ENVIRONMENTAL MANAGEMENT ACCOUNTING PROJECT

CASE STUDY SUBJECT: G H MICHELL & SONS

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Structure of report

Executive Summary

This report provides information about an environmental management accounting project undertaken at GH Michell & Sons, in Adelaide, South Australia. Michell is Australia's largest wool and leather processor and makes sales throughout Australia and overseas.

The process that was investigated in the case study was the carbonising process located at the Adelaide premises of Michell. This process is used for wools which are not of the highest grade and which, at the time Michell acquires the wool, include a relatively high amount of foreign matter, inclusive of vegetable matter, salts, and so forth. This foreign matter is removed, as is wool grease, during the carbonising process. There are different grades of wool that are used in the carbonising process, and the various gradings reflect, amongst other things, the amount of foreign matter included within the wool.

The focus of the case study was to determine how specific costs incurred in the carbonising process, costs which were also considered to have environmental implications, were accounted for within the existing accounting system. Specifically, the case study required the participants to document how the existing accounting system accounted for energy costs, detergent costs, water costs, and transportation costs. A primary question was whether the output of the accounting system reflected the actual consumption of these resources? Restricting the analysis to these four categories of costs made the process manageable (and it is acknowledged that the analysis could have been extended to encompass other costs which also could be construed as having direct environmental implications). What became apparent in the analysis of the accounting system was that the costs being examined were being allocated to the wool processing activity (and therefore, to the final wool product being produced) on the basis of bales entering the carbonising process. All bales, regardless of wool type (and associated yield – yield being the proportion of wool by weight that is ultimately produced from the bale) were allocated the same proportion of processing costs. This ignored the fact that some grades of wool required more resources to process than other grades of wool.

The next step was to understand and document the carbonising process in terms of the actual use of resources (and particularly in this case study, the use of water, energy and detergents). What became apparent was that different grades of wool use different amounts of resources, this being reflective of the fact that some wool grades start out 'dirtier' than others and thereby need more processing. This was not what was reflected by the existing management accounting system.

The analysis indicated that the assumptions used by the accountants (that all bales require the same processing) were perhaps too simplistic. Effectively, by allocating the same costs to all wool grades, the 'cleaner' wool grades were subsidising the 'dirtier' wool

grades – but this subsidisation was being hidden by the accounting system. However, whether it was worth refining the accounting system to get more accurate data really depended upon whether the costs of refining the system were likely to generate associated benefits. It was considered that the potential benefits from having more accurate data exceeded the costs associated with refining the accounting system.

Apart from the manufacturing process, an analysis was also undertaken of how the costs associated with transporting the wool bales to the processing factory were accounted for. As with the other costs described above, transport costs per truck were allocated to the wool on a per-bale basis. Again, this failed to take account of the fact that some wool grades actually included more foreign matter than other grades of wool, and hence provided different yields after being processed.

After a deal of consideration, it was decided to allocate the water, energy and detergent costs on the basis of the expected yields of various wool types. This was deemed to more accurately reflect the use of resources than the existing approach which allocates the same proportion of costs to all wool on the basis of bales entering the system. A similar revision was made in relation to transport costs. It was found that the revised costing data was sufficiently different to the data previously being generated so as to cause the organisation to question the grades of wool that were currently being acquired at particular costs, given the associated processing costs. Decisions to acquire relatively higher grade (‘cleaner’) wool would have the implication of reducing the consumption of water, energy, detergent and transportation costs.

The case study also raised a number of other issues which are discussed in this report. These included issues associated with costing other outputs from the carbonising process, inclusive of wool grease that is sold to external parties, and ‘sludge’ which is generated by the carbonising process (the sludge is further treated before an external party takes it - at a cost to Michell - for the purposes of producing compost). The report also addresses relevant threats associated with the current European Eco-Labelling Scheme which has direct relevance to the textile industry (as well as to a number of other industries).

The insights provided by the case study are believed to have relevance to numerous other organisations, particularly those industries which process agricultural commodities of varying grades or yields.

1. Overview of report

This report describes a particular wool processing activity undertaken in Adelaide by G.H. Michell and Sons. The report identifies how specific costs (electricity, detergent, water and transportation costs) are currently being accounted for. As is shown, the current approach to allocating these costs to processed wool fails to take account of inherent differences in the classes of wool being processed, specifically with regards to differences in their associated yields. A revised approach to cost allocation is proposed which allocates costs on the basis of wool types and associated yields. The revised costing data tends to question the profitability associated with processing certain wool types – specifically those with lower yields. The relevance of these findings to other forms of processing in other industries is discussed. The report concludes with a discussion of other non-core issues that were raised during the investigation, but which nevertheless have broader relevance.

2. Background to the process under review

GH Michell & Sons (Australia) Pty Ltd, hereafter referred to as Michell, is Australia's largest processor of wool and leather. Michell processes between 30 to 35 million kilograms of wool each year. It is commonly known that wool processing does not generate high margins, with the final profit contribution representing a very small percentage of the various acquisition and processing costs. Hence cost changes or realignments can have the potential to make certain lines of wool appear unprofitable. This potentially emphasises the sensitivity of various cost allocations.

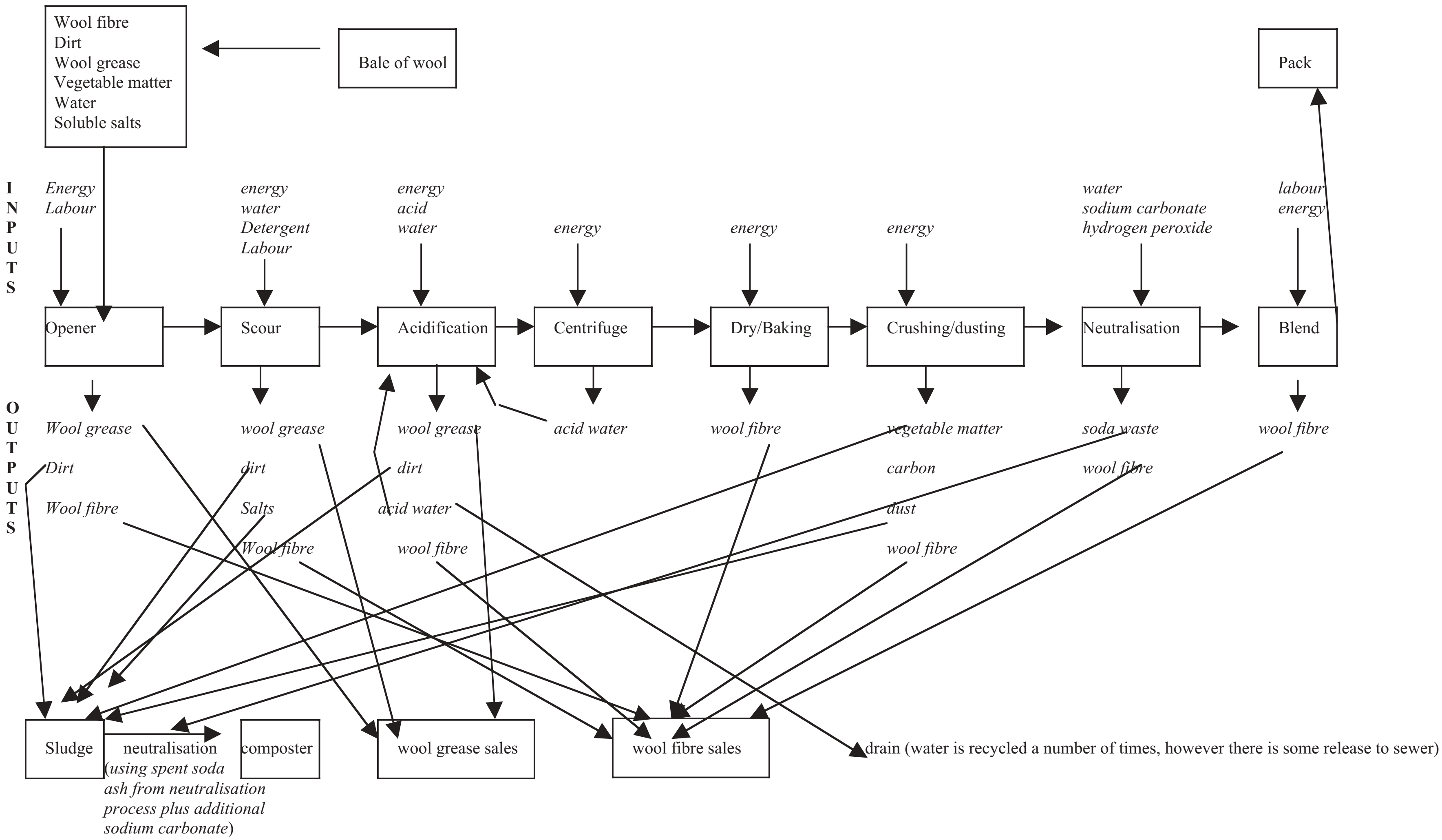
In relation to the processing of wool it should be noted that the wool that is introduced into processing can come in a variety of qualities, including differences in the amount of foreign matters attaching thereto. For the purpose of the EMAP, we have concentrated on the process referred to as wool carbonising which is a process which processes wool which is not of the highest quality but which nevertheless has a number of end uses, including use in garments (crudely put, the carbonising process is used for the 'dirty' wool which will typically not find its way to 'top end' markets – such as those relating to fine wool suits). This process tends to be more complicated than that associated with the processing of high quality 'clean' wools (referred to in the industry as 'tops'). The wools used in the carbonising process typically include a relatively large amount of dirt, vegetable matter (for example, burrs) and water-soluble salts. To remove this matter, there are various inputs into the carbonising process, including:

- Wool
- Water
- Detergent

- Acid
- Sodium bicarbonate
- Hydrogen peroxide
- Energy
- Labour
- Machinery use

Throughout the carbonising process wool travels through many machines before finally being packed as a blended wool product. It is a highly capital intensive process. The process starts with wool initially going into an 'opener' which effectively separates the wool fibres which have been firmly packed for transportation purposes. Following this it goes into a scourer (there are fours scourers in a row). Energy, water and detergent (and labour) are added throughout the scouring process. Following scouring an 'acidification' process is implemented wherein energy, acid and water is used. The acidification process acidifies the burrs and vegetable matter which are initially attached to the wool, thereby turning them to ash which is removed from the process (and used as an input to other products). A centrifuge is then employed to remove the water (requiring energy inputs – this water is recycled) before a dry baking process (energy inputs) is employed. A crushing/dusting process then follows (energy inputs) and then a 'neutralisation' process is implemented in which water, sodium carbonate and hydrogen peroxide is added. A blending process is then undertaken before the wool is packed. A diagrammatic representation of the process is provided below.

Figure 1
A diagrammatic representation of the carbonising process



3. Recycling initiatives and commercial use of wastes

Apart from generating processed wool, the carbonising process generates a number of by-products which, whilst once treated as wastes, are now used in further processes. The process generates wool grease which currently sells for approximately $2 per kilogram and which is used by organisations, external to Michell to produce a variety of products. Approximately a decade ago, wool grease was incinerated. The fact that the wool grease is now sold and used by other organisations, rather than being incinerated, has positive environmental implications.

The carbonising process also generates a deal of 'sludge' (which is generated because of the various foreign matter attached to the wool when it commences getting processed – because of the addition of water throughout the processing activity, the resulting sludge has a 45% water content). Whilst this once went to landfill this now goes through further processing (in which it is neutralised) before it becomes suitable as input to a composting process. This composting process is undertaken by a party not related to Michell. Michell pays the composter $15 per tonne to take the neutralised sludge.

During the processing there is also a relatively small amount of wool fibres which are separated from the balance of the wool. Some of the fibre is recycled into the production process, but a limited amount of fibre remains separated from production. These fibres are typically referred to as 'broken ends', or fibres that are damaged through the carbonising process. They are typically quite short in length, which restricts their usefulness. These fibres are collected and sold as a lower grade product, for use in various processes, such as the production of insulation. If there was not this external use of these wool fibres they could otherwise have ended as waste.

Whilst the entire carbonising process does use a deal of water, the water is actually used within a loop in which it is recycled a number of times. The water that is used in the second and third stage (scouring and acidification) goes into a treatment loop where settling tanks are used with one separating further wool grease (which, as noted, is sold for approximately $2 per kg), and one separating dirt which is used in a subsequent composting process (as noted above, the composting process is completed externally by an unrelated entity). Some fresh water is added to the process and the water is then returned to the carbonising process (some still goes to the drain when the solution gets too dirty). Wool grease is extracted at various stages of the process.[1]

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[1] What is of interest is that wool processing necessarily generates wool grease – there is no way around this. Michell does not allocate any costs to the wool grease itself based on the argument that even if wool grease was not saleable, it would still be extracted as a necessity in processing wool. The costs of the extraction, together with the other processing costs, are treated as a cost of processing the wool. Indeed, wool grease was extracted when it had no market. The incremental costs associated with packaging the grease in a manner suitable for sale are accounted for and allocated to the wool grease. The wool grease

As noted above, inputted wool can be of many types with different microns, different vegetable matter content, and so on. There is an established industry system of classification for the various wool types, and the classification directly impacts the prices the Michell wool traders pay for the wool. Traders make decisions on the basis of perceived margins, which obviously, rely upon an assignment of projected processing costs. Traders are provided with details of estimated processing costs associated with particular classes of wool. This project will concentrate on whether these estimated processing costs are perhaps in need of some refinement. Adjusting perceived margins (as a result of adjusting estimated processing costs) could affect what types of wools are acquired by the traders (and hence, subsequently processed by the company). This is the core issue of this case study.

4. Some key definitions

This *Environmental Management Accounting Project* was funded by a consortium involving Environmental Australia, EPA (Vic) and ICAA with the purpose of encouraging organisations to put in place *environmental management accounting systems* which identify (and potentially reduce) operating costs which also have environmental implications – potentially referred to as *environmental costs*. Because these terms are central to this project, they are worthy of some definition.

Bennett and James (1998, p. 33) provide a definition of 'environment-related management accounting', this being:

> The generation, analysis and use of financial and non-financial information in order to optimise corporate environmental and economic performance and achieve sustainable business.

The International Federation of Accountants (1998) defines environmental management accounting as:

> The management of environmental and economic performance through the development and implementation of appropriate environment-related accounting systems and practices. While this may include reporting and

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does raise an interesting issue – at what point would/should the company start identifying costs associated with wool grease? This is not an issue that is resolved within this case study but nevertheless is an interesting one worthy of further thought. Michell's approach does appear reasonable. As with wool grease, no costs are separately attributed to the relatively small amount of wool fibres which are separated from the balance of the wool during the processing. Incremental costs pertaining to packaging and selling the fibres are separately recorded.

> auditing in some companies, environmental management accounting typically involves life-cycle costing, full-cost accounting, benefits assessment, and strategic planning for environmental management.

Environmental management accounting can therefore, depending upon the system implemented, provide a broad range of information about financial and non-financial aspects of an organisation's environmental performance. According to definitions such as those provided above, environmental management accounting systems have the dual purpose of managing and improving the economic and environmental performance of an entity. For the purposes of the project with Michell, the environmental management accounting project involves identifying some resource costs which are generally known to have environmental implications (water, energy, detergent and transportation costs), and through attempts to more accurately allocate these costs to particular processes, to see if greater costing precision alters the product mixes of the entity (thereby potentially leading to revised practices which create positive financial and environmental impacts). It is acknowledged that there would be other resources that are used within the carbonising process which might also have environmental implications. However, acknowledging that the refinement of the management accounting system has to be done in a manageable way, it was decided to initially restrict the 'environmental costs' that would be considered. The 'behaviour' of other costs can be analysed by Michell at a later date.

Turning our attention to the term 'environmental cost', this is a term that can take on a variety of meanings. Environmental costs have traditionally been thought of as being the 'end-of-pipe' costs, such as the costs associated with cleaning up sites after production, or waste-water treatment costs. But a broader interpretation would see the term 'environmental cost' also encompass material and energy used to produce goods and services (particularly from non-renewable sources), the input costs of generated wastes (including the capital costs, labour costs, materials and energy costs used to produce the unwanted waste) plus any associated disposal costs, storage costs for particular materials, and environmental regulatory costs including compliance costs and licensing fees, inclusive of any fines. For some organisations, the costs might also include the environmental impacts caused to other entities by the organisation's operations.[2] For the purposes of the Mitchell project we are ignoring the *externalities* – also referred to as 'societal costs' - caused by the entity (such as any expected costs that can be associated with the generation of greenhouse gas emissions – emissions for which Australian

[2] With very few exceptions (and these exceptions typically originating in Europe would include BSO/Origin, Ontario Hydro, Interface Europe, Anglian Water, Wessex Water), organisations do not tend to account for the *negative externalities* caused to other entities as a result of the organisation's activities. However, externalities caused by an organisation are often recognised as costs by other entities. For example, releases to water may require other organisations 'down-stream' to treat the water before they can in turn use it, or government or health funds might have to pay for environment related health costs.

organisations are not currently taxed) and we are also ignoring many other 'environmental costs'.[3] We are concentrating on a limited number of resource inflows that are known to have environmental implications.

What should be stressed is that there is no single accepted definition of 'environmental costs' such that different organisations will employ different definitions. For example, electricity costs might be an 'environmental cost' in some organisations, but not be identified as such in others. As such, 'environmental costs' might look higher in some organisations than others, yet the difference will possibly relate to differences in how expenses are classified. It is imperative that a detailed description be provided in the notes to the financial statements or other financial reports about how *environmental costs* have been determined (if indeed, the term is being used – which it typically is not) – particularly given the lack of guidance, and the inconsistency of reporting terminology in the area.

There are also issues to do with *capitalising* versus *expensing* the 'environmental costs'. At a general level, when organisations make expenditures, other than dividend payments, the expenditures are either treated as *assets* and carried forward in the balance sheet (or as it is also called, the statement of financial position), or treated as *expenses* and offset against profits (in the statement of financial performance, or as it is also known, the profit and loss statement).[4] Whether an item is *expensed* or *capitalised* can potentially have a significant impact on profits. Employing generally accepted accounting procedures, if we capitalise the expenditure (treating the expenditure as leading to the creation of an *asset*) there must be an expectation that the expenditure will provide future *economic benefits*.[5] If this is the case then no expenses (or 'costs') will be shown at the time the expenditure

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[3] The US EPA has provided a useful dichotomy - *private* versus *societal costs*. According to US EPA (1995, p. 1), the term environmental cost has at least two major dimensions: it can refer solely to costs that directly impact a company's bottom line (termed "private costs"), or it also can encompass the costs to individuals, society, and the environment for which a company is not directly accountable (termed "societal costs"). Again, in this case study we are concentrating on private costs.

[4] For readers of this report who are unfamiliar with accounting terminology, when expenditure is carried forward to future periods because the expenditure is deemed to have created an *asset* (meaning there is an expectation of future economic benefits associated with the expenditure), this deferral is referred to as *capitalising* the expenditure.

[5] For example, we might capitalise expenditure incurred in constructing a recycling plant. From an accounting perspective this expenditure would be deemed to relate to an asset, rather than to an *expense* to the extent the recycling plant will generate future economic benefits. Within Australia, recognition criteria pertaining to the elements of accounting (assets, liabilities, expenses, revenues, equity) are provided in Statement of Accounting Concept No. 4, which was released by the Australian Accounting Research Foundation in 1992. An amended version was released in 1995. Assets are defined as "economic benefits controlled by the entity as a result of past transactions, or other past events" (Statement of Accounting Concept No. 4). Although expenditure might lead to future environmental benefits, if there are no associated economic benefits to the entity, then accounting would not treat the expenditure as relating to an *asset*, but rather, as an *expense*.

is incurred.[6] This is often not recognised in discussions pertaining to 'environmental costs' or 'environmental expenses'. Further, some expenditures might provide future *environmental benefits*, but this might not coincide with future *economic benefits* – which means that they will be treated as *expenses*, rather than *assets* (even though the expenditure might be beneficial for the environment). Much professional judgement is involved in such decisions and unless a person is aware of the accountants' asset recognition rules, then understanding the differences between *environmental assets* and *environmental expenses* as displayed in financial reports can be a tricky exercise. Again, however, it is emphasised that the use of terms such as *environmental assets* and *environmental expenses* in financial reports is far from common.

However defined, what is important is that environmental costs are not ignored. As US EPA (1995, p. 18) stated:

> An important function of environmental accounting is to bring environmental costs to the attention of corporate stakeholders who may be able and motivated to identify ways of reducing or avoiding those costs while at the same time improving environmental quality.

Because there is much variation in how *environmental costs* are defined and measured, it is again stressed that any use of the term within an organisation must be clearly defined for those people reading the reports in which the term appears. Without clear description the reports will tend to be ambiguous. For the purposes of this project we have defined environmental costs quite narrowly as costs that are incurred by the organisation (thereby excluding 'societal costs'), and which are deemed to have environmental implications. As already indicated, we will concentrate on electricity costs (which have various environmental implications, including those related to the generation of greenhouse gas emissions), water costs (use and subsequent release of water has obvious environmental implications), use of detergents (which necessitate removal prior to release to waterways) and transport costs (which also has implications in relation to the generation of greenhouse gases). Our view is that if we bring these costs to the attention of management, and if we are able to find ways to reduce these costs, then *prima facie*, we will generate positive environmental (and financial) effects. Of course, it is also likely that consideration of other costs and/or other process would also have positive effects – but as mentioned previously, to make the project manageable we have set defined boundaries. Another point to make is that costs pertaining to water, electricity, and transport costs (the subject of our analysis) are, in many organisations, obscured in

[6] Although the asset would need to be depreciated over its useful life, and this periodic depreciation would be shown as an expense.

overhead accounts. It was interesting to investigate how Michell accounted for these costs.

Having provided some insight into how we define *environmental costs* for the purposes of this project, we will now broadly describe the steps undertaken in this case study.

5. Steps undertaken in this research

There are a number of steps that we undertook in this project and they are summarised below.

5.1 Obtaining management commitment to the project

Because the revision of the management accounting practices of the organisation:

- necessarily involved the participation of various people from within the organisation;
- lead to a questioning of existing systems which might have been accepted for many years;
- involved using sensitive and confidential data

there was need to have the support of senior management. In Michell, this was forthcoming. For some time the management of Michell has demonstrated its awareness of environmental issues by putting in place state-of-the-art water recycling initiatives; by working on a project to convert waste to compost; by seeking markets for the by-products of wool processing; and, by taking actions to instil an 'environmentally-aware' culture within the organisation. Hence, the staff were very receptive to the necessity of the project. This support was essential for the success of the project.

5.2 Identifying processes within the organisation that use resources that have environmental implications – that is, identifying the boundaries of the project

We are looking at the carbonising process (as previously described) within the Salisbury plant in South Australia. As already noted, we limited our consideration to related electricity, water, detergent, and transportation costs. In making such a judgement it was necessary to talk to people who have considered the environmental implications of the organisation's operations and it appeared that we had identified some of the more significant environmental implications of the Michell operations.

5.3 Determine who will be in the project team

It was necessary to have people who understood:

- The current accounting systems
- The existing manufacturing process
- The flow of materials and resources into the manufacturing process

- Potential for change to the existing processing system.

The team provided by Michell had a mix of experience and involved a number of senior personnel with environmental, engineering, and accounting backgrounds. In the early phases a *corporate strategist* was also involved to 'drive' the project.

5.4 Review existing accounting systems pertaining to the process under review

Having identified which 'environmental costs' we were going to consider, we needed to determine how these costs were currently accounted for. In many organisations, such costs as those that relate to water and energy usage, as well as transportation, are accumulated in overhead accounts. Overhead accounts accumulate costs which will not be directly related to a given product or process and these accounts often tend to 'hide' many environmental costs. As Ditz *et al* (1998, p. 164) state:

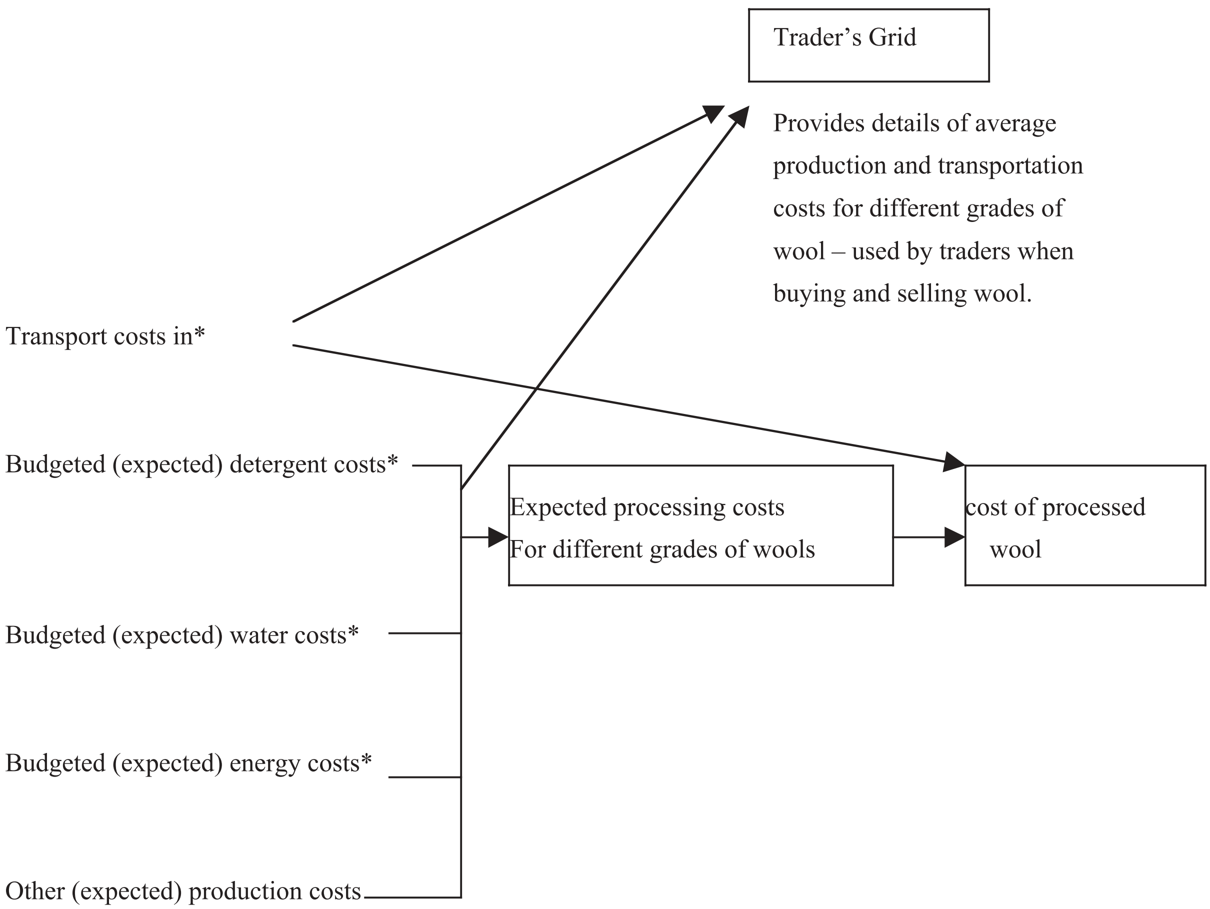
> the common practice of pooling overhead costs can conceal and distort critical information on environmental and other costs.

In Michell, electricity, water and detergent costs are accumulated in an account that specifically relates to the carbonising process. These costs are then allocated to the different classes of wool as they are being processed. Hence, Michell does not accumulate such costs in an overhead account as is often the case elsewhere. However, there are still issues to resolve in terms of how the costs are subsequently allocated to the various classes of wool being processed. If different classes of wool use approximately the same resources to process then a fairly arbitrary basis of allocation can be used with little need for further refinement. For example, allocation on the basis of kilograms of wool entering processing could be appropriate. Indeed, this was the basis of assigning detergent, water and electricity costs to the various classes of wool. Implicitly, this assumes that all types of wool, regardless of the associated foreign matter included therein, require the same amount of detergent, water and electricity to process. Of course, this sounds unrealistic, but whether the costs associated with refining the costing data would provide benefits (the usual *costs versus benefits* test used by economists and accountants) in terms of influencing purchasing and processing decisions is not something that was initially clear.

In relation to transportation costs, our investigation showed that these costs are also added to the cost of the processed wool. However, these costs per truck delivery (averaging $2,000 per truck – Michell does not own the delivery trucks) are simply allocated on the basis of bales such that all wool types receive the same allocation for transportation costs.

Figure 2 below provides a simple diagrammatic representation of how costs associated with energy, water, detergent and transportation costs are allocated to processed wool costs.

Figure 2: Existing process for allocating costs to wools processed in the carbonising plant



* *costs are allocated on a 'per bale' or kilogram of input basis with all wool grades being allocated equivalent costs. The costs are predetermined on the basis of expectations about the costs to be incurred and on the basis of expected production levels (that is, by way of a standard cost). These expected processing costs are communicated to traders who use the information in determining prices to pay for wool (traders also consider future sales prices when making a decision to buy wool – many of which are 'locked-in' via forward sales contracts). Any differences between expected processing and transportation costs and actual processing and transportation costs (cost variances) are transferred to the production costs of wool on a periodic basis. Standard costs are revised regularly, although the basis of allocation is static.*

5.5 A major accounting issue – was the existing basis of allocation appropriate?

At the present time many costs are assigned to the products on a kilogram of input basis which does tend to ignore the fact that particular wool types require more processing and hence more energy, water, detergent, and acid than others (for example, a kilogram of inputted product will generate a different amounts of 'final' wool depending upon amount of vegetable matter and so forth). Preliminary estimates indicated that if we focus on actual water, detergents, and energy requirements, then costs are different depending upon the input type (class of wool) and these cost differences, if made part of the costing to be considered by the traders, could impact traders' decisions. Further, it appeared that wool grease recovery is more effective and cost efficient from the higher quality wool inputs, further impacting relative differences in product returns.

As noted earlier, 'transport costs in' are added to the cost of the processed wool. However, allocating the delivery costs on the basis of bales being delivered ignores the fact that some bales are 75% useable wool by volume, some is only 50 % by volume, and so forth (again, this information is reflected in the wool grades as initially acquired by the traders). If transport costs (which also have environmental implications) are allocated in terms of the expected yield of the unprocessed wool (rather than simply on bales of input), then this will further affect traders' acquisition decisions (again, one must always keep in mind the low margins on wool). What is being emphasised here, is that many costs (including energy, water, detergent, transport) are being allocated effectively on a basis which bears little relationship to what wool is ultimately being recovered from each bale – if these costs are recalculated to reflect recovery rates then projected margins will probably change with consequent implications for trading decisions.

5.6 Review the physical flows of the resources being used within the processing activity

As can be seen from the above brief discussion, the perceived limitations relate to how certain costs are allocated to classes of wool in determining likely profit margins. It is argued that the costs would be more correctly estimated if a revised measure based on proportion of final product (wool) per bale was considered. This is a pretty simple thing to do. The calculations would be based on sample runs that are used with particular lines of wool types, and average costs per wool type would be determined. A process of material tracking (which in many respects is a necessary precursor to any form of activity based costing) will be used.[7]

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[7] These processing runs when monitored would provide average resource consumption data and would form the basis of subsequent costing revisions. These runs would have to be measured periodically to determine that the physical flows remained relatively unchanged. Within Michell these runs do happen to be constantly checked as to their use of resources, but in the past this has tended to be in relation to environmental and production efficiency decisions, rather than for product costing purposes. This is

The implications of the existing system of cost allocations are, basically, that 'dirty' wool inputs are being subsidised by 'clean' wool inputs with the possibility that some wools which are really generating low (perhaps negative?) returns are being acquired when they ought not to be (unless of course the traders could acquire the wool at reduced costs which compensate for the additional processing costs). That is, no allowance is being made for the different yields of the wools being processed and the fact that the 'dirtier' wool needs more processing. Changes in acquisition decisions will have implications for energy, water, detergent, and transportation use. If we are satisfied that the revised costs are likely to make a material difference, then this will directly influence the wool traders' decisions (as already indicated, they use what is referred to as a 'Grid' which summarises production costs and which they use when assessing what wools to acquire and at what price).

Revising costs to take into account the improved estimates of the actual (physical) use of resources could also mean that product prices could be reduced for the 'cleaner' wools, yet the same margin could be maintained. This would have potential social benefits. However, it should be appreciated that in various commodity markets, including the wool market, supply and demand typically determines prices such that traders and processors are often price takers, rather than 'price makers'. Indeed, market conditions might be such that prices achieved at different times for processed wools might be less that costs incurred – although clearly, this would hopefully be a short term phenomenon. Prices for processed wools can move in different directions to the costs incurred to acquire wools for processing.[8] Hence, it is not necessarily the case that changes in internal costings in a commodity market such as wool will necessarily lead to a change in the prices of processed products. For example, a reduction in processing costs will not necessarily lead to a reduction in the sales price of the wool.

In the process of trying to allocate resource costs to products, and as indicated previously, some form of 'tracking' is required. The process of material tracking (also referred to as 'process flow mapping' – Bennett *et al*, 1996) has been defined by US EPA, (2000, p. 14) as:

> An assessment of what, where, why, and how much material is used, incorporated into products and co products, and channelled into waste streams. The initial analyses are often limited to the largest or most regulated material

probably reflective of many organisations, where production people tend not to 'talk' to the accountants, and *vice versa*.

[8] As a case in point, in 2002 there was a general increase in the costs associated with acquiring wools of various classes from wool growers. At this same time, the prices of processed wools was falling, particularly in overseas markets.

steams because these are most likely to generate the highest costs. Regardless of the scale of the analysis, the result is a better understanding of material flows through the facility.

To undertake the process of material tracking requires a significant amount of time. The process necessarily involves the participation of people who are experts within the processing activity. A diagrammatic depiction of the materials flows was produced.[9] This is based on Figure 1, provided earlier.[10] Subsequent to this, a diagrammatic depiction of the accounting process pertaining to the processing activity was also prepared. This is simplistically summarised in Figure 2. The two diagrams were compared and a review was undertaken to see if they really appeared to be describing the same underlying process. Clearly, the way the accounting system allocated the costs, on the assumption that each bale used the same amount of resources to process, was not terribly realistic. At issue was: *Does the current accounting system make sense when compared to the underlying process to which it relates*? This is a VERY central point to this whole exercise. Is the difference between the accounting system and the actual use of resources significant enough to warrant a revision of the accounting system? Would more 'realistic' costs alter any of the production decisions being made by the organisation?

In doing the analysis it became apparent that greater amounts of water, detergent and electricity went into processing 'dirtier' lines of wool, yet costs were being allocated on a per bale or per kilogram of input basis. Whilst the difference in allocated costs (being the difference in the amount allocated on the basis of weight, versus the cost allocation on the basis of yield) was only small in some cases, given the low margins on wool, this was appearing to be a significant finding.[11] Further cost adjustments to take account of revised transport cost allocations based on yield made the cost differences even more significant.[12]

Subsequent discussions also revealed that there were other costs that could be reassigned to the wools on a basis which reflected the expected yields of the wools being introduced into the processing. There are costs associated with storing and insuring potentially hazardous chemicals (for example, acids and detergents). Arguably, the wool-types which use more chemicals (the 'dirtier' wools with lower yields) should bear more of

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[9] As already noted, the staff at Michell were already aware of these flows. The flows are regularly monitored.

[10] We have elected not to provide detailed information about the actual water, energy, and detergent usage for different grades of wool because of the competitive nature of this information.

[11] The difference between allocated costs based on the 'old' approach as opposed to the 'new' approach (based on yield) was typically les than 10 per cent across the various wool types.

[12] Again, across the various wool types, the cost revision was typically less than 10 per cent – but as already mentioned, given the relatively low mark-ups on processed wools, these findings were quite significant.

these costs. Currently they do not, and these costs are being allocated to wools being processed within the carbonising process on the basis of bales going into the process. Allocating the storage costs on the basis of expected yields further changed the costing mix between the cleaner and dirtier (higher and lower yield) wools, with the dirtier wools receiving a greater allocation under the 'new' approach.[13] Also, the releases to water systems could be reduced if cleaner grades of wool were acquired, thereby relaxing load constraints, and associated risks, associated with discharges. Whilst similar arguments could be made for labour and purchase order costs, at this stage these costs (which were not directly deemed to be 'environmental costs') were not factored into the calculations.

As a further issue, it appeared that wool-grease recovery (and wool grease is a saleable product, as mentioned previously) was more efficient from the higher quality grades of wool. Working this out with any precision would be a costly exercise and was beyond the scope of this project. Nevertheless, this was another factor which, if accounted for, would potentially make the costs of processing higher grade (higher yield) wools relatively lower.

In summary, the data we collected showed that the differences in the costs we had considered were significant enough to warrant a revision of the accounting system. In the absence of undertaking a materials flow analysis, in conjunction with a review of the existing accounting system, this would not have been apparent. This emphasised the value in undertaking a materials flow analysis.

5.7 Suggested changes to accounting system

With the above information in mind it was decided to recalculate costing data on a basis that takes into account the differences in the yield qualities of wool that enters the carbonising process. It was considered that allocating costs on the basis of expected yields more appropriately matches the actual use of resources than the existing method of allocation based on kilograms or bales of wool placed into the processing activity.[14] As already indicated, wools are classified into various classes that take account of such

[13] Consistent with the previous cost recalculations, in percentage terms the change in cost is fairly modest when considered in isolation (typically not expected to be more than 5 per cent across the different wool types).

[14] As a very simple example of how the allocation of costs on the basis of yields can be done, assume that a bale of a certain grade of wool is expected to yield 90 percent wool, whilst a bale of another grade of wool is expected to yield 70 per cent (due to a relatively higher amount of foreign matter in the bale). Assume that these bales are the only ones being processed and that the total energy cost is $100. If we take the sum of the inverse of the yields (1/0.9 + 1/0.7), this equals 1.42857 + 1.11111, or 2.53968. The amount to be allocated to the higher yielding wool would be $100 x 1.11111/2.53968 which equals $43.75, and the amount allocated to the lower yielding wool would be $100 x 1.42857/2.53968, which equals $56.25. This can be contrasted with a system which would allocated equal amounts ($50.00) to each bale. There would also be other mathematical approaches to allocating costs on the basis of expected yields.

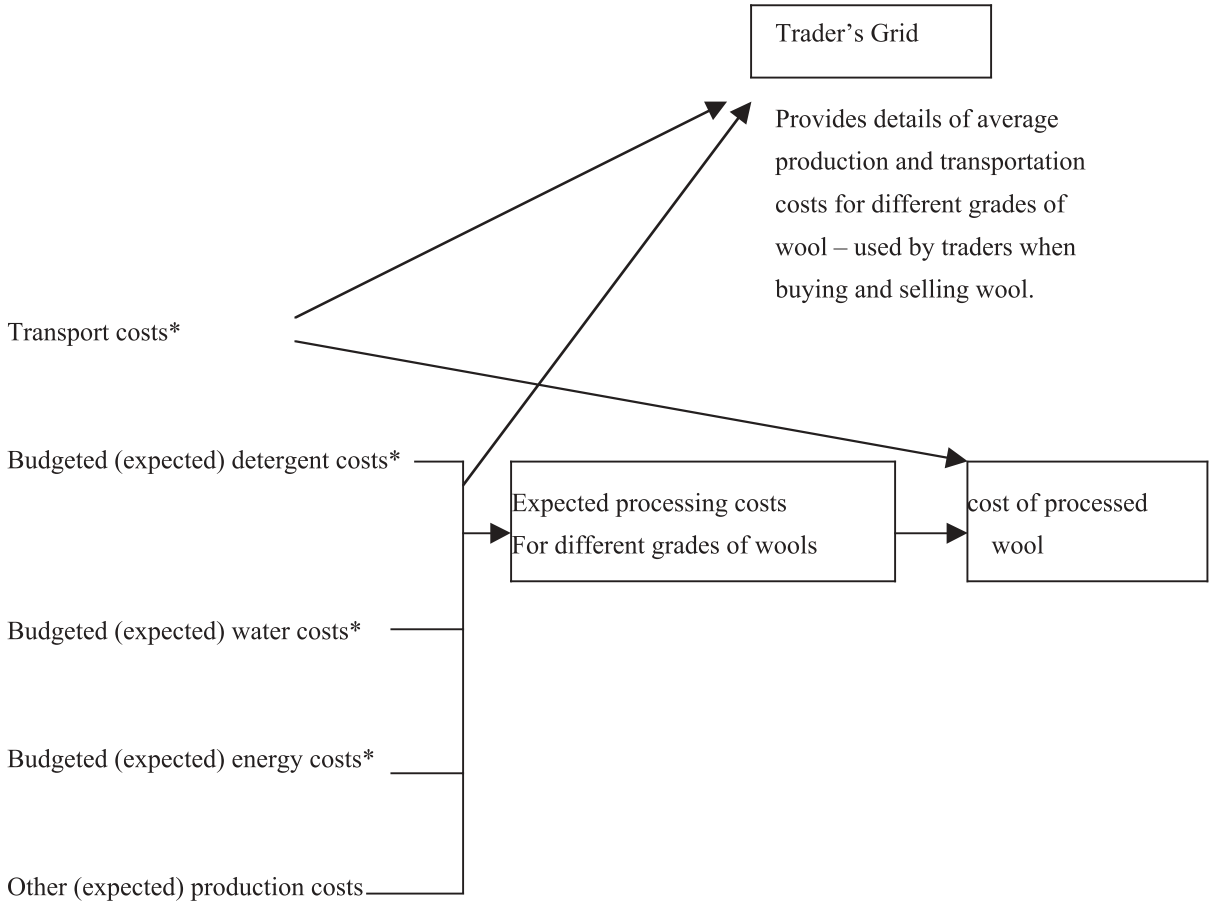
things as the amount of foreign matter included in the wool. Again, it was believed that assigning electricity, water and detergent costs on the basis of expected yield would provide a more realistic perspective of the actual resource usage (meaning that higher yield wools had less foreign matter and thereby required less processing). It was also decided that it would be more appropriate to allocate ‘transport costs in’ on the basis of expected yield.

The results of the above exercises changed the calculated average production costs of the various wool types. The change in allocated processing costs for particular wool types depended upon the estimated yield, and as would now be appreciated, the lower (higher) yielding wools would be allocated higher (lower) costs, relative to the previous system which did not consider the different yields. The cost changes for the different wool types was typically less than 10 per cent, yet with the traditionally low mark-ups for wool, such changes could be expected to impact buying decisions. The revised calculations can be transferred to the information provided to wool-buyers who can then use the information when deciding what wool-types to acquire. The implication is that unless there are downward movements in prices for some wool types, then the organisation might subsequently elect to only buy ‘cleaner’ wool with subsequent implications for the resources to be used in the processing activities.

What should be appreciated is that all the information for the revised costing data was already available within the organisation. For environmental control reasons, staff were already aware of the process flows – what was needed was to align, in some respects, the accounting system with the physical system. The costing revisions are not controversial from an accounting perspective. For example, no notional costs are calculated for externalities caused, such as the emission of ozone depleting substances, releases to water, and so on. The required data was already being captured by the existing systems – it just was not be used for accounting purposes.

The revised accounting system is diagrammatically illustrated in Figure 3 below. What should be appreciated is that this diagram is very similar to Figure 2, previously provided. The only difference between the ‘old’ and ‘new’ costing systems is the basis of the allocation.

Figure 3: Revised accounting system for allocating costs to process wool



* *costs are allocated to classes of wool on the basis of expected yields for the wool. They are predetermined on the basis of expectations about the costs to be incurred and on the basis of expected production levels (that is, by way of a standard cost with each grade of wool having its own standard). These expected processing costs are communicated to traders who use the information in determining prices to pay for wool. Any differences between expected processing and transportation costs and actual processing and transportation costs (cost variances) are transferred to the production costs of wool on a periodic basis.*

6. Transferability of project insights

Many industries, particularly operating within the agricultural and mining sector, would be involved in processing inputs which generate variations in final product yields. That is, whilst the inputs might be treated from an accounting perspective as being homogeneous, from a physical perspective, this might not be the case. The results of this project will have direct relevance to such industries particularly to the extent that they allocate processing costs on the basis of volume or weight of inputs, rather than expected yields. It is possible that there are many processing plants throughout Australia wherein the accounting system in place shows limited resemblance to the physical flows of resources.

The arguments regarding transportation costs would also, arguably, have relevance to a number of organisations. If transport costs are more precisely allocated on the basis of expected yields of the transported raw materials then it is possible that some raw materials might, on recalculation, not be considered to be profitable and therefore not be acquired and processed. In the case of wool, a deal of the transportation costs actually related to bringing in materials which were not actually wanted (vegetable matter and so forth). The lower the amount of the unwanted waste, the lower the transportation costs. Reduced use of transportation has obvious environmental implications.

7. Other relevant threats and opportunities

7.1 Creating compost from the wastes of the processing activity

Michell is currently paying $15 per tonne to have dirt/sludge from wool processing removed from its Adelaide site. Sixty tonnes of this type of 'waste' is generated each day (a daily cost of $900 to have it removed, which obviously does not include the resource costs that contribute to the sludge, which is 45% water). The sludge is removed for the purposes of creating compost, the majority of which will be used by vineyards in the Adelaide area. The ultimate use of this compost will have positive environmental effects as evidence shows that vineyards that use the compost save significant amounts on both chemicals and water – real environmental benefits which are not captured within the accounts of Michell, but by others (for example, by the vineyards). That is, there are *positive externalities* which given current accounting systems (within Michell and elsewhere) are not brought to account. This is an interesting issue, but one that is not further pursued here other than to highlight that just as conventional accounting systems ignore *negative externalities* generated by an entity, they also tend to ignore *positive externalities.*

Because of the process used within the carbonising activity, the sludge that initially comes from the process needs to be neutralised. Whilst the entity would neutralise the sludge in any case (thereby making it suitable to the external entity that produces the compost), the costs associated with neutralising the sludge and then paying the external entity $15 per tonne (to remove the sludge) are less that the costs that would be associated with having the un-neutralised sludge removed. Of course, there are also positive reputational effects (which of course are difficult to measure in financial terms) associated with reducing waste releases and of being associated with the composting process.[15]

Another issue that arose in relation to the composting is whether management of the process could be enhanced by placing a 'cost' on the 'sludge' that was being generated. Obviously, as with all waste, there is an associated cost. The sludge is made up of raw material that was transported into the entity within the wool bales. The transportation of the various wastes included within the wool obviously contributed to the transportation costs. The sludge also comprises certain chemicals, water and so forth, all of which are acquired at cost.[16] Removing the sludge as part of the carbonising process also requires energy. However, these costs are treated as part of the cost of the wool processing and as such are measured and monitored. The sludge itself is not actually costed. What is occurring is that various wastes are being removed and these wastes together constitute the 'sludge'.

It is considered that this 'sludge' is not something that can be avoided as a result of processing wool – all wool has vegetable matter, salts, and so forth that has to be removed.[17] What is relevant are the incremental costs associated with further processing the sludge. These costs, pertaining to the neutralisation process have been determined and it has been shown that the neutralising costs, plus the costs paid to the external composting organisation are less than the costs that would be incurred by the company if they were to try and dispose of the unneutralised sludge to places, such as to landfill.

Consideration was given to creating the compost in house, but at this stage the payback period associated with setting up the required infrastructure is deemed to be too long. The payback period analysis took into account the costs of designing and constructing the

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[15] There are many potential benefits associated with appearing to do the 'right thing' for the environment. For example, it is often assumed that organisations with good social and environmental performance profiles are likely to attract the better employees. Whilst this is interesting, we do not pursue the identification of such benefits in this report – but nevertheless, these 'other benefits' are something that organisations should consider when contemplating particular social and environmental initiatives, such as the implementation of an environmental management accounting system..

[16] As already noted, the water is recycled a number of times, such that final waste water has been through the process a number of times. Whilst some water remains in the sludge, other water is released to sewer as waste. The total use of water is closely monitored.

[17] This can perhaps be contrasted with a situation where raw materials, that are all potentially useable, are wasted as a process of producing a particular product. For example, where only 90 per cent of a metal panel is used to make a particular product. The 10 per cent that is not used (perhaps an off-cut) is no different to the balance of the material that is used. An increase in the efficiency of the production approach could lead to a reduction in this waste. However, in processing particular wools, increases in efficiency will not lead to a reduction in the amounts of dirts, vegetable matter and other wastes that are produced as these need to be removed from the wool. Buying different grades of wool is the main way of reducing the amount of foreign matter acquired with the wool. Because of the capital intensive nature of the processes, it is not feasible to consider removing the foreign matter at the point of acquisition of the wool.

necessary infrastructure to create the compost. It also took into account (via discounted cash flow analysis) the expected revenues associated with selling the compost, and the costs associated with processing the sludge and thereafter selling the compost. Because of the confidential and competitive nature of the potential composting process, we are unable to provide costing data associated with the composting process. If the price for compost increases then it has been indicated that this project is something that might be revisited in future periods.

7.2 European Eco-Labelling Scheme:

As already noted in this report, *externalities* generated by an organisation are often recognised as expenses by other entities. For example, releases to water may require other organisations to treat the water before they can in turn use it, or government or health funds might have to pay for environment related health costs. It has been argued that unless the costs of externalities are somehow *internalised*, then some managers in some organisations might have limited incentive to change their behaviour. From an accounting perspective, unless direct costs are imposed upon an organisation (perhaps in the form of taxes, levies or fines), then any social and environmental 'costs' associated with an organisation's operations will not have a direct impact upon reported profits.[18] This is seen, by many people, as being a fundamental flaw of accounting.[19]

Across time, the cost of more 'externalities' will be internalised by organisations, perhaps as a result of regulatory intervention. For example, the relatively recent introduction of environmental taxes and tradeable pollution permits within some countries acts to internalise some environmental costs which might not have otherwise been recognised[20]. Once internalised, the associated costs will have a direct result of reducing reported

[18] This is due to the way in which traditional financial accounting recognises assets. For an asset to be recognised by an organisation it is a requirement that the resource be 'controlled' by the reporting entity (see Statement of Accounting Concept No. 4, paragraph 14). *Control* mean that the entity has the ability to benefit from the asset and also the ability to deny or regulate the access of others to the asset. Because organisations do not 'control' resources such as air, waterways and so forth, they cannot be considered to be the assets of the reporting entity. That is, their existence is not recognised for accounting purposes. As a result, the resources' use (or abuse) is not recognised by the entity as an expense. As Deegan (1996) suggests, and using a rather extreme example, imagine that an entity destroys the quality of water in its local environment, thereby killing all local sea creatures and coastal vegetation. Under traditional financial accounting, if the entity incurs no fines or other related cash flows as a result of its actions, the externalities would not be recognised for accounting purposes. Conventional profit measures could show such an organisation to be operating very 'successfully', despite the damage it is doing to the environment.

[19] In 1992, the European Union released a document entitled *Towards Sustainability* as part of its Fifth Action Programme. The EU called for a redefinition of accounting concepts, rules, and conventions and methodologies so as to ensure that the consumption and use of environmental resources are accounted for as part of the full cost of production and reflected in market prices (European Commission, 1992, Vol. II, Section 7.4, p. 67) The accounting profession has not acted upon such suggestions.

[20] There is much debate about how these 'costs' should be priced and whether environmental taxes and tradeable pollution permits are the appropriate mechanisms to reduce such effects as ozone layer depletion.

profits. Also, when goods are produced the consumer will generally have to dispose of them at the end of their useful life – that is, the ultimate disposal costs are typically ignored by the producer (they are an externality) and are borne by the consumer. However, in some countries, this is changing. For example, Germany requires many industries to take responsibility for the disposal of the packaging of their products which has led to some good recycling innovations as producers attempt to reduce the associated costs. This trend towards internalising 'societal costs' will, most probably, continue.

Another approach government (and perhaps industry) can take to regulate the use of particular resources, or to minimise the releases of particular substances, is to directly prohibit the use of particular materials within processing operations. Governments can typically only prohibit particular practices of companies operating within their own borders. One way to influence production processes of foreign entities is to place forms of restrictions on what goods the country is prepared to accept. Whilst not directly forcing an entity to undertake particular production practices, the foreign entity would know that to enter a particular market then revisions to production processes could be required. In this regard, and of direct relevance to Michell and other Australian manufacturers exporting produce to Europe is the recently formulated Eco-Labelling Scheme operating in Europe. Details of the European eco-label can be found at http://europa.eu.int/comm/environment/ecolabel/. According to the European eco-label website, the eco-label is supported by the European Commission and by all the Member States of the European Union and the European Economic Area. To signify that the standards of the eco-label have been achieved, a logo, the *European flower*, appears on the products covered by the scheme. The eco-label website discusses the objectives of the process, and these are described as follows:

> The EU Eco-label has a clear objective of encouraging business to market greener products. Part of our mission is to provide the producers with the necessary information to reap the advantages of this strategy. For the consumers, there is no better way to make informed environmental choices when purchasing …. Being a market-based instrument, the primary function of the EU Eco-label is to stimulate both the supply and demand of products with a reduced environmental impact. With respect to supply, the EU Eco-label has a clear objective of encouraging businesses to market greener, officially licensed products …. The scheme is NOT establishing ecological standards which all manufacturers must meet. It is for the producer, retailer or service provider to decide whether or not to apply once the criteria are published in the Official Journal. Given the underlying rationale of the scheme to provide incentives for green manufacturers and public purchasers, the success of the scheme will offer

a considerable pull effect for retailers, SMEs and manufacturers to better promote and market their products and contribute to the European IPP.

The eco-labelling scheme is voluntary and organisations that do not meet the standard are not prohibited from trading within Europe – although it will become increasingly difficult to attain market acceptance. Foreign producers are permitted to apply for the logo if they meet the criteria and want to market their products in the EU/EEA. They can still attempt to sell their products within the EU/EEA markets without the 'flower'.

There are specific requirements for the textiles industry, as there are for producers within other industries. The eco-label requirements state that to receive the EU Eco-label, textile producers must meet various ecological and performance criteria, including limitations pertaining to specific toxic residues in fibres; reductions in air pollution generated throughout the production process; and, reductions in water pollutants generated by the production process. Of some relevance to Michell are the restrictions pertaining to the use of chlorines and particular chemicals that often are included within detergents.[21]

Hence, whilst the Environmental Management Accounting Project is focussed towards finding cost effective ways to reduce the use of particular materials, external 'shocks' might be imposed which require us to cease using particular materials if we want to maintain a presence in particular markets. Management needs to be vigilant and be able to anticipate such changes. Whilst this project has not considered *opportunity costs* (which can be basically defined as losses in earnings that result from a particular decision), management seeking to maintain a position in markets that restrict or ban the inflow of goods that use particular processes or inputs must consider the lost revenues (and related expenses) that would result from either withdrawing from the market, or that would result from staying in the market as a result of modifying production processes.

Management needs to stay ahead of initiatives such as the Eco-Label. This may actually involve more costly (but more environmentally-sensitive) processes being put in place prior to any restrictions being imposed. However, 'staying ahead' provides obvious advantages when best practice requirements, such as those required pursuant to Eco-labelling, are introduced. Such initiatives as the Eco-Label will continue to provide both threats and opportunities for Australian businesses. Organisations that do not stay ahead of such developments are subjected to greater business risks and this should have direct implications for how an organisation is valued in the market place. Public knowledge about losses of market position will have direct implications for the value of an organisation's equity (shares). Further, failure to keep abreast of current developments

[21] One product which Michell sells is *Superwash* wool (anti-shrink wool). The process used to make Superwash wool relies upon the use of chlorine.

overseas can have implications for the valuation of the organisation's assets. For example, equipment that relies upon processes that do not comply with particular requirements could conceivably have to be written down as a result of reassessments of associated cash flows. Reduced demand can also act to reduce the value of existing inventories. The valuation of goodwill associated with the business (purchased goodwill is an intangible asset that appears as a non-current asset in an entity's statement of financial performance) would also conceivably be negatively impacted by the inability of an organisation to trade within particular markets. Other intangible assets, such as brand-names could also be adversely affected. This discussion emphasises that social and environmental developments, such as the introduction of an eco-labelling scheme, can have implications for the accounting valuations associated with a reporting entity. Organisations wishing to maintain asset values need to keep abreast of changing environmental expectations and requirements.

8. Lessons learned, skills required, and concluding comments

A key lesson learned in the process is that it cannot be assumed that accounting systems necessarily reflect the actual use or flow of resources. Accountants often make simplifying assumptions that in turn can have the result of obscuring the fact that some products use more resources than others. This might only come to light when a materials flow analysis is undertaken and then used as a basis for comparison with how the accountant costs the same process. As costs of resources change across time, the potential impact of any simplifying accounting assumptions may become even more significant. Another lesson to be learned is that unless a comparison of the accounting system and the physical flow of material is specifically placed on the agenda then it is an issue that perhaps is unlikely to attract attention. Those people who study the physical flow of resources within an organisation, and those people who account for those flows are typically different parties, and it is not to be assumed that these parties necessarily communicate at regular intervals.

Another lesson to be learned was that organisations might already have the available information to enable a revision of the accounting system – hence an exercise such as the one described in this report does not necessarily involve a great deal of investigation or cost.

In undertaking this case study a mix of skills were required which in turn necessitated the inclusion of a number of people in the case study team. There was a need for somebody who could understand the overall reason for undertaking the analysis – somebody that had insights into the possible limitations of accounting and understood how it would be possible to refine existing accounting systems to make them more environmentally aware. There was a need to have somebody associated with senior management who could 'champion' the project. There was a need to have somebody who clearly understood the physical flow of resources throughout the process – which perhaps relies upon engineering and scientific knowledge. There was also a need to have somebody who understood the accounting system as it relates to the costing process. At Michell we were lucky enough to have a team that included people with this expertise. Without such skills, it would be very difficult to have undertaken the analysis.

Given the relative infancy of efforts to consider and address the environmental costs being generated by organisations, progress in the area is really about incremental improvements. As efforts progress in the area, a number of benefits should result, for example:

- Explicit consideration to particular costs which are often obscured in overhead accounts;
- An analysis of environmental costs might reveal opportunities, some of which might lead to revenues through recycling, or use of 'waste' in other activities;
- Given the infancy of environmental management accounting, explicit consideration, and associated publicity, might provide competitive advantage;
- Efforts to reduce environmental costs will have reputation implications;
- Will enable more informed pricing of products; and
- Will generate human benefits as a result of improved environmental performance.

As a final concluding comment, whilst we have spoken about environmental management accounting in this project, what we have really done is simply refine an existing management accounting system. We have looked at activities that are known to have an impact on particular 'environmental costs'. A similar process could be taken in respect of other priority areas. For example, similar reviews could be made in relation in relation to activities that are perceived to have recognisable health and safety implications.

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