Improving the Economic Decision-Making Capability and Viability of Chinese Wool Textile Mills

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1. Overview

Shifting international comparative advantage and changing textile trade arrangements have led to declining fortunes and severe adjustments in the United States and European textile industries and have focused attention on the Chinese textile sector. At the same time, the Chinese textile sector has not been immune from major upheavals and restructuring. In this paper the transition within the Chinese wool textile industry is investigated along with ways of improving the viability of Chinese mills and their ability to efficiently take advantage of emerging opportunities in world textile markets.

Wool textiles account for less than 10% of the Chinese textile industry (CNTIC, 2003). Nonetheless it is an industry with a long history and with a diverse group of industry participants reliant upon it. Labour and enterprise reforms have shrunk mill workforces, but these often large, labour intensive, enterprises can have a significant impact on local economies. Mills have also been established in some inland wool producing regions to lead efforts to develop an integrated wool industry. Nevertheless the bulk of wool inputs are imported, and as the Chinese industry is the largest wool textile industry in the world, the fortunes of overseas wool producers in countries such as Australia and New Zealand are also dependent on the ongoing viability of Chinese wool textile mills.

Official statistics from the Statistics Centre within the Textile Industry Bureau reveal the turbulent period Chinese wool textile mills have encountered over the last decade. Between 1997 and 2002, around 45% of state-owned mills, 30% of collective mills and 20% of joint-venture mills were incurring losses (NTIBSC, various years; CNTIC, 2003).

Restructuring in response to these losses saw the number of State owned mills fall by around a third over this period to 200 while the number of collective enterprises fell by 40% to 140 enterprises. Furthermore the level of annual investment in the wool textile industry rose markedly from Rmb0.5 billion in 1998 to Rmb2.5 billion in 2002 with two-thirds of this investment coming from self-generated capital. Although the official figures mask many of the nuances of the mill reform process, they reveal that enterprises have primarily had to generate their own sources of capital for investment in the restructuring process and at a time when substantial losses were being incurred. This has led to an industry with a diverse array of ownership and governance structures.

Section 2 of the paper first outlines three stages of transition for Chinese wool textile mills. Although mills are well advanced in the first two states of transition—ownership reforms and technological upgrading—they are still developing their analytic capacities, especially in respect of key economic decisions. With rapidly changing markets, technology, ownership and governance structures, the managers of wool textile mills throughout China are under mounting pressure to make decisions in a more rigorous way. Economic decisions can range from evaluating a new investment, to determining the relative merit of different product orders, to managing costs at a workshop or product level. Chinese mill managers are keen to develop the necessary analytic skills, but in an environment where many other short-term imperatives capture their attention, the tools must be readily adaptable, fit with their existing information systems and complement their current decision-making processes. A collaborative Sino-Australian research project has sought to address key mill decisions as outlined in Section 3 through a series of analyses and through the development of a model

known as *CAEGWOOL*.[1] Sections 4 and 5 briefly report on these analyses and the *CAEGWOOL* model.

2. Transition, restructuring and modernization

The underlying pressures confronting the Chinese wool textile sector have forced wool textile mills to undergo a series of fundamental changes. Brown *et al.* (2005a) highlight that these pressures and changes are also occurring within many other industries in China. They break industry transition in China into three phases. In the first phase of industry transition, ownership and governance structures have undergone fundamental changes with a much more diverse set of structures compared with the central planning and early reform era. In the second phase of transition, the restructured enterprises have embarked on a process of upgrading their equipment and technology in an attempt to maintain international competitiveness. In the third phase of transition, enterprises embark on new operational procedures, management practices and decision-making processes.

The first two phases of industry transition have proved very challenging but are well underway within the Chinese wool textile industry. Asset Management Commissions and Companies have overseen the change in State-owned mills to shareholder or group enterprises. These changes are driven partly by the need to source non-State funds to invest in technology and facility upgrades and also to downsize mill labour, which is easier to

[1] Specifically the project involved collaboration between researchers from the China Agricultural Economics Group (CAEG) at the University of Queensland and from the Chinese Research Centre for the Rural Economy (RCRE). Various mills and Chinese wool textile industry organizations were also closely associated with the research. Further details of the project can be found at the CAEG website at http://www.nrsm.uq.edu.au/caeg

implement in the new ownership structures. Despite—or perhaps because of—the ownership reforms, many issues such as the lack of co-ordination within group structures as well as the lack of service provision to the new enterprises remain unresolved.

The second part of the transition focuses on new technology and equipment that potentially enables mills to process more efficiently, to create new products and to access higher value markets. However careful appraisal is needed to ensure that the technology matches the resources, skills and the market environment of the mill. In the highly dynamic environment in which Chinese wool textile mills and managers find themselves, due diligence can often be overlooked for fear of being left behind in the rush to modernize.

New structures, technology and facilities often require new skills and management practices. Furthermore the changing market and institutional environment demands a level of sophistication in mill decisions in areas such as product selection and input procurement, product pricing and service charges, investment appraisal, analysis of cost efficiencies, and proactive identification of new market and growth opportunities. It is in this third phase of industry transition that the Chinese wool textile industry is lagging. Managers at wool textile mills are actively seeking ways to improve practices and to adopt a more analytic approach to their decision making. However in the dynamic environment where attention and priorities are often turned elsewhere, efforts to promote this phase of the transition require approaches perceived to be of direct relevance and that build upon existing mill information sources and structures.

3. Key mill decisions

The multi-stage, multi-product nature of wool textile processing means that managers face a myriad of decisions in trying to successfully guide the operation of wool textile mills.

Figure 1 outlines some of the key economic decisions that mill managers face and seek guidance on.

Figure 1 around here

One of the most important sets of decisions relates to output pricing and the determination of the profitability of specific orders. Traditionally many Chinese wool textile mills "passively" produced customer orders, rather than actively promoting or selling particular products. Even within this passive mode of operation, however, key decisions need to be made about how to price the particular order or what service charges should apply. Where markets set the price, decisions have to be made about which orders to process necessitating detailed information about the relative profitability of particular orders.

Another important set of decisions relate to the choice of fibre or raw material inputs. That is, there are a number of ways to combine different wools and other fibres to produce particular wool textile outputs. Given that wool inputs can make up the majority all costs of producing wool fabrics, the selection of fibre inputs impacts significantly on the profitability of processing a particular order either through: (a) the direct costs of the fibre inputs (different wool types sell for different prices); (b) the impact on processing or transformation yields (yield losses as wool is transformed into wool textiles can vary according to the type of raw wool); or (c) the impact on unit costs of processing (some wool inputs may require additional processing, different machine settings, or interrupt production runs and involve higher labour costs).

The tight margins associated with many orders, as well as the multi-stage nature of wool textile processing, means that mill managers are also concerned with cost management. Although many mills keep substantial cost records, this cost information has been used in the

past predominantly for government reporting or tax purposes rather than for management purposes. Furthermore, while mills often have costs disaggregated by individual workshop and type of cost, they also need to allocate these workshop costs to individual products or orders. Mill processing may involve tens or even hundreds of orders in large mills in any one month, so workshop costs mask cost variations across products. Managers would like to know how these workshop costs can be allocated to specific products to assist them in their decisions on product and input selection, and product or order pricing. Apart from workshop costs, there are also general mill overheads that managers would like to be able to allocate to specific orders.

As mentioned, Chinese wool textile mills face enormous pressure to modernise their operations and upgrade their technology. New technologies and processing equipment involve substantial investment. Careful economic investigation is needed to ensure that the investments are both profitable and feasible. New technologies and equipment can influence processing costs, product types (and so returns) and the inputs required to process the product. Thus the investigation requires a model that can trace through the physical ramifications of the new technology and its impact on costs and returns.

The decisions highlighted in Figure 1 represent only some of the decisions that mill managers confront. Although managers will base these decisions on various criteria, readily available economic information tailored to their specific manufacturing systems, products and cost structures will greatly enhance these decisions and enable mills to navigate successfully the third phase of transition.

4. Improving viability from a whole-of-mill perspective

Many mill decisions are made on a partial basis, namely without regard to the consequences they may have elsewhere on the mill operations. The many stages or

workshops associated with wool textile processing along with the differing objectives of workshops and their managers heighten the problem. For instance, purchases of lower quality wool inputs by purchasing departments may be at the expense of higher costs elsewhere in the mill to process that wool. Thus the analysis of specific decisions must be made in the context of broader mill operations. In their collaborative research project to aid these mill decisions, the authors have adopted this whole-of-mill approach. As shown in Figure 2, a core mill model is supplemented by various supporting analyses.

Figure 2 around here

Allocation of workshop costs: One of the most pressing problems perceived by senior mill managers is how to allocate costs of manufacturing to particular product orders. Products incur different unit costs of processing because: the characteristics of the product affect the type and level of processing; the attributes of the wool input may also require different processing; or because each product may be associated with a unique yield or physical processing loss that, in turn, affects the amount of input that has to be processed and so per unit costs. Through anecdotal observations, managers are aware of broad product cost variations but have little basis for determining them in a more precise manner. During the planning era, fixed coefficients for particular product types were specified by the Ministry of Textile Industries and applied within the SOE mill network. However, these outdated coefficients were determined for a different set of products and processes. Some mills still use these old cost coefficients or alternatively allocate costs based on throughput alone leading to significant biases in cost or profit analysis and inaccurate and arbitrary pricing of orders. Approaches to estimating product specific cost coefficients are critiqued in Figure 3. Within the collaborative research project a statistical approach was developed that could be

tailored to and employed by individual mills. Specific details of the approach and its application to particular mills is reported in Brown *et al.* (2005b, Chapter 2).

Figure 3 around here

Analysis of yield losses: Wool processing is a demanding mechanical process that places great pressure on wool fibres at various stages of transformation resulting in breakages and short fibres, damaged fibres and neps that cannot be used in subsequent stages. These yield losses can have a large impact on wool textile mill profitability. Thus one of the major tasks for mill production managers is to try to minimize these yield losses through equipment settings and other procedures. However, yields also vary according to the type of wool being processed and the outputs produced. Thus the yield losses associated with particular product orders or wool types will be crucial to mill profitability. From the mill and workshop managers' perspective, the problem can be expressed as how to determine yields to apply to particular product orders or types. However the analysis can also reveal product transformation coefficients that can be employed in more general mill models to examine the cost and revenue implications of particular fibre input selections.

Analysis of wool and wool textile prices: An analysis of wool and wool textile prices figures prominently in any investigation of the viability and profitability of Chinese wool textile mills, either indirectly (by aiding understanding of the incentives of different participants in wool production, marketing and processing), or directly (by, for example, providing endogenous inputs into the core mill model). Thus the price analysis in the collaborative research project involved several dimensions as outlined in Figure 4 and reported in Brown *et al.* (2005b, Chapter 4). Specifically, the analysis of wool and wool

textile prices centred on three main areas: (a) the determination of the implicit price or value of the attributes that make up wool and wool textile products; (b) analysis of the extent of price integration across wool markets in space, time and form dimensions; and (c) identification of the extent of seasonal and between-year variation in wool and wool textile prices as well as the general trend in wool prices relative to other fibre prices.

Figure 4 around here

User characteristics and preferences: Apart from the specific empirical analyses referred to above, investigations aimed at improving mill viability need also to investigate the broader systems and environment in which mills operate. For instance, new technologies and processes will be of little benefit if they cannot deliver products that mill customers demand. Thus a whole-of-mill approach warrants investigation of the users of mill textile products in order to determine their characteristics and preferences. These users are typically not final consumers but suit, garment, sweater and other wool textile product makers. Understanding the derived demand and the preferences of this group of mill customers is crucial for the mills.

Wool supply chains: Wool input costs account for a large proportion of overall costs.[2] Thus a close investigation of the supply chains both for domestic wool and imported wool (which is the main input for worsted mills) is warranted when considering the overall viability of wool textile mills. In both cases the analysis involves identifying the supply chains and marketing channels that can minimize the costs of sourcing appropriate types and forms of wool from suppliers to mills, and cover aspects such as specification, timeliness,

[2] Raw wool fibre costs can be up to 80% of the total costs to produce wool tops and 50% of the costs to produce wool fabric.

availability and price differentials. Different issues arise in relation to the supply chains for domestic wool and imported wool. For domestic wool the fragmented and disaggregated nature of the supply chain and lack of marketing services entails difficulties for mills in identifying and sourcing wool in the form they require. For imported wool, chronic problems mostly associated with imperfect information have beset the smooth flow of wool from overseas wool producers to Chinese mills for a long time (Brown *et al.*, 2005a, Chapter 6).

5. Building economic decision making capability

To bring the different elements together, the CAEG team developed a model known as *CAEGWOOL* which is a *Visual Basic* model embedded in a Microsoft *Excel* Spreadsheet. *CAEGWOOL* is designed to assist decision making by mill managers and technicians in their managerial accounting and economic evaluation of a wide variety of mill decisions. The model has been developed by researchers from the China Agricultural Economics Group at the University of Queensland and the Chinese Research Centre for Rural Economy in close association with mill managers and technicians from various Chinese wool textile mills and organisations. Technical reports that include CDs with both Chinese and English versions of the model as well as manuals and supporting documentation can be found in Brown *et al.* (2005b) and Zhao *et al.* (2005). The core model draws upon the associated analyses reported in Section 4 above.

Figure 5 highlights key parameters and connections contained within this simulation and budgeting model. Even in this simplified presentation of the actual model, it is apparent that the intricate network of connections which contain many subsystems are not straightforward and so make it difficult for managers to accurately analyse decisions in the absence of a model.

Figure 5 around here

Figure 6 provides a simplified representation both from a user's perspective and from a model perspective of how CAEGWOOL inputs data, calculates values, reports findings and manages model runs. A key aspect of the data input is a dynamic interactive template that enables mill managers to enter the product design for the order by interactively and progressively working through the various manufacturing stages with a series of logical checks to avoid input errors. From this product design, the model endogeneously determines values for prices, product cost coefficients, and yield coefficients by drawing on some of the analyses reported in Section 4 above. These endogeneous values appear on subsequent input sheets as a guide for users but may also be overwritten. The product design is also used to format the remaining input sheets to ensure minimal and simplified data entry.

Figure 6 around here

Once the data is entered, the model performs a physical reconciliation of all product flows based on the product design and yield losses, and determines intermediate inputs, purchased inputs, final outputs and by-products. Based on these physical flows as well as the endogeneous or user-specified prices, fibre input costs and product sales revenues are estimated. Workshop and overhead costs are then allocated by the product cost coefficients. Intermediate prices which draw upon these costs are then estimated, as are value added revenues by each workshop. Value added and profit taxes are calculated from the estimated costs and revenues specific to these taxes.

Output from the model generates two sets of worksheets. The first set comprises physical reconciliation; profit statement; disaggregated costs; disaggregated revenues; and intermediate prices worksheets. The second set comprises detailed workshop sheets for each workshop specified in the model run. Thus the output is designed to provide both whole-of-mill information for general mill managers on a particular order or group of orders, and also a detailed physical flow and cost information to workshop managers to facilitate their efficient processing of these orders.

Once the calculations have been performed and outputs generated, the model is saved to a user specified file. Key model indicators (such as net profit) are also compared with other model runs to facilitate an analysis of alternative scenarios. Finally the model provides for various levels of input data modification from clearing input sheets for an entirely new scenario to retaining product design with adjustment of a few key parameters only.

6. Concluding remarks

Chinese wool textile mills and mill managers find themselves in a fast moving environment that poses exciting growth opportunities but also substantial challenges. Taking advantage of these opportunities requires not only suitable governance structures, facilities and technology but also the capacity to deal with increasingly complicated operational and economic decisions. The analyses and model briefly overviewed in this paper provide some sophisticated, yet readily useable, tools to do assist mill managers cope more efficiently with this third stage of industry transformation and hence improve their chances of remaining viable in the longer term.

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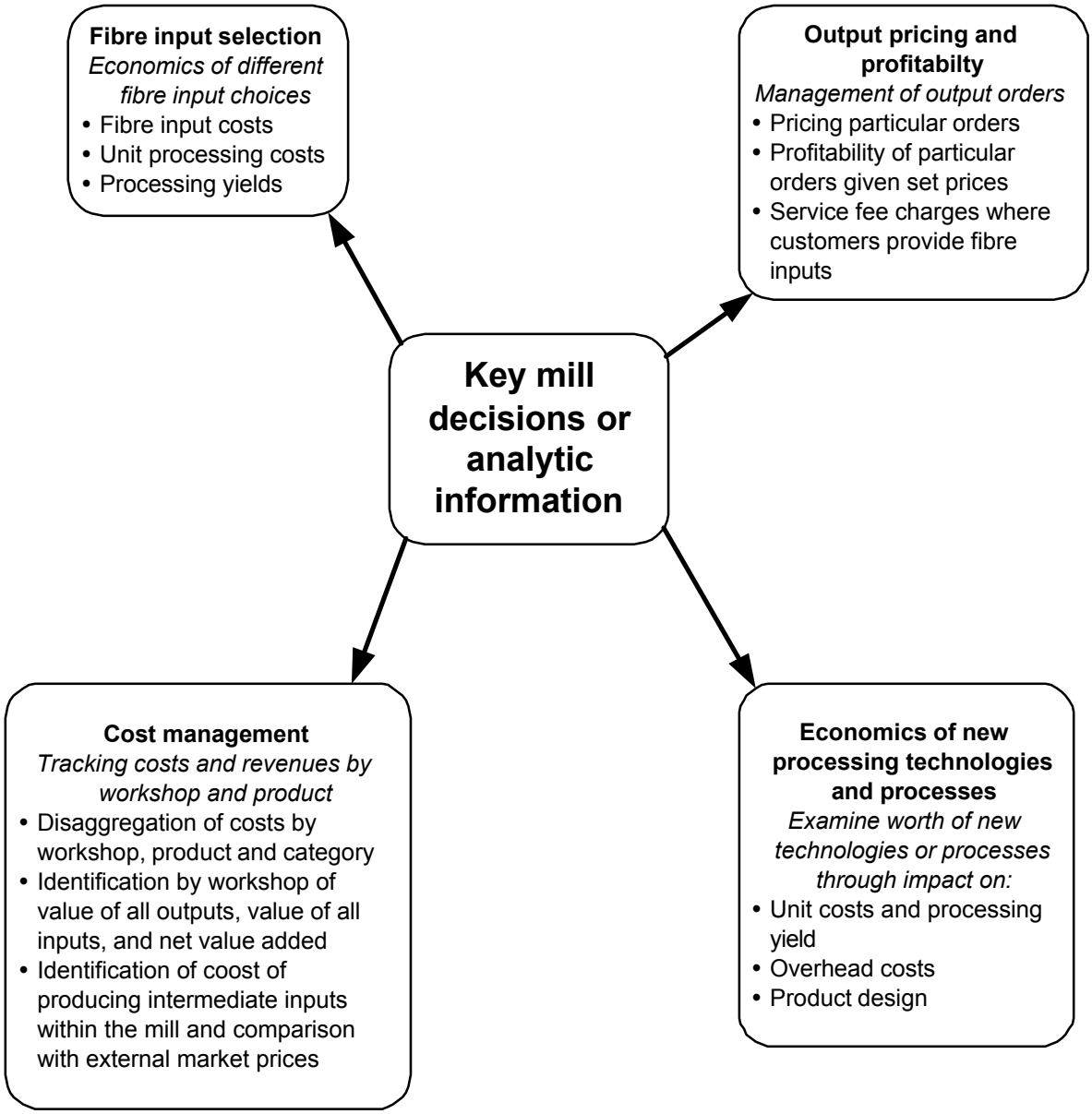

Figure 1 Key mill decisions

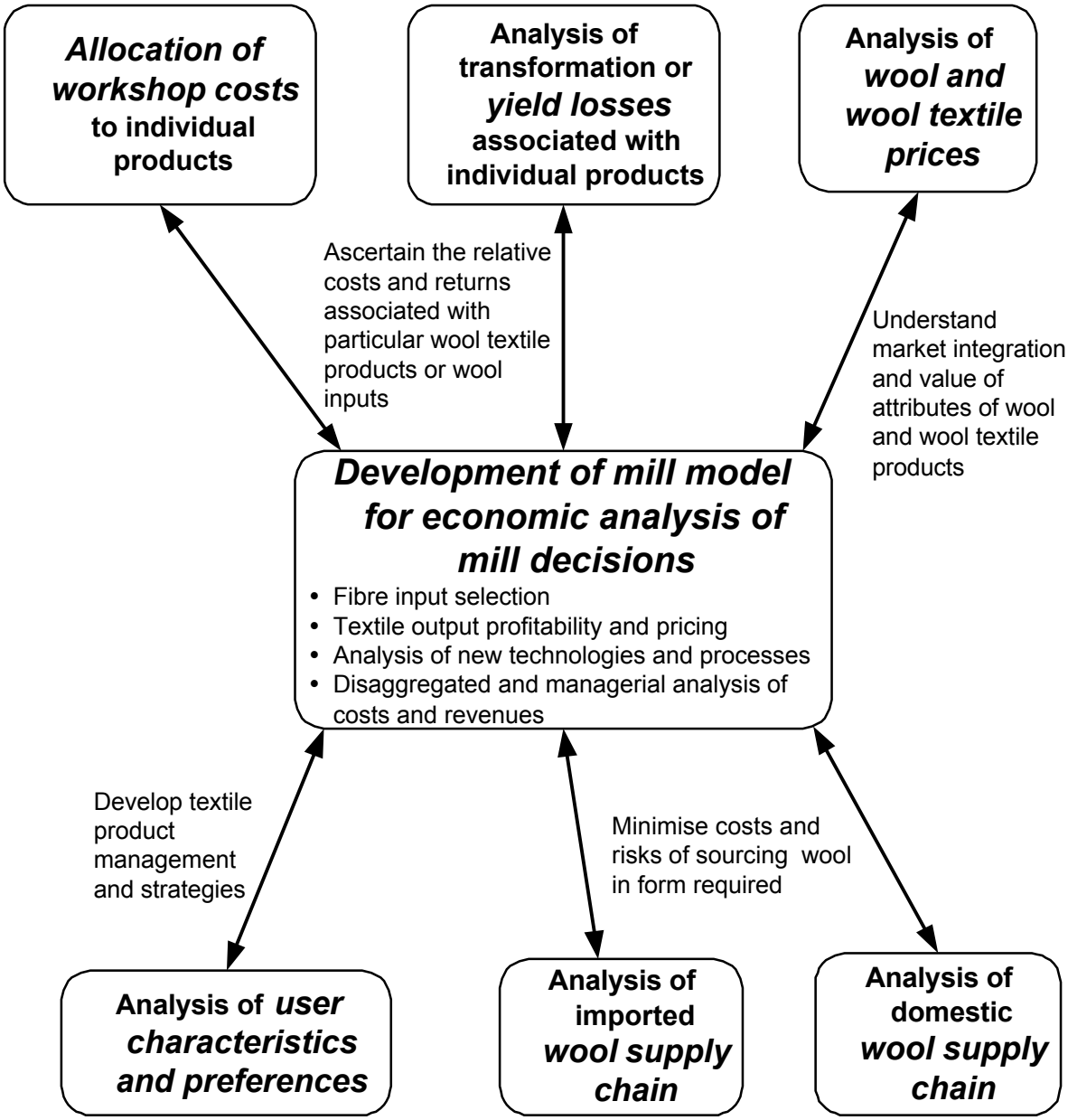

Figure 2 Whole-of-mill modeling approach

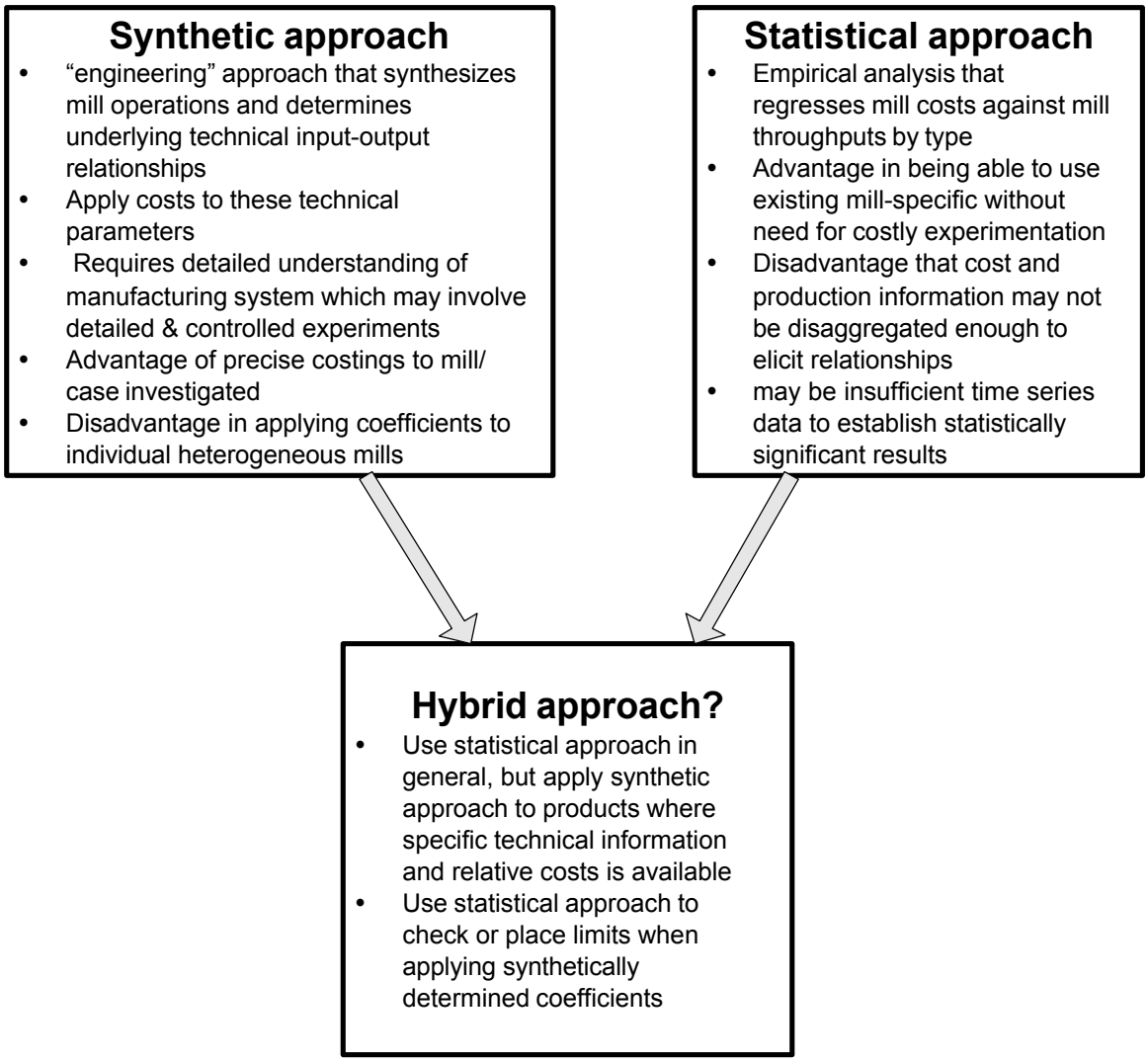

Figure 3 Approaches to estimating product cost coefficients

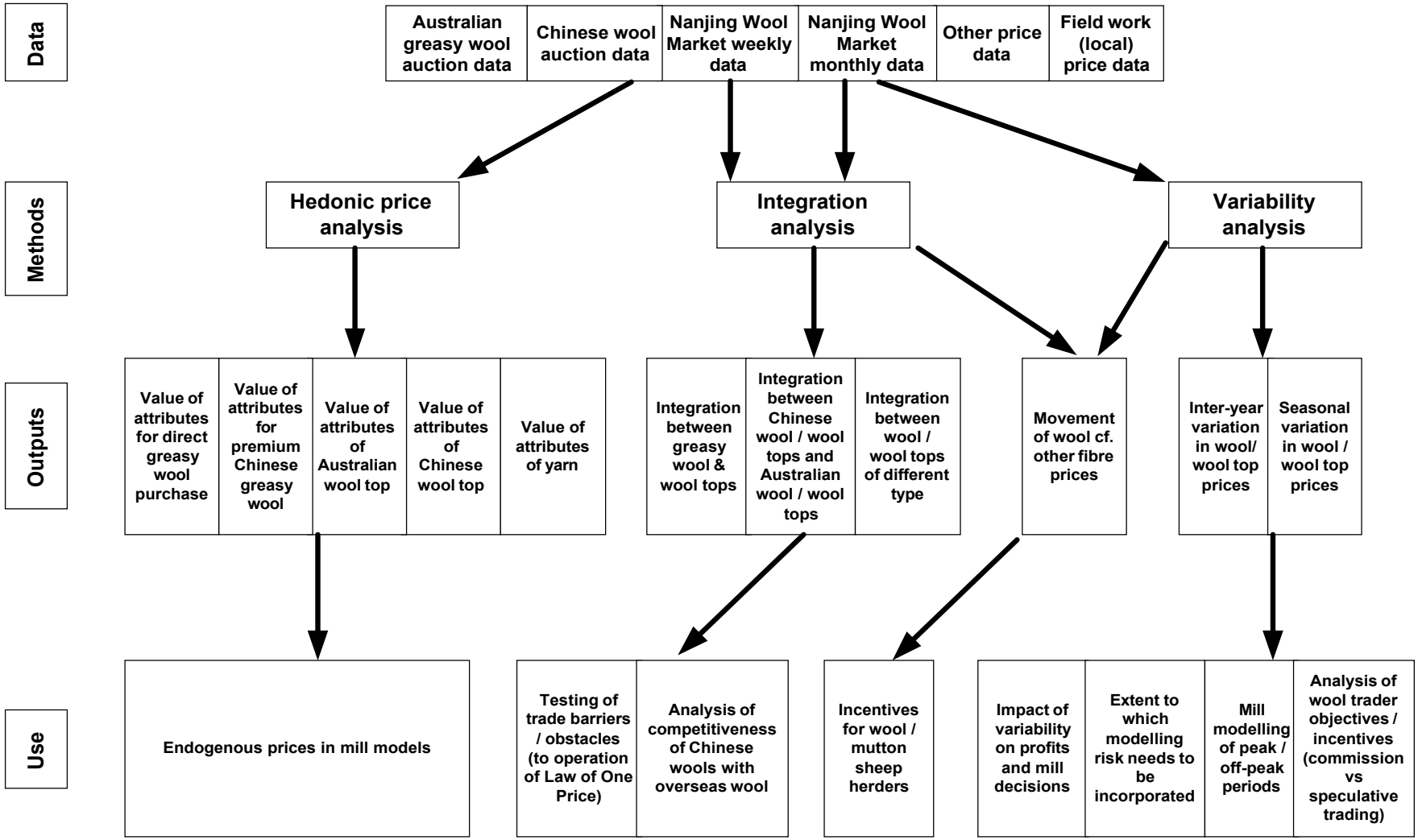

Figure 4 Price analyses

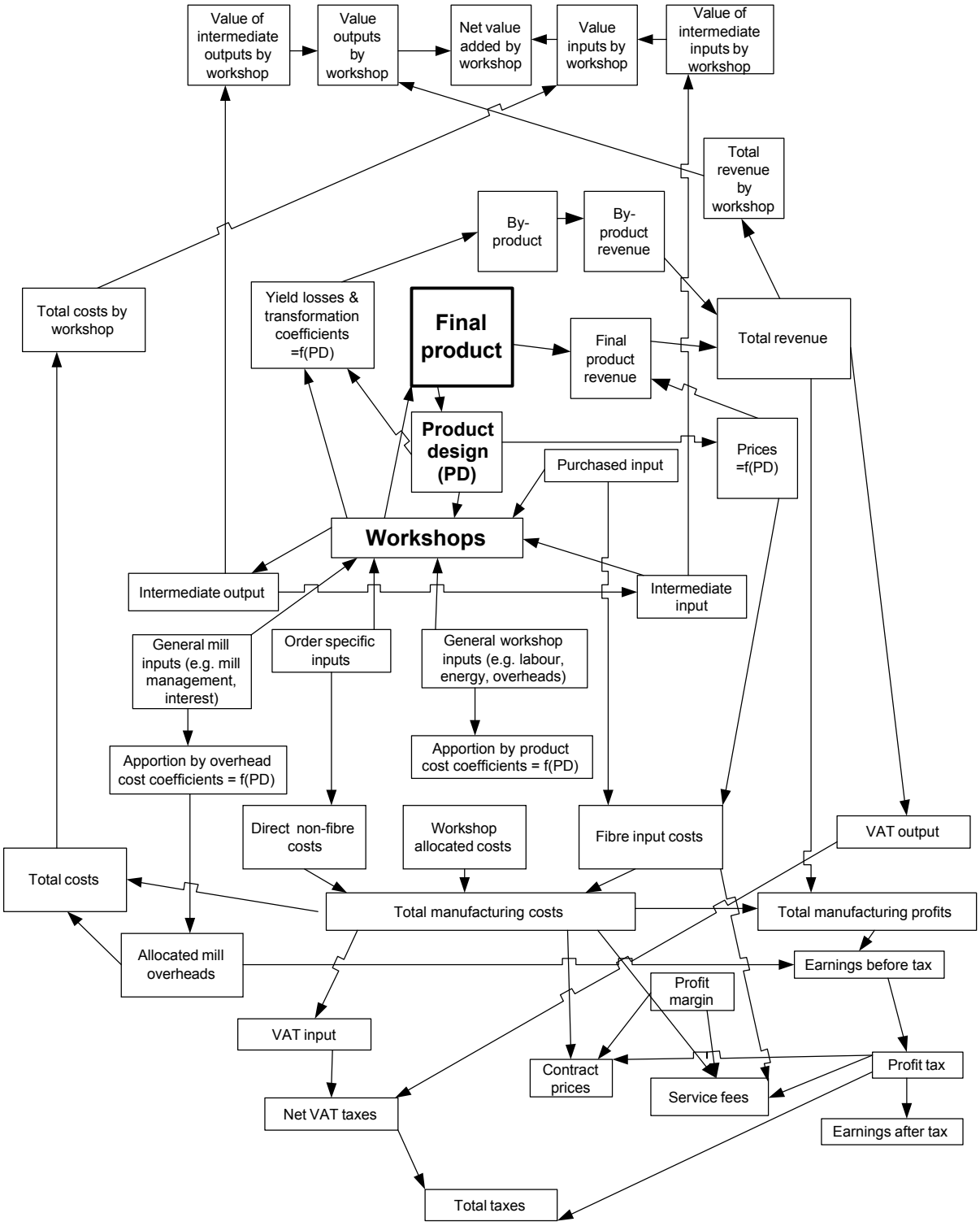

Figure 5 ***CAEGWOOL*** **flowchart**

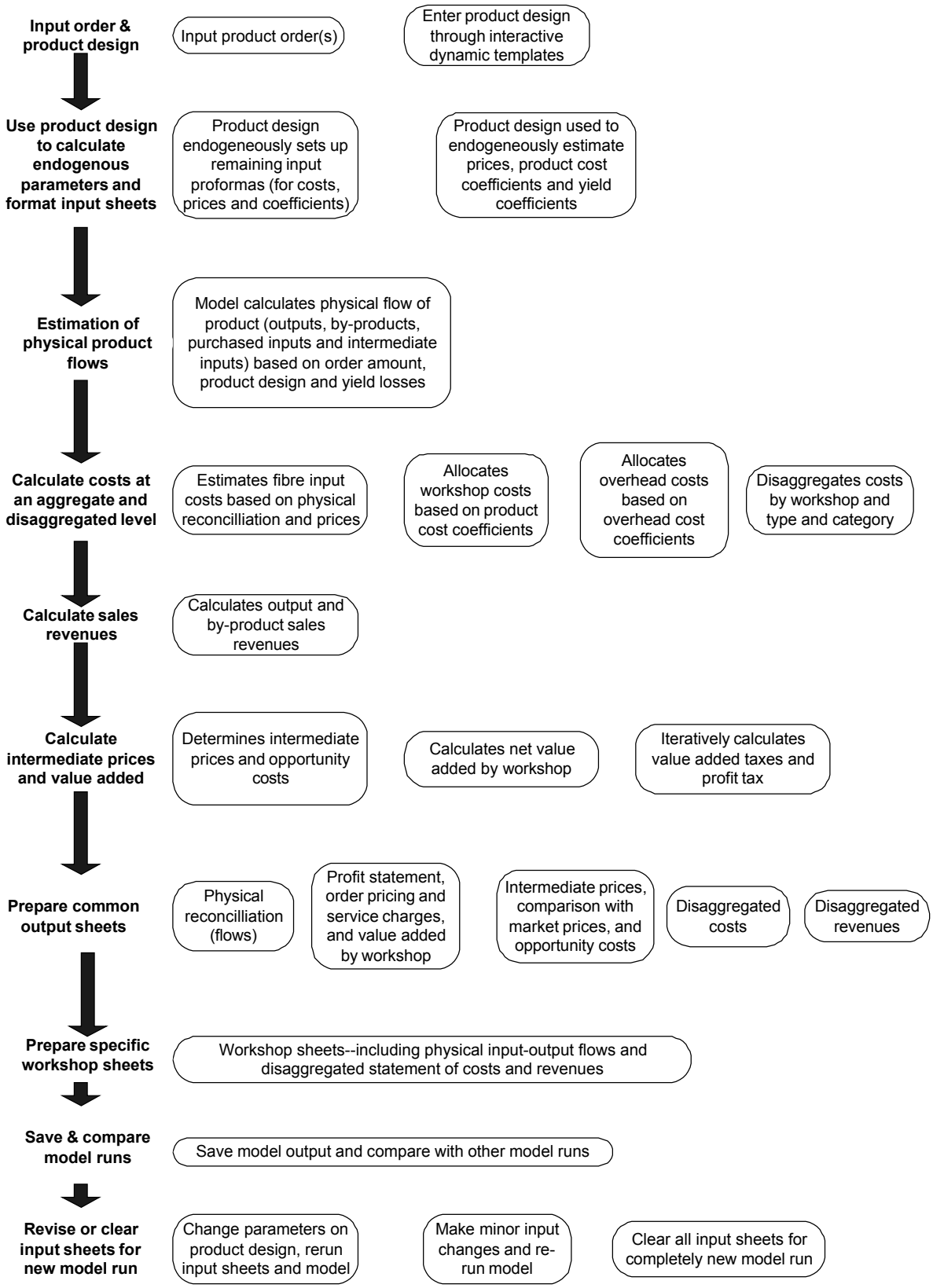

Figure 6 Overview of CAEGWOOL model