Resource Group Inclusion in Different Hierarchical Levels in Industry, and Variety Considerations of its Steering Activities

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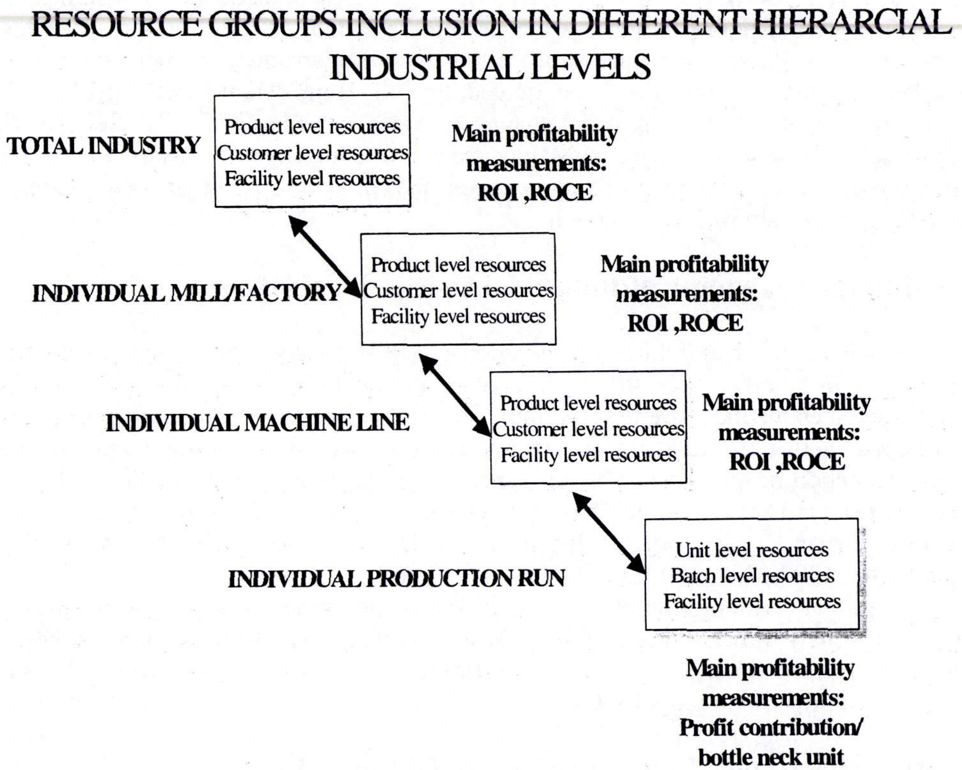
Abstract
The anticipatory aspect of industrial economic steering systems, and the corresponding new models, centres on increased accuracy in determining the individual performance measurements used in long and short term steering activities. This study discusses the application of Activity-Based Costing in creating more accurate systems, its main economic indicators on different hierarchical levels, and the extension of these approaches, to the total models, required in industrial processes and factories.
Keywords: Industrial modelling, Anticipation of Model Outputs, Economic Steering of Industrial Activities

1. Introduction

Most management measures, as they are commonly understood, are worthless in the actual task of managing. Of course they are required, often legally required. But they are elastic, and can be manipulated (Beer, 1990, p.275). This pertains particularly to measurements, where by definition, usually of one of its component variables is elastic, mostly owing to accounting rules. This situation is all too well-know to skilled managers, who can thus approach economic steering information with a sceptic general attitude. The main problem thus centres on the allocation accuracy of the different resource components involved in the actual production and its general management activities, and the varieties of the corresponding measurements hereby generated. One additional problem concerns the transfer of information from a lower hierarchical level to that of a higher one, as discussed in this paper. The particular problem for this kind of anticipatory study of systems concerns the problem of verification of the results hereby obtained.

2. Basic Approach to an Industrial Hierarchical Taxonomy

The hierarchical paradigm, which can be identified in each and every manufacturing process, by its delegation of authority and demand for clearly identified accountability, uses the resulting chain of dependencies as its ´glue´. The actual determination of different hierarchical levels has to be carried out, both from a practicability and cohesion point of view, to assure maximum organisation efficiency. Because the basis for of horizontal linkage is the cross-over point occurring at a higher hierarchic level, the particular requirements for information from a lower hierarchical level to the next higher one has to be kept in mind, particularly when creating basic steering information, to be used on different levels. This represents one of the main aspects of cohesion, which is to guarantee the practical success of this liaison between different hierarchical levels. This aspect of connections between different hierarchical levels, and their most useful taxonomy, has received slight attention in textbooks and scientific papers, dealing with this particular Management Accounting problem. The most useful hierarchical taxonomy, from a practical point of view, is depicted in Fig. 1. The division is thus made from a maximal steering efficiency point of view, taking into consideration the resource groups, identified on the different hierarchical levels.



ROI=Return on Investment   *ROCE=Return on Capital Employed*

Figure 1. Hierarchical levels in industrial activities

3. Traditionally Identified Industrial Hierarchical Levels

A traditional approach to industrial hierarchies can best be approached, either from an accounting or a traditional leadership point of view.

The traditional accounting approach could be envisioned from the division of required production resources, classified as either variable or fixed ones. This simplified model thus pertains to a division of hierarchies in only those, either pertaining to the actual production of the final product or service, or to all the other auxiliary management and required service activities. This division does not give any indication of the actual hierarchical levels involved.

The traditional industrial management division, on the other hand, only identifies levels II, III and IV in Figure 1, which indicates the total absence of the most influenceable resource consumption level from a modern, accurate accounting, or economic steering point of view, which is represented by level I, or the individual production run, though the final stratification could be much more detailed. As an excellent example of this could be quoted that of Hunt (Hunt, 1991, p.17), who distinguishes between the following managerial levels: I Shop Floor, II Section, III Department, IV Division (General Management), V Company, VI Group, and finally VII Corporation From a resource aggregation and allocation point of view, none of these taxonomies are inclusive enough.

4. Optimal Taxonomy of Industrial Hierarchical levels

The basis for the hierarchical stratification in Fig. 1 consists of the need to identify and utilize most effectively those resource groups and their allocation possibilities, which generates the most useful economic industrial performance measurements for the continuous, both daily and longer term, anticipatory steering activities, and also for periodical reporting purposes. This also means, that each and every hierarchical level includes resource groups, which have already been studied in great detail in previous scientific papers, even some included in previous CASYS-papers by this author (Fogelholm, 1997,1998, 1999a, 1999b, 2001, 2000a).

This optimal configuration of hierarchical levels and the resource groups included in each level is thus shown in Fig.1. The application in this case is from the paper industry, which illustrates a situation, where the stratification and resource allocation problems to be discussed are easily recognized.

5. Resource Group Configurations on Different Levels

The picture in Fig. 1 deserves a more detailed scrutiny. As can be noticed, there are some resource groups common to more than one level, the most prominent of which is the customer resource group, which is to be found on three levels, and the product resource group on two levels. But the biggest discrepancy is to be found in the resource group contents on the level of the industrial production run, and the next higher level, usually consisting of one individual main machinery or an individual production line.

As easily can be seen, when comparing traditional resource consumption paradigms generally based on bookkeeping data bases, to modern accounting systems, first accurately promulgated by Cooper (Cooper, 1990), the main omission in the old paradigm consisted in the omission of the batch level resources, not all of which are to be found in traditional bookkeeping data bases. This omission can be considered to have been the main reason for the corresponding resource consumption discrepancies, as reported through product cost specifications. In a typical industrial production process, with fluctuating lengths of production runs, these discrepancies have usually been investigated to be on the level of 5-15% of the total production costs (Merz & Hardy, 1993, p.25).

The problem of recourse consumption estimations, required for future production runs, which represents the main practical problem for anticipating the behaviour of future production activities, is aggregated on the batch resource level, particularly when including those found in the process industries. A typical example of this is shown in Fig.2, which shows the recycled raw material, when changing over from one production run to the next one (Fogelholm, 2000c).

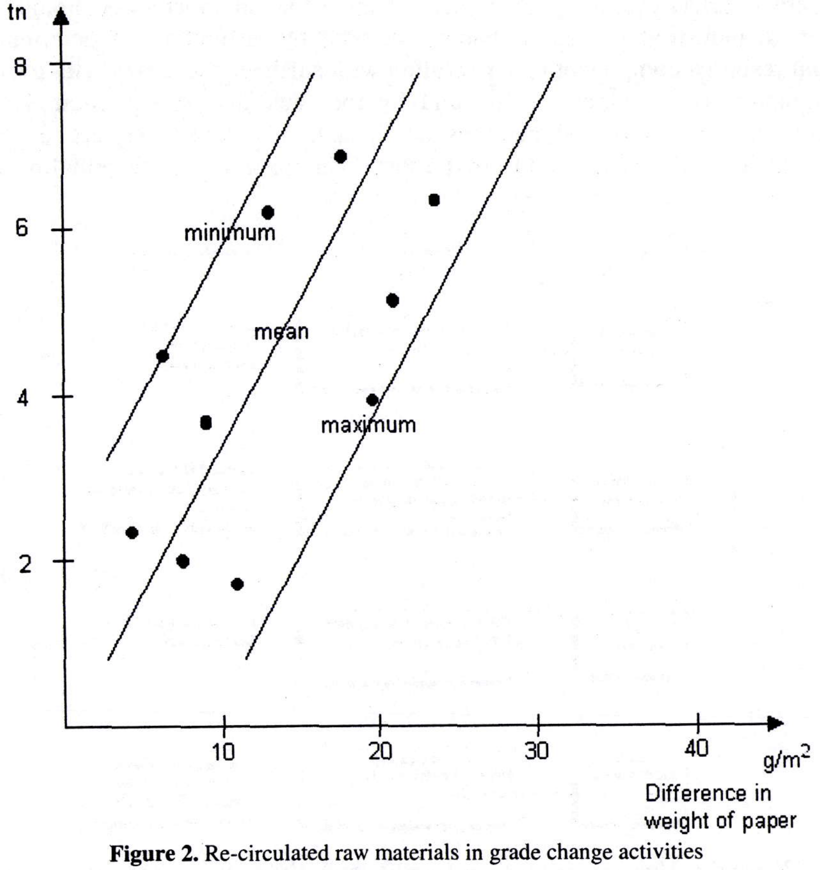


Figure 2. Re-circulated raw materials in grade change activities

The possibility of accurate prognostication for these resource groups have been found also by this author to be considerably more difficult than those on the unit level. In the depicted case shown above, no clear correlation was to be found between this resource consumption unit, and any one of the potential single parameters available. The reason is all too apparently that the final result is clearly depending on a whole range of factors, with individual varying impacts. In cases like this, one has to accept a figure with a potentially big spread around its mean value, which significantly diminishes its prognostic accuracy.

6. Actual Vs. Calculated Resource Consumption

An anticipatory economic steering model emphasize as its main characteristic the possibility and requirement, to identify and to determine in advance, as accurately as possible, the different resource components included in the separate production runs, and from this level, to determine in a corresponding way the other resource components included in the higher hierarchical levels.

The actual variety capturing capabilities of any actual anticipatory economic steering model of an industrial process is hampered, both by difficulties of determining the individual resource component under scrutiny with sufficient accuracy with only one or two parameters or resource drivers, and by the fact, that some required resource components are to be allocated, and thus anticipated, only from purely accounting point of view. This is easily recognized from the specifications in Fig. 3 (Fogelholm, 2001).

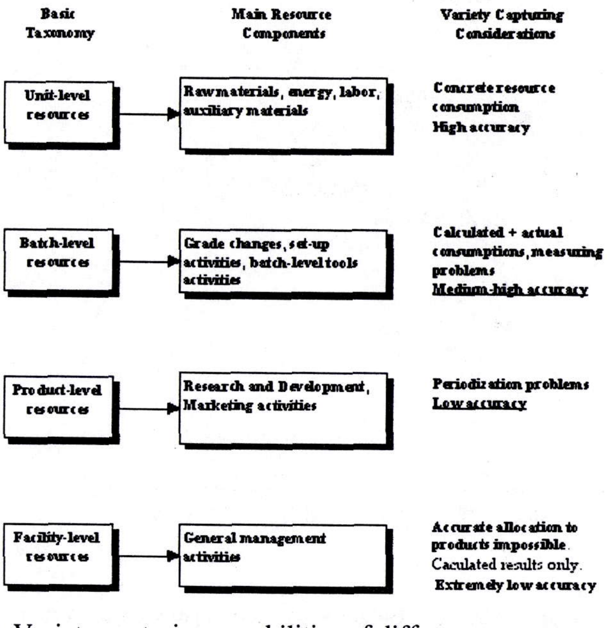


Figure 3. Variety capturing capabilities of different resource groups

Naturally, when variety is defined as the number of possible states of whatever it is whose complexity we want to measure (Beer, 1990, p.32), it is clear, that we are not (always or seldom) able to provide proper measures of variety in each unique situation (Beer, 1990, p.208). But an intuitive feeling for these discrepancies in anticipated accuracies would at least be required.

The figure 3 clearly indicates, that the unit level resources are by far the most accurate in any anticipatory system for economic steering activities, with few or none merely accounting determined resource components involved. The situation changes drastically, when scrutinizing the allocation of resources on the facility level, all of which generally have to be determined for any individual product or production run, using solely basic accounting principles. The final allocation of these different kind of resources, which include both human resources, different kind of depreciation, and a lot of general overhead activities and their costs, are not possible to allocate with the same methods and accuracy as those of the unit and batch levels

The best example of the problems involved is from an industry well known to this author, and concerns the allocation of head office resources to the products, made on individual machines in mills, usually situated far away from these kind of offices. As an example could be quoted the solution, as found in one individual company, and which allocates the total resources of the head office first to the different factories, using the turnover as the basis for allocation, then to the individual machines, using the production volume as the main allocation base, and finally down to the individual production runs and products, using the production time as the basic allocation base. These kind of allocations can thus not be considered to be scientifically determined in the same way as those on the unit level and batch level, but have to be accepted as determined purely from an accounting point of view (Fogelholm, 2000a).This is the reason, why the economic steering information for everyday sales information of new products to be priced, should not include resource consumption costs outside unit- and batch levels.

7. Performance Measurements on Different Levels

Performance measurements and their determination for different kinds of industries have been the focus for a massive scientific investigation, which could be traceable back to the article by Kaplan and Norton (Kaplan & Norton, 1993). The article has since then been enlarged to one of the core books of performance measurements (Kaplan & Norton, 1996), which is used as one of the main text books in many universities all over the world. The continuous applications of the basic ideas is nowadays regularly reported in a journal and its yearbooks, consecrated to area of economic steering activities (see: Performance Measurement, 1997-).

One of the main area of these, by now standardized industrial performance measurements consists of the economic and particularly profitability indicators, of which the long range ones, articulated in some form of return on investment, represents one of the main ones in any industry and its companies. However, the return on investment can not be applied to individual production runs, or the individual products thus being manufactured, but has to be expressed in profit contributions, or preferably, as profit contributions per bottle neck unit. This bottleneck usually consists of the time of the bottle neck machinery of the individual production line or its main machinery. Se Fig. 2.

All previous remarks of these economic indicators thus indicate that each type of industry by now is fully aware of the optimal basic methods available for economic steering purposes. This does not remove the intrinsic problem of utilizing the basic steering information from the unit level to the next higher level(s) of the hierarchy. As Fig, 1 indicated, from the level of the individual production line upwards, the return of investment is to be used, which does not make any similar difficulties of calculating the corresponding return on investment figures. But two main problems still remain to be discussed, owing to the innate difficulties of these calculations, their variety problems and anticipatory aspects.

8. Connecting Unit Level and Batch Level Main Economic Indicators

When scrutinizing the situation depicted in Fig.1, one interesting feature is easily recognized. Except for the level of the individual production runs, the main profitability measurement consists of ROI or ROCE, which represents a longer range time horizon than a profit measurement like a Profit Contribution/ bottleneck unit, which represents a short range measurement for the continuous daily sales activities. This also means that to aggregate the ROI information to higher hierarchical levels, the same type of basic information can be used. The situation of the connection between the individual production run and that of the individual machine or production line includes aggregation of short range profitability measures, which has to be compared to a longer range (1/2 –1 year) indicators, which also includes figures (the calculated value for the investment, which has to determined through accounting principles), which are not actual or resource consumption-based, in the same sense as that of those figures used determining the measures for the individual production run.

This author has once had to solve this problem in a real case, already a long time ago in company, with many factories and a paper mill, owing to the need to find a solution to bridge the communication gap between the managers of the factory and the managers in charge of the economic results from the day-to-day activities. The results were published (Fogelholm, 1971) and these kind, or similar results, have not been seen since then, neither in textbooks, nor in professional articles. The basic results of this study and the corresponding charts are shown in Fig. 4. (Fogelholm, 1971, p.537).

This type of diagram makes it possible to transfer crucial economic steering information from one hierarchical level to another one. The algorithms behind these figures contain information, which partly is based on accounting figures, which to a certain extent can be considered to be "subjective" from a Systems Science point of view.

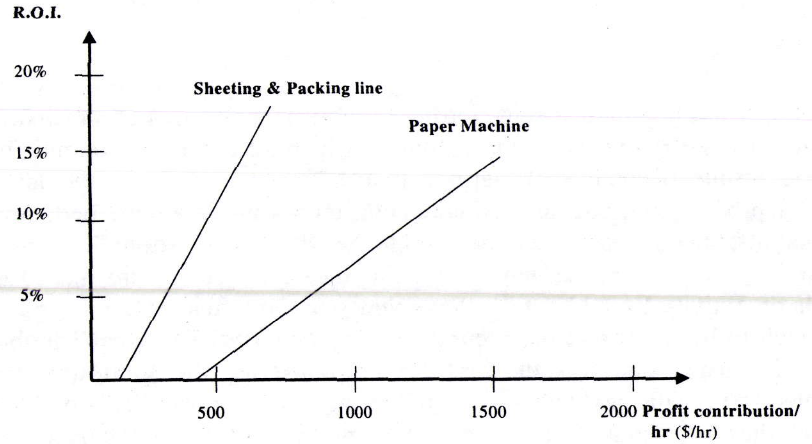


Figure 4. The connection between economic indicators on different levels

9. Variety Capturing Aspects of Measurements on Higher Hierarchical Levels

In this paper it has repeatedly been emphasized the need also to take into consideration the variety aspect of the economic steering information of production processes, included in manufacturing companies. The accuracy in the determination of the main profitability measurement on higher hierarchical levels, usually calculated in the form of ROI, represents one main area of élasticity´, already previously mentioned. As ROI by definition is calculated as the annual profit(s)/investment, this definition makes it possible to use different values for the denominator, The problem is discussed in length in Management Accounting textbooks, of which Drury´s is the best known and most extensive (Drury, 1994, p.738). The value of the investment is thus usually either overstated or understated, which has a decisive effect on the final value of the calculated investment. The problem is aggravated when the machinery is either old, or values for machinery replenishments are difficult to determine accurately. As a practical example of this could be quoted the situation, where the value of the investment is based on the initial cost of machinery, which could have taken place already 10-15 years previously, which is a typical situation in the process industries. The corresponding ROI values would in a case like this give a totally bias result. An understated investment could thus easily generate diminished requirements for the daily sales activities in the form of required profit contributions/unit of time in bottleneck machinery, as shown in Fig.5. Variety in accuracy on the level of unit level resource consumption on the production run hierarchical level is transformed into problems of accounting approaches to investment values on higher hierarchical levels, both of which have significant impact on the usefulness of information from economic steering systems, used for anticipating and maximising the behaviour of the system to be managed.

10. Conclusion

This paper has highlighted some intrinsic problems in the area of anticipation in the behaviour of industrial resource consumptions, which form the base for anticipating the economic results of both short term activities, which pertain to the level of the individual production runs, and to more long term considerations, pertaining to the individual machine or production lines, and to the whole factory or mill.

It can thus be noticed, that notwithstanding the new systems, propagated under the umbrella of Activity-Based Costing, the accuracy of these final economic indicatorsstill leave much to be desired in the accuracy hereby obtained. The second problem dealt with in this paper concerns the problem of transfering the short time results, in aggregated form to the next levels, without loosing too much of anticitation accuracy.

It can thus be stated, that one particular problem of this anticipation aspect of systems behoviour, clearly shows the more probalilistic nature of industrial activities, in comparison with the more deterministic behaviour of the physical world, as studied by Physics and Chemistry. This aspect of Management Accounting has received all too scant emhasis in textbooks, in comparison to its impact in real life. This paper thus tries to draw attention to this particular aspect.

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