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# Supply Chain Management in Agriculture - Including Economics Aspects like Responsibility and Transparency

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## ***Supply Chain Management in agriculture – including economics aspects like responsibility and transparency***

### **Abstract**

Supply Chain Management as a business strategy can combine both microeconomic and macroeconomic aspects of preferred value chains. This paper (1) shows the impact of SCM, (2) stretches out the three dimensions of performance, costs and quality of the processes along the supply chain and (3) highlights the SCM-enabler. The method of a process chain analysis is demonstrated for the allocation of resources. Various results of carried out and studies in progress are given and identified through the classification into economical and management aspects.

### **Keywords:**

Supply Chain Management (SCM), Activity Based Costing (ABC), Process Transparency, Efficient Consumer Response (ECR), marketing of quality alternatives

### **1. Introduction**

The key statement connected with Supply Chain Management (SCM) is that long-term competitiveness is based on the control of the entire value added chain. The present article deals with two complementary targets in front of this background.

The business management aspects of cost reduction are obvious. Nevertheless the context of performance improvement, cost reduction and quality is the main focus on supply chain optimizations.

Up to now the economic aspects have been disregarded despite of their increasing importance. According to the three process dimensions: performance, costs and quality, the focus here is an appropriate supply and marketing of diverse process variants that show in the extreme “completely industrialized agriculture” and “pure ecological agriculture” respectively. From the economic point of view the process dimension quality is in focus - and quality is considered to be in context to transparent processes and process responsibilities. Knowing about transfer payment costs and performances plays an important role if there is a common understanding that efficient process chains should be supported instead of inefficiencies.

It is evident that supply chain observations can take both aspects equally into account. Agriculture in general is reserved about supply chain thoughts. The driving force in supply chain optimization by now is the processing industry and chances for agriculture are wasted by this passivity. Because of the tight connection of SCM and ECR (Efficient Consumer Response) these ECR-cooperations would lead to the theme likewise. Unfortunately agriculture belongs to the stragglers in ECR as well.

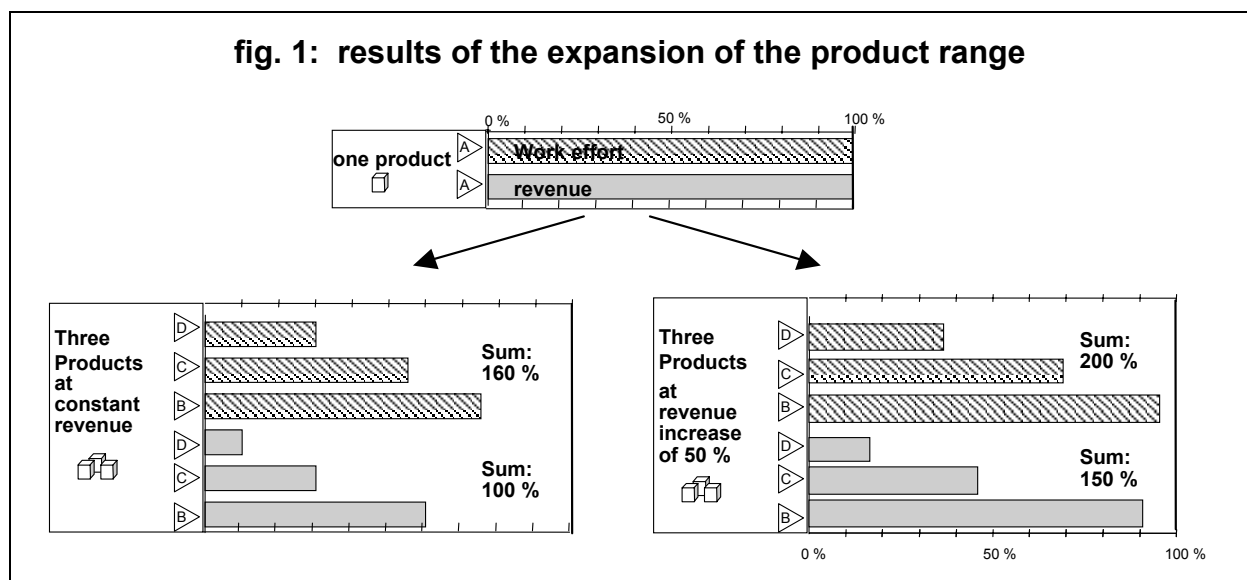
There is essential need for action. Business management optimizations can take economic aspects into account if carefully considered. Vice versa economic aspects require SCM-applications in the enterprises, if additional costs for data collections should be avoided. Political and social interests can influence the implementation of SCM in the process chain as well. The interdependencies are evident. And the starting-point is a SCM-implementation in the process chain. The following explanations are based on this and link the economic requirements at suitable points again.

## 2. Basics

Dealing with the entire value chain turns out to be a new dimension in competition. Success factors are the control over all processes throughout the chain, cooperation with business partners and the suitable use of information technology. All efforts to improve the value chain are in context with the concept of ECR.

SCM opens up sufficient potentials within a single enterprise but especially along the value chain. A large share of the total costs is at the interface of the involved companies. Improvements in operation processes are an appropriate way to increase margins in stagnating industries.

Furthermore focusing the entire supply chain complies with the end-consumers' current requirements. Process chain and costs examinations enable detailed economic viability analysis of **alternative production methods** and ultimately alternatively produced products. Figure 1 shows the impact of a diversified product line that is not adjusted on overall economic viability based on the increasing inventories throughout the supply chain.



source: with variations taken from MAGEE (1960): p. 91

**Variations in the process chain** will expand the number of available products. Beside the cost problem marketing strategies are required to communicate changes in products to the consumers. The shift in quality must be transparent and sustainable. In the food industry brands satisfy this quality demand. For agricultural products, respectively improved differentiation of quality levels along the supply chain, brands

like this are missing. The postulated change to assure the confidence of the consumers can be achieved quasi by the way through a complete implementation of SCM and ECR strategies.

Improved quality must be reflected in the sales price to make this change in the process chain worthwhile. An example for this are the costs and revenues for eco-farming and conventional enterprises.

Example: The market output of € 1.100 per hectare in conventional farming exceeds that of organic farming by € 250 per hectare. The resulting difference in performance among both process chains is partly equalized by transfer payments for the eco-farming processes. Thus the total difference is reduced to less than € 150 per hectare. The variable costs in conventional farming are about € 150 per hectare higher compared to eco-farming, which almost or completely renounces the use of nitrogen fertilizer and (anorganic) pesticides. As a result the net yield is almost identical (PETERSEN, p. 65).

Public intervention in an over-supplied market is less accepted and according to this transfer payments will increasingly be connected to defined performance measures. The political pressure on transfer payments and competitiveness of the production chains is expected to increase. Technical progress on the other hand is only consensus, if objectively measurable demands (quality, safety, environment) can be sufficed. Crises like BSE tighten those demands. The future profitability of agriculture (ecological and conventional) compared to other sectors of the economy and to other countries is closely connected to the political and social acceptance.

The upcoming WTO-negotiations will try to reduce the distortion of competition by an extensive decoupling of transfer payments and production (PETERSEN, p. 65). All strategies that stimulate certain production methods and products – for instance through the specification of quality, social and environmental standards - are rated critical.

The “agriculture policy environment” plays a prominent role for the prices of eco-products . The aspired target of a 20 percent market share of eco-products within 10 years in Germany can only be covenant with sustainable business stability of the enterprises, if the larger supply does not notably lower prices for these products.

### **3. Supply Chain Management – requirements**

Part of the responsibility of process management are analysis, valuation, development/improvement as well as supervision and control of the value-added process in and between companies.

The requirement of supply chain management is the use of the respective enablers:

- Technology application (electronic data interchange, barcoding, scanning etc.)
- Process analysis
- Activity based costing

➤ Support of the top-management

Chain management requires a fast, standardized and safe data interchange. Before the implementation of chain management it is important to carry out a comprehensive process analysis. The functional orientation of the traditional company organization can be surmounted through the process contemplation. The assistance of activity based costing creates a data pool on which ECR- and SCM-strategies can be based.

One of the enablers is the declared intention of the top-management to establish process management. When the management is not full of good intentions there is no pressure for changes in and between the organizations (moving towards process management).

#### 4. Process Analysis – activity-based costing

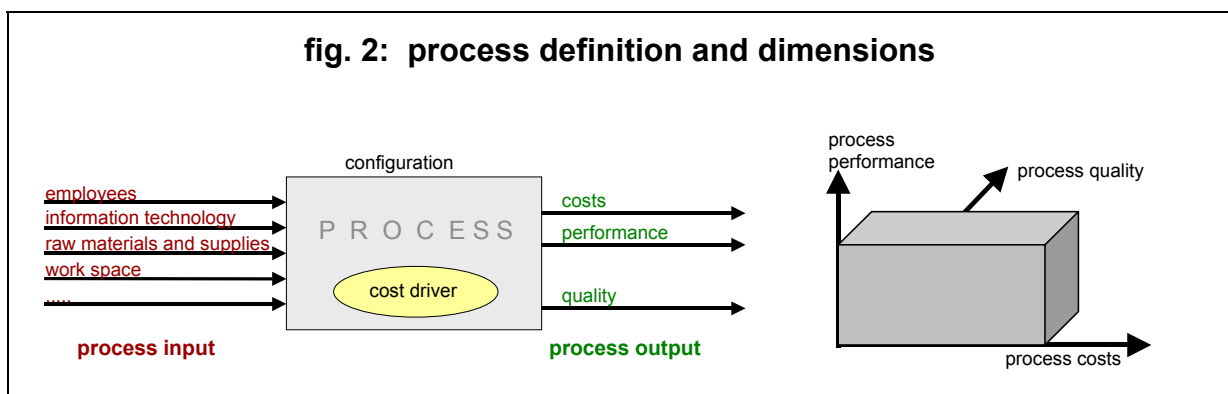
This chapter aggregates extracts of carried out projects. The first step towards a process analysis is the process definition, followed by an appropriate analysis of the processes and an process based costing (known as activity based costing). The emphasis of the description is the target of a process chain orientated accounting under quality and performance aspects. The chapter is completed by an insight to process cost analysis.

##### 4.1 Process definition

The process definition covers all aspects of input and output factors of the processes and the definition of the level of significance of the three processes dimensions quality, performance and costs.

A process is seen as a structure that consists of tasks with logical consequences. A process has measurable, predefined input and output and exists to bring a specific value for the customer/consumer. Therefore a process must always add value.

The input triggers the process by determining a preliminary task, a predefined point of time or by modified environmental conditions. Customers are all individuals, departments and enterprises that acquire any output from the process. Beside this “process row view” the input is measured by the demand of factors that are required to generate the process output (see fig. 2 left).



source: MAU (2000): p. 91

Worksteps performed for following processes or customers, produce items or services generate “performances” as a part of the process output. An holistic evaluation of the process output includes also the success factors quality and costs (SCHOLZ/VROHLINGS, p. 58). As a result the three dimensions of the process validation are shown in figure 2 right.

### ***Process quality***

Beside the monetary evaluation of the processes and the performance measures the quality of the process chain is an increasingly important dimension. Quality measurements extend the average analysis horizon and support process improvements. The process quality must be measured contemporaneously to identify failures at an early stage. To limit the process assessment on deviants in performance and costs is insufficient.

One important quality factor for instance is the process capacity. It specifies the possible (measurable) performance by a given resource input within a time unit. The following quality parameters can be differed (MAU, 2001, p. 24): process time, process reliability, process preparedness, process condition, process flexibility and process modalities.

### ***Process performance***

The process output can be measured in the majority of cases in activity quantities per time unit. To obtain a realistic proposition all documents (forms etc.), information and material (goods, facilities) must be present at the beginning of the output calculation to ensure a frictionless procedure – otherwise the results will be flawed.

Within the scope of an output analysis capacity adjustments according to the demand of specific performances in and between the process links are of interest.

### ***Process costs***

Costs along the supply chain record a consumption of resources in general (HORVÁRTH, foreword). To evaluate process costs the overall resource input required for the process output in the different sub-processes is accounted. Setting a successful design of the process chain requires precise cognition on costs and use of resources in the sub-processes along the supply chain - the cost management of the affected departments, interfaces and sub-processes is based on this.

## **4.2 Purpose of process costs recording**

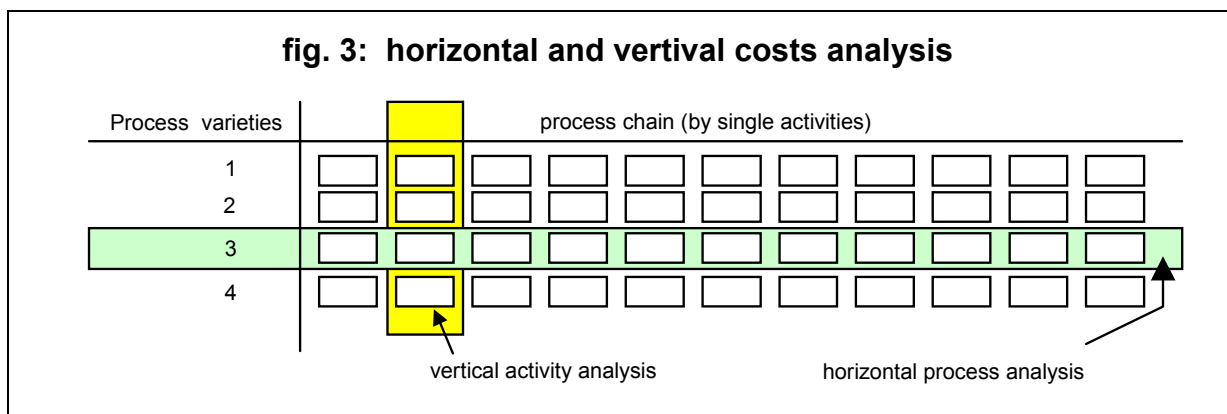
The purpose of the process costs recording covers the following four aspects:

- Generate costs transparency
- Enable a reasonable process configuration
- Enable process control

➤ Form a foundation for calculations

Costs transparency is the premise for process improvements. A detailed view on single activities and sub-processes is the only way shed some light on indirect costs. Thinking in processes is basis and outstanding advantage of activity based costing (ABC). All further benefits are based on this structure. Without the transparency ABC enables a reasonable process control is not possible.

Through the process-centered view vertical and horizontal interpretations of costs are feasible (fig. 3). Whereas the vertical perspective emphasizes the single activities along the supply chain and exposes for instance quality relevant single actions and specific cost drivers, the horizontal perspective serves to register the costs per performance or process variation (e. g. consumer group specific production constraints). Different process variations must be seen as cost objects (SCHOLZ/VROHLINGS, p. 79). The perspective according to the information requirement is used.



source: MAU (2000): p. 103

The rating of processes is also starting point for the process configuration or redesign. It is also of interest in respect to process elimination.

Analysis of the process costs are an additional instrument of the process control (SCHOLZ/VROHLINGS, p. 77). However used, frequently or from case to case, ABC offers essential information for process control in activities, sub-processes and along the entire supply chain.

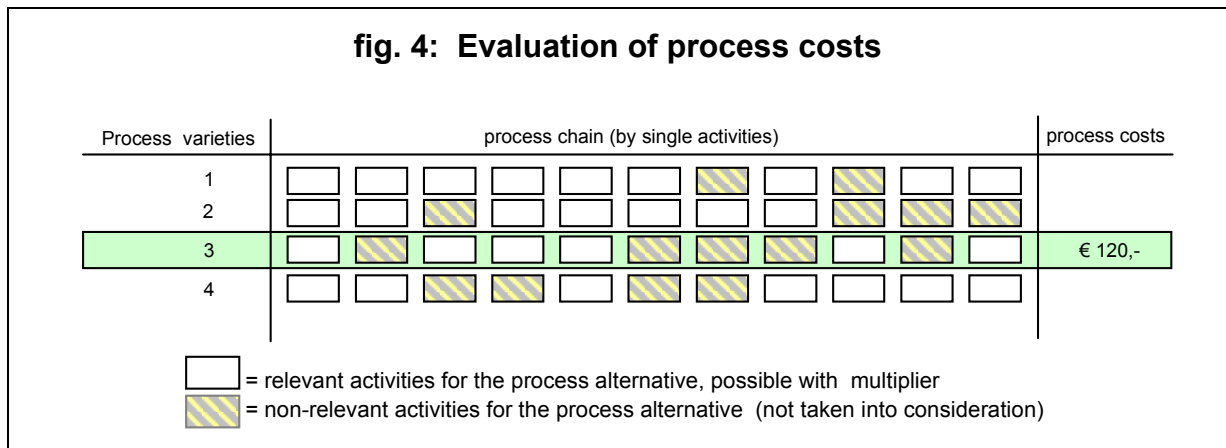
ABC facilitates a strategic calculation along the logistics chain and supplies the basis for outsourcing-decisions, for changes in the process chains as well as the right settlement for logistic services. It serves both, a further cost settlement of the products and transparent and better planning and control of indirect costs (MAYER, P. 269).

#### 4.3 Evaluation of process costs (resource utilization)

The evaluation of the activity-based costs is a result of the use of single activities by the relevant process variations. Getting these costs is bounded up in the beginning with a lot of work. After the relevant activities of each variant are known, the analysis will be automatically made in the future periods – as long as there are no new vari-



ants. (For the case of new variants, they have to be added to the costs.) The illustration 4 shows the horizontal evaluation of the activity-based costs.

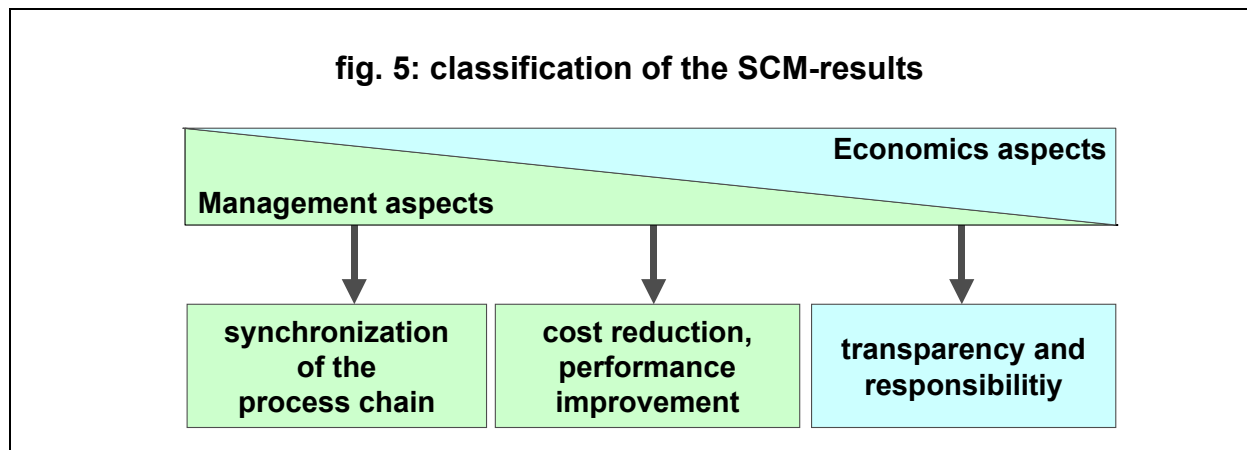


source: MAU (2000): p. 113

The costs for a complete performance of process variants are the result of the added combining along the process chain. The relevant activities can be summed up, the appraised activity costs can be seen. These activity-based costs and the marginal costing can be used for the comparison of cost in the supply chain, so that there is an instrument for the chain management which serves the aims mentioned above.

## 5. Results from completed projects

Goal conflicts along the supply chain have to be resolved when attempting to optimize business management and macroeconomic intentions. The knowledge of cost interdependences respectively influencing parameters on cost, output and quality characteristics is of fundamental importance for the design of the (logistic) processes regarding an optimization of the overall system. Based on the categories "synchronization of the process chain", "cost reduction and increase in output" as well as "transparency and responsibility", results from completed SCM and ECR projects are presented. The implications shift from business management to economical optimizations (see illustration 5).



source: own illustration

### **5.1 synchronization of the process chain**

#### ***Planning accuracy***

Among other factors, weather controls agricultural production, which can only be partly influenced. The processing by the processing industry takes place as promptly as possible and is for that reason directly coupled to the secure and steady material supply to the factory. The seasonality inevitably leads to inventory of the finished product, regardless of whether the food manufacturer or retailer has these in stock. If the dealer has no cost responsibility for excessive inventory, then poor quantity prognoses can be expected. These, in the long run, affect the total costs of the process chain and thus the product price. By means of an early prognosis, adapted to the requirements of the businesses in the process chain (see also 5.2) planning accuracy increases and the quantities contracted can be accurately specified, benefiting all participants.

In contrast, wrong predictions by the dealers' sales expectations and missing arrangements between farmer and processor affect the requirements for the entire process chain. The examined chains show unnecessary, interdependent fluctuations in the direction of preceding elements – also designated as whiplash or jump effect. The more comprehensive the database the better the prognosis can be. Demand uncertainties directly affect the system's process costs. As a significant cost driver they affect safety stocks, utilization, quantities contracted, production shifts, overtime, bottlenecks/ shortfalls, delivery difficulties etc.

#### ***Logistics / Efficient Replenishment***

Along the entire supply chain readiness for delivery is an important criterion. If problems develop right at the beginning of the chain, then these, at times with increasing effect, persist to the end. If the plant breeder cannot supply in time, the cultivation on the farm is impeded. A delayed cultivation leads to smaller yields and delivery volumes, causing the processor to be unable to fulfill the quantities contracted with the dealers. In the worst case the product is not available in the supermarket. The delivery reliability rises among other things to that extent that it is possible to synchronize the contract negotiations between dealer and processor, processor and farmer as well as farmer and plant breeder. This alignment need is obsolete in the case where the processor is also supplier of the seeds.

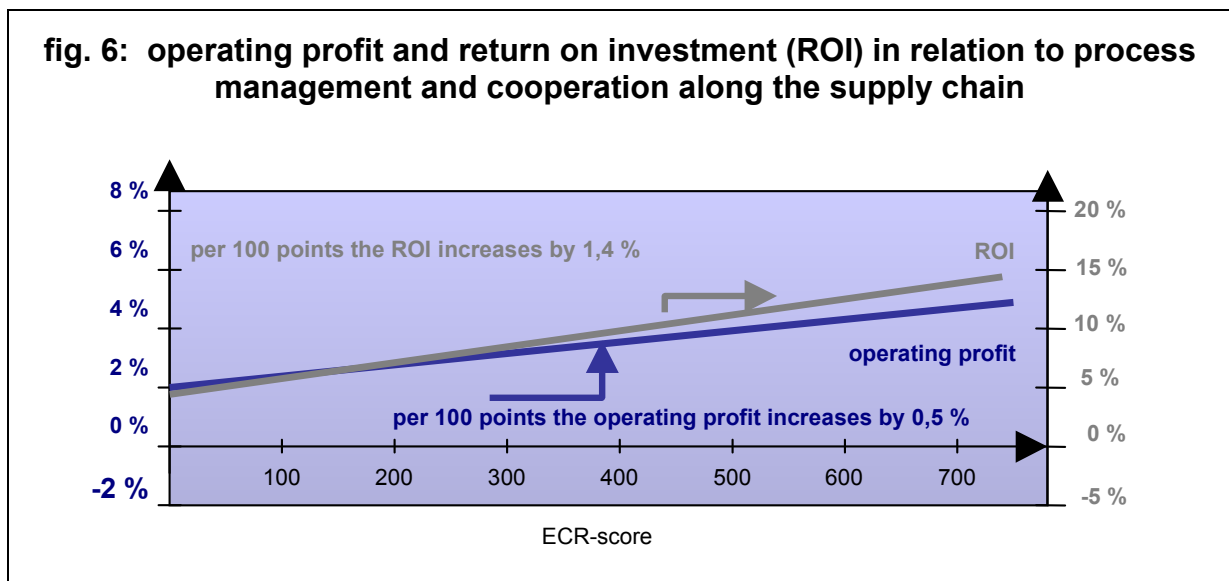
The willingness of all elements in the supply chain to share information serves to minimize risk and reduce costs. The largest reluctance to share information is between the foodstuffs industry and dealers.

Decentralized production, central processing of food raw materials as well as long-term connections between producers and processors with only small product varieties lead in the direction of Efficient Replenishment for the delivery to the processors (STROHM, p. 49f. ). Since suppliers/producers offers are often scattered the crucial impulses come from the buyers.

Efficient Replenishment is in most cases not only an instrument for decreasing stocks, the planning of the in time delivery of raw materials by the processors also offers the possibility to expand the control span, at times even to the production of the supplier resulting in a facilitation of own production planning, and an improved utilization of production capacities. In accordance with ECR applications between industry and trade this is also denominated pull principle.

### **Improvement of operating result**

Illustration 6 shows the relation of operating result and return on investment in dependence on the company's orientation towards process conformity and co-operation along the supply chain. The achieved ECR score was utilized as assessment criterion.

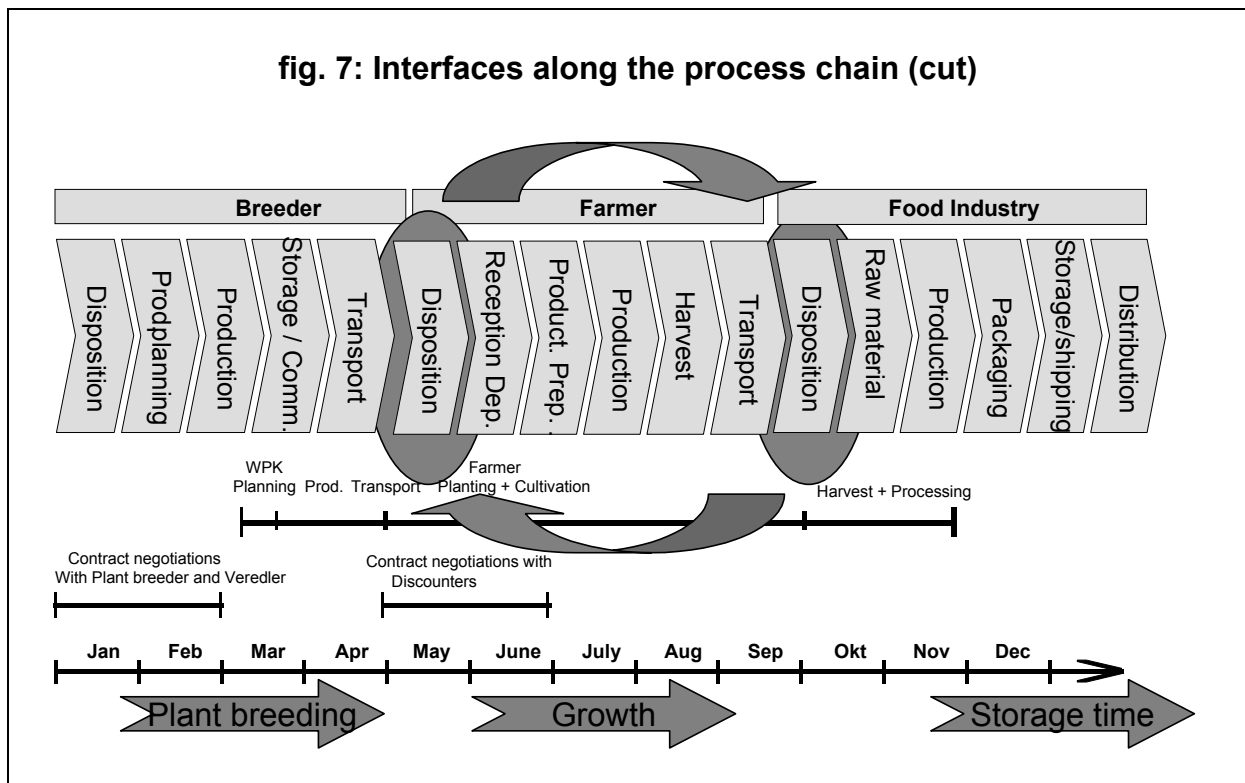


source: MAU (2000): P. 154

## **5.2 cost reduction and performance improvement**

To analyze the process chain from the supply of the agricultural production to the shelf of the food retailer the status quo has to be made transparent first. The result is a complex set of information, product and money flows between the departments of an enterprise and to departments of other enterprises of the chain. Here the optimization begins.

For all parties involved the described process chain (again illustrated substantially simplified) begins with the disposition. As seen on the time axis in illustration 7, first problems arise already at that point. The contract negotiations for the farmer and the processor proceed in the wrong order. Thus a risk develops for both.



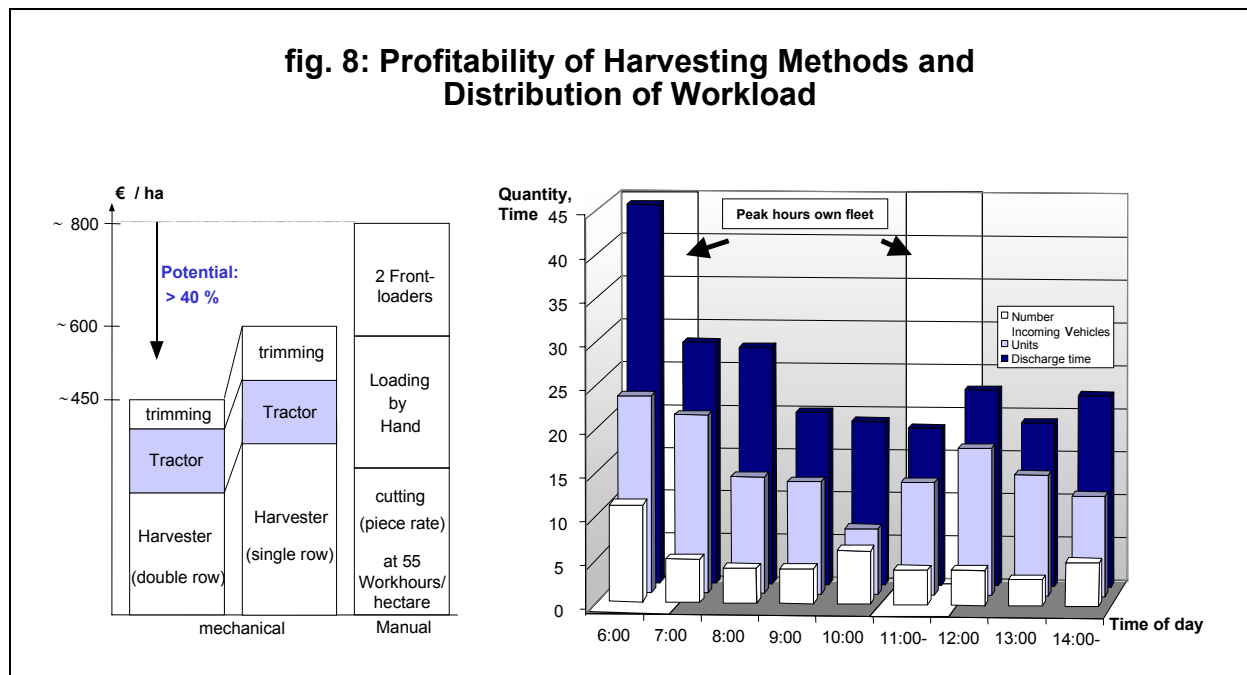
source: own illustration

Example „agriculture“: The risk for the farmer lies in the creation of the land utilization plan, as he must plan land use already in the fall. Once planned, he can't use the reserved land for other potentially more fruitful crops. The farmer can continue planning no sooner than January or February after the negotiations with the processor are completed. If the reserved area is too small, he must till already sown in plots again. In case the area is too large it has to be cultivated with other crops. Both variants result in disadvantages for the farmer. On one hand costs of additional work arise and on the other hand diminished yields in relation to the optimal crop may result.

The **entire process time** is essentially determined by the breeding at the plant breeder, the growth of the plants until harvest and the storage time of the finished product at the processor or dealer. These three major periods are to a large extent uncontrollable, in contrast to the interfaces between the companies where a potential exists. Through time-window managed delivery the temporary storage at the processor for example can be minimized and the finishing process stabilized. All activities associated with temporary storage and uneven utilization of processing facilities can be eliminated by a considerable degree. Illustration 8 right shows the situation in the manufacturer's goods receiving department before the optimization.

Example "harvest mechanization": Another example is the mechanization of the harvest: since a manual harvest in darkness is connected with larger losses and risks the usage of machines has to be considered. The calculation of such a solution's

profitability should be based on the production per area. The employment of machines is profitable only if the usage extent rises and thus a high utilization is ensured. The advantage of harvesting machines then consists in lower costs, the facilitation of work and the constant output - no diminishing productivity during the course of the day. Disadvantages arise as a result of the worse cutting quality, increased soil residue on the red cabbage, higher harvest losses, stronger ground pressure and heavier weather dependence. Illustration 8 left shows the cost differences for this alternative of this section of the process chain.



source: own image

### 5.3 transparency and responsibility

Transparency and responsibility are the key terms, which position themselves as economical requirements for the quality of the process chains for foods and thus Supply chain management.

#### Quality assurance

Certain product qualities are presupposed by consumers and thus also by dealers. For extended quality criteria still no uniform, transparent market established is so far. That is not inevitably a disadvantage, as it leaves room for brand development.

Since the liability for defective products in the supply chain affects the food manufacturers first, they in principle attempt to take appropriate measures for quality assurance. The dealers and processors define the quality of agricultural products in the terms of their own customers in accordance with the legally possible specifications and if necessary additional requirements.

Example of cultivation contracts: The instrument to assure the quality standard within an existing supply chain in agriculture up to the processor is cultivation contracts.

Closed systems should include breeding, propagation, soil choice, planting, growth, harvest, storage and processing. Guidelines from the farmer's customers frequently include the varieties to be cultivated (in part the seeds are provided), quality characteristics, the cultivated areas and locations, crop rotations (e.g. cabbage only every 7 years), plant protection and fertilization procedures as well as the harvest time (through cultivation advisors). The obligation to record all measures applied during the plants' growth provide for constant control. The transparency of this chain and the farmers' willingness to share information are guaranteed here.

Successful quality assurance systems count on stage responsibility and interlocking of the stages with one another. This ensures the consumer a comprehensive protection. Accordingly labeled foods supply the buyer with the necessary orientation for his purchase decision.

Surely the continuous price competition in the food retail sector contributed to the fact that products with a test label, which causes additional costs, could not penetrate the market more successfully.

An underlying factor is that consumers behave differently when actually purchasing food, compared to what they indicate in questionings. The will frequently expressed in inquiries to spend more on food of a certain quality is torpedoed by the actual purchase on basis of the lowest price.

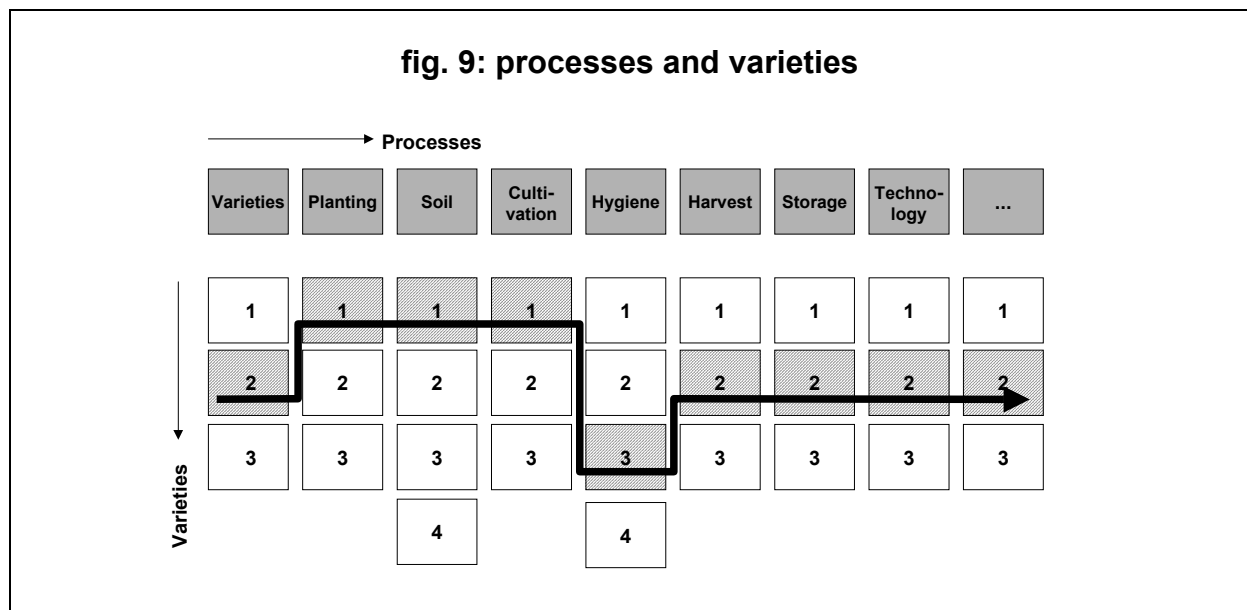
Possible causes for the still small demand for organic food in Germany could then be the wrong address of consumers, the lacking availability of suitable organic products, deficient marketing strategy and partially also the high price level. The missing protection of the term "bio" is just as critical, as are the missing labels for differentiable quality classes, to which certain price levels are then attributed.

In the food market two types of segments exist: one with quality-oriented products - in the form of branded articles - and one with anonymously produced products. The majority of the farmers still produce an exchangeable product under the focus of quantity maximization and cost minimization. Caused by the predominantly horizontal organization of agriculture (cooperatives, producer alliance etc.) the vertical dialogue with the following production stages is predominantly limited to the delivery of the products to be processed. The ability to trace the food origin is generally not possible – which contradicts the demand for transparency (BLAHA, p. 70).

### ***Requirements of process variants***

It remains unclear, how the consumers evaluate the individual process variants and whether they get the possibility to consider certain process characteristics during the purchase decision. Many particularities in the process chain remain invisible for the final consumer and thus are not considered to add value to the product. If this is the case no increased payment reserve for exceptional characteristics can be expected from the customer.

Different quality standards are associated with different price structures. Consequently in each case alternative quality levels can be offered for the different sub-processes along the chain (see illustration 9).



source: MAU (2002): p. 190

This is sensible only if the necessary activities and resulting costs are borne by the final consumers as well. The price for example is then justified with the sinking yields caused by the reduced use of synthetic fertilizers and plant protection agents and the more complex cultivation methods. Apart from this specialization - by application of the individual alternative modules to certain plots - the requirement applicable to the standard solution demands for larger connected plots to enable cost-efficient operations.

In closed production chains quality criteria are defined for agricultural raw materials as well. An important economic component is the correct marketing of such products. If this marketing does not succeed, then it is hardly worthwhile for the farmers to produce products of higher quality.

### Quality as elementary process dimension

To achieve the goal of "qualitatively exceptional products", all enterprises along the process chain must assume responsibility. For dealers this happens indirectly, since they can determine only the quality of the delivered goods, without being able to affect them at that time. An influence is possible by means of an appropriate payment reserve for high quality of both the trading companies and processors. The adoption of the responsibility towards more quality requires the development of comprehensible self-controls. They consist of internal audits and certification through third party. The government administration is limited to control of the self-control. Quality assurance and product liability must be introduced in the context of supplier customer relations for supplied raw goods also. Illustration 10 shows an example of a process assessment using a part of an analyzed process chain.

**fig. 10: Assessment for single activities along the process chain using the process dimensions**

| Process step       | Picking                         |                       |
|--------------------|---------------------------------|-----------------------|
| Discrete Activity  | Picking Regular Assortment [21] | Loading pickings [22] |
| Description        |                                 |                       |
| Cost driver        | Picking list                    | Picking list          |
| Assumptions        |                                 |                       |
| Time-Max. (sec.)   | 780                             | 90                    |
| Time-Min. (sec.)   | 360                             | 60                    |
| Time-Durch. (sec.) | 700                             | 90                    |
| Material costs     | 0,05 €                          |                       |
| € average          | 7,78 €                          | 1,00 €                |
| Hourly wage:       | 20,00 €                         | 20,00 €               |
|                    | <b>4,32 €</b>                   |                       |
| Quantity per day   | 76                              | 76                    |
| Quantity p. a.     | 18.173                          | 18.173                |
| costs p. a.        | 141.344,00 €                    | 18.172,80 €           |
| costs Sum          | <b>159.516,80 €</b>             |                       |

21st discrete activity in entire process chain (running number)

Process step in process chain

Description of specific quality characteristics

The process step picking includes the two activities „picking regular assortment“ and „loading pickings“

The cost driver of the activity „picking regular assortment“ are the picking lists

Maximum value under „normal“ conditions for carrying out the activity. Applies also for minimum and average values.

Additional costs directly linked to the cost driver „picking lists“

Assuming average processing time at given hourly wage (see below) expenses for one execution of discrete activity are 1 €

Total costs for one execution of sub process „picking“

Hourly wage of employee carrying out this activity (as basis for the time-cost assessment of activity).

Total costs per year for carrying out sub process „picking“

The number of executions p.a. result from the number of working days

The discrete activity is carried out 76 times per working day

source: own illustration

Transparency in the processes facilitates the allocation of responsibilities. Special developments in the process chain can be made comprehensible using transparency of standardized production procedures (quality manuals, daily activity list), own controls and certification in vertically coordinated production chains. As a result the condition for customer acceptance is given.

These measures create a comprehensive, transparent chain which must be delivered to the consumer in form of a compact yet complete message - not as a flood of bits and pieces of information and declarations.

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