:

1. Using traditional costing, allocate direct and indirect costs to each product line (Aus Bricks and Artisan Bricks). Calculate the operating income and determine the profitability for each product, by calculating operating income as a percentage of revenue.

2. Now re-allocate indirect costs to each product line using an ABC system. From this, recalculate direct and indirect costs based on relevant activity drivers, once again calculating the operating income and profitability for each product, basing the latter again on operating income as a percentage of revenue.

3. What do the above calculations reveal about the cost distribution and profitability you observe between the two product lines? How much change do you observe between the results under traditional costing and under ABC and why? What implications does this have for Brick Co within the context of their current concerns?

Given the results of the above, you started working with a team of engineering consultants to understand where Brick Co could save on their electricity and gas consumption. From this work, you also propose three possible upgrades to the brick production plant that have the potential to reduce costs. These are as follows:

1. Replacing the two direct on-line motors used to mix the clay with water, with two units of more efficient motors and variable speed drives (projected to have a useful life of around 10 years).¹ These are estimated to reduce electricity consumption by 30%, at a cost of \$60,000 each.

¹ Assume all technology upgrades have a salvage value of \$0.

2. Using waste heat generated by the firing process and redirecting it towards the drying activity. This would involve investment in a waste heat recovery system at a cost of around \$360,000 but would entirely eliminate natural gas consumption associated with drying. The waste heat recovery technology would have a useful life of 12 years.

3. Replacing 50% of natural gas consumed in the firing process with landfill gas produced by a neighbouring landfill site. In addition, the engineers proposed replacing the kiln burners with efficiency burners, improved kiln sealing, entry chambers and fans, all of which retain heat and reduce heat loss. These improvements would require an upfront investment of \$1.2 million but would have a useful life of 20 years.

Based on the investments proposed, you would like to suggest several additional changes in pricing to management as follows:

1. Given the significant increase in building activity in the economy, since the government introduced building grants due to Covid-19, you propose Brick Co advertise to customers an increase in the selling price for both Aus Bricks and Artisan Bricks of 10% each from 2022 onwards where orders are for less than 30,000 or 15,000 bricks respectively. However, where orders exceed these amounts, customers are told that the selling price increase will be for 5% on top of the 2021 price only.

2. In suggesting this, you forecast more high-volume sales and fewer low-volume sales that will have the effect of reducing the number of orders by 10% but increase the volume of bricks sold overall by 15%.

3. You also forecast that the effect of these changes is likely to reduce overall machine setups by 20%.

4. Finally, and in line with the slow rates of recovery from Covid-19, costs for direct materials and labour are also projected to increase in 2022 by 2% on 2021 levels.

Requirements 2:

Using the above information, and assuming all other cost information increases by 2% from the 2021 budget, you now conduct sensitivity analysis on the effects of the proposed interventions on the 2022 contribution margin. The managers of Brick Co have requested that in doing so, you consider both the effects on the income statement as well as on the pricing of each of the two types of products relative to the costs involved. Management would like you to do this analysis under both traditional costing and ABC.²

To do this:

1. Categorise the different costs according to whether you believe them to be either variable or fixed, explaining your reasoning for doing so within your analysis.

2. Then provide a critical analysis by comparing and contrast the effects of these changes first for the traditional costing contribution margin and then for the activity-based costing contribution margin, explaining why the outcomes are as they are and what the implications would be for Brick Co.

In doing the above please be sure to state any assumptions made.

3. Follow your analysis with recommendations to the management of Brick Co with respect to the investments and pricing policy changes. Then comment on any specific flaws in Brick Co's proposed ABC system and in any of the proposed interventions.

² Assume depreciation is pro-rated across the two products according to relevant activity drivers (under ABC) and volume of bricks produced and sold (under traditional costing).

PART A: CASE ANALYSIS (GROUP)

Based on the information analysed and the calculations your team has provided, you need to prepare a PowerPoint presentation to report to the Management of Corinna Corporation. Your report should contain the following for Part A.

1. **Executive summary** (1 slide limit) – provides an overall succinct summary of the case including background, analysis, major findings, recommendations and limitations (so that an executive reading the report will have enough detail to attend and participate at a meeting even if he/she has not read the rest of the report in detail). An executive summary needs to be thorough and informative but also succinct.
2. **Background** – a description of all the important issues and their background that is relevant to the case and the findings.
3. **Analysis** – an overview of the critical analysis and the insights and results obtained. Significant calculations and tables of figures should not be included here (but in the appendices), with this section referencing the appropriate appendices.
4. **Findings** – detail and justify your findings/insights from the analysis (this should not be a simple repetition/rephrasing of the analysis). Take care to recognise and describe any assumptions or where additional data may be necessary to further understand the situation.
5. **Recommendations** – detail and justify your recommendations from the analysis and findings ensuring that the recommendations are reasonable/justifiable and directly address the case and/or the analysis undertaken above.
6. **Action Items (Next steps)** – map out a detailed plan that highlights specific/concrete actions to be taken in order to implement any proposed changes based on the findings and recommendations noted. This should not be a simple repetition/rephrasing of the recommendations.
7. **Limitations** – detail specific limitations from the analysis such as assumptions made, any missing information, limitations (or assumptions held) regarding the data, calculations and case context.
8. **Appendices** – include all other relevant supporting material such as detailed calculation work (that has been referenced in the body of the report). There should be no new material or important material in the appendices.

PLEASE NOTE THE FOLLOWING!

- **Important:** While your calculations are important, the assignment will be valued mainly for its critical analysis, depth and creativity.
- **Cover page/title slide** - provide a separate cover page with student names, SIDs and email addresses. **Only one soft copy required per group.** Cover pages can be found in Canvas.
- **Executive Summary:** One slide limit.
- **Report:** You are required to prepare your report using *PowerPoint*. The report must meet the purpose of providing details for a manager with sufficient time to sit and read the material (you will not be required to present it). You are encouraged to be succinct in your writing style (do not waste space on stating the obvious or stating mere descriptions of calculations or including tedious calculations or including definitions of management accounting terminologies; while dot points are encouraged, the writings should be sufficiently informative and detailed). Also, remember that management would normally require as much information as would be required to help them make informed decisions, while at the same time they would not prefer information overload. To reflect this, the slides should be detailed and

informative but not be crowded with words and/or diagrams. Each slide must be self-explanatory, with proper headings and sub-headings.

- Please *make sure* to **read the Marking Guide** for further information.
- **Note:** The executive summary and report will be **a total of 10 slides (1 for the executive summary and 9 for the body of the report)**. Please also include a cover/title slide in Power Point (with your names and SIDs); this will *not* be counted as one of your 10 slides.
- **Appendices:** You are encouraged to provide all supporting information as appendices (these do not need to be in PowerPoint – you may use Word or Excel). The **appenices should be no longer than ten (10) A4 pages**. Please attach the appendices at the end of the PowerPoint report.
- **Peer evaluation:** Each group is required to sign and **submit ONE (1) peer evaluation form** that needs to be attached to their PDF submission. If you are in a group of four – member #1, #2 and #3 will jointly decide the contribution of the member #4; member #2, #3 and #4 will jointly decide the contribution on member #1; member #1, #3 and #4 will jointly decide the contribution of member #2. And member #1, #2 and #4 will jointly decide the contribution of member #3 etc. You will not be required to evaluate your own contribution.
- **Contribution:** **Each member should be aiming for 100% contribution** based on the tasks assigned by the group. Contributions of 80% and below warrants investigation by the Unit Coordinator and a potential penalty for all group members, whether deemed to have contributed or not. In other words, if you have a noncontributing group member it is your responsibility to get that individual to contribute, and hence this being a group task - you risk being penalised as well.
- **Soft copy:** Create a **single** electronic PDF that includes the cover page, PowerPoint report, and appendices and submit via the Canvas submission link.

Part B SAP component (Individual work)

- 1) **Key Assumptions:** You are required to make the following key assumptions while mapping the costs in SAP.
 - a) Treat all budgeted costs for the **year 2021 calculated/found in the assignment scenario under traditional costing method as budgeted costs for the current month (Do not calculate monthly costs).**
 - b) Treat all the **projected costs with the proposed interventions for the year 2022 calculated/found in the assignment scenario under traditional costing method as actual costs for the current month. (Do not calculate monthly costs).**
- 2) Your submission should:
 - a) Be a PDF document with around 15 pages. There is no strict limit to the maximum number of pages. But if you provide the screens that are required and place two screens (properly cropped) per page, it will not generally exceed 15 pages. Also, note, there is no need for a separate cover page.
 - b) Have your SAP User account: i.e. **LEARN-### & student SID in every page header.** Penalties apply if the assignment does not have these identifying information.
 - c) Contain in the first page, a list of master data elements you have created in the system (G/L accounts, cost centres, cost elements, activity types, statistical key figures etc.), document numbers generated by the system and allocation cycle numbers that are available in the system in a tabular form.
 - d) Include appropriate screen shots of: i) **Actual distribution/assessment basic list** (after actual run with the document number clearly shown in the screen) and/or direct activity allocation document display screen showing details of cost centres, document number and allocated values; ii) actual/plan/variance cost centre reports (comparing BUDGETED figures with ACTUAL figures) for the Brick cost centre group BG### and for each cost centre; and iv) actual/plan/variance cost centre reports for Factory cost centre group BF### for the CURRENT MONTH.
- 3) You must first decide which master data (G/L accounts, vendors, cost elements, cost centres, cost centre group, activity types and statistical key figures), which transactions and which allocation methods are required to reflect the scenario and the reports required. You should then map them in the system by creating relevant master data elements (**in client XXX to be given in Week 7 and to be posted in a separate announcement**) using your SAP user account (LEARN-###) assigned to you in workshops, perform transactions and produce reports in the system.
- 4) **Hint 1:** Considering the complexity of the software, limited time, and the real-time nature of the accounting system, it is easier and efficient to repeat the relevant steps if mistakes are made, rather than correcting the errors. Please note, the data or transactions CAN NOT simply be deleted, and the errors will therefore carry into the final cost centre reports.
- 5) **Hint 2:** For mapping the values and posting transactions in SAP, please consider the actual (and budgeted costs for the traditional costing method) either given in the assignment or calculated by you for the **CURRENT MONTH** only. This will produce cost variance reports consistent with your calculations.
- 6) **Hint 3:** There is no need to map details of sales and profitability in SAP.
- 7) **Table 1** provides a list of master data codes and **Table 2** provides a list of generic field values to be used while creating master records and executing transactions in the SAP system. **For all other values that are not given in these tables, please use the values you have used in SAP exercises.**

Table 1: Master data codes to be used in SAP

	Details of master data and transaction evidence	Master data codes
1	Bank Account	100 ###, 105###, 106### etc.
2	A/P Recon. account	250###, 255###, 256###, etc.
3	Expense accounts (possible twelve account codes given to choose from)	700###, 701###, 702### etc; 710###, 711###, 712### etc; 720###, 721###, 722### etc; 730###, 731###, 732### etc; 750###, 751###, 752### etc; 770###, 771###, 772### etc; 780###, 781###, 782### etc; 790###, 791###, 792### etc. 690###, 691###, 682### etc; 680###, 681###, 682### etc; 660###, 661###, 662### etc; 670###, 671###, 672### etc;'
8	Secondary cost elements	810###, 811### etc.
9	Cost centres	As indicated in the Assignment description
10	Cost centre group(s)	As indicated in the Assignment description
11	Assessment cycle	A###, A1### etc.
12	Distribution cycle	D###, D1### etc.
13	Activity type	SS###, SS1### etc.
14	Statistical key figure	AR###, AR1### etc. or EM###, EM1### etc.

Table 2: Generic field values to be used in SAP Master data and transactions

Details of field	Field values
Account currency	USD
Assessment Cele	Assessed Costs
AType category – manual entry, manual allocation	1
Activity Unit – Hours	HR
CElem category	1 (Primary costs/Cost reducing revenues) or 43 (Internal activity allocation)
Company code	US00
Controlling area /Hierarchy area	NA00
Cost centre category	H
Country (vendor record)	US
Currency	USD
Current year	2021
g. cat.	Fixed value or Tot. values (to be determined)
Payment Terms – Payable immediately due net	0001
Plan version	0
Price Indicator – plan price automatically based on activity	1
Profit center	NA00
Receiver Cost centre group	To be determined
Receiver Rule	To be determined
Sender Rule	Posted amounts
Sorting key (posting date)	001
Stat. Key fig. UnM. (unit measure)	M2 (Square metres) or PRS (persons) or other relevant UnM