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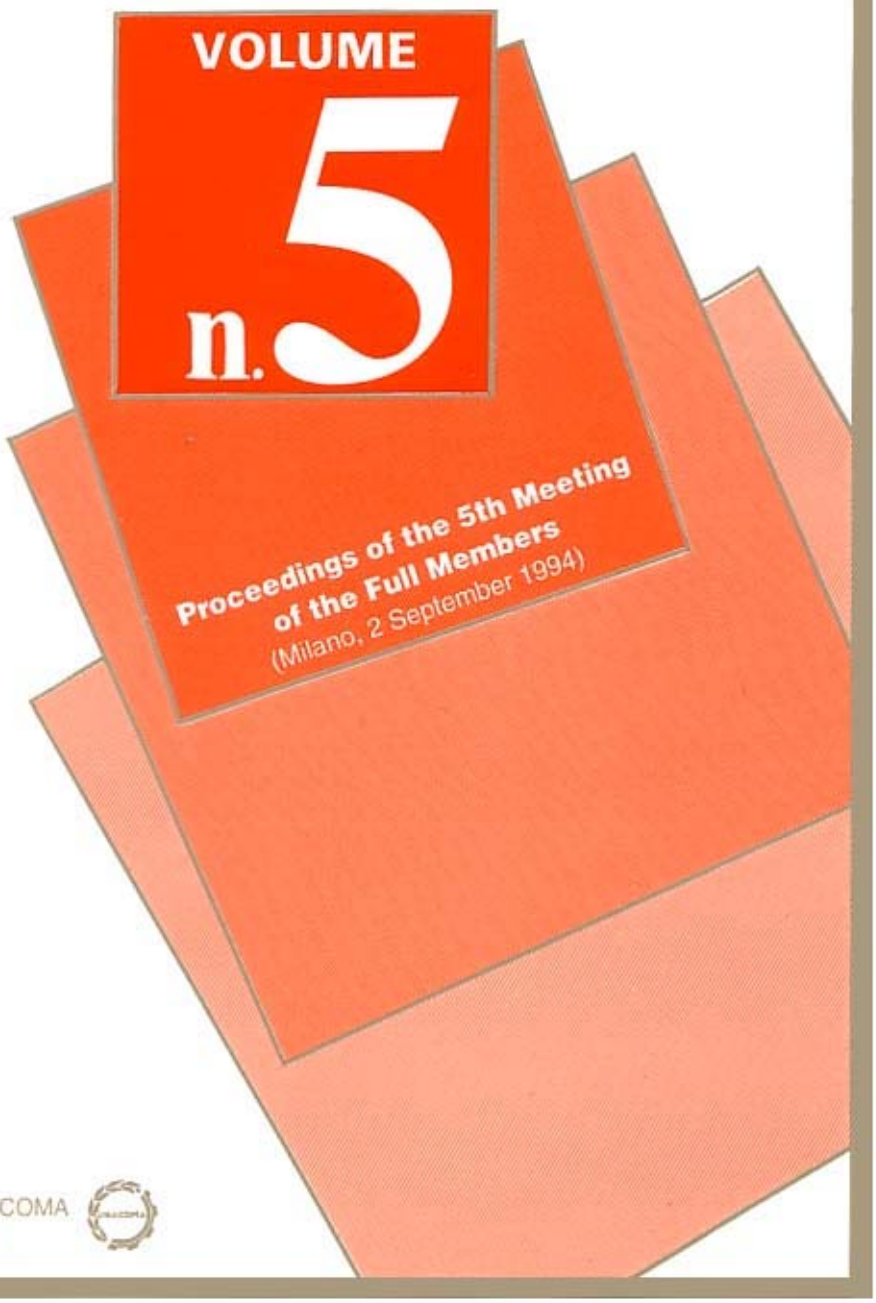

EDIZIONI UNACOMA
SERVICE s.r.l.

CLUB OF BOLOGNA

PROCEEDINGS
OF THE 5TH MEETING
OF THE FULL MEMBERS

Milano

2 September 1994

University Headquarters

Conclusions and Recommendations

Conclusioni e Raccomandazioni

Opening Session

(Special Lecture)

Session 1

List of Participants

Edizioni UNACOMA Service s.r.l. - CIGR

CONCLUSIONS
AND RECOMMENDATIONS

The Club of Bologna met on September 2, 1994 in Milan, on the occasion of the XII C.I.G.R. World Congress and AgEng '94 Conference on Agricultural Engineering. 53 experts from 23 countries participated and discussed the following topics:

i) multifarm use of mechanization in Egypt;

ii) new agricultural machinery design concepts to meet the technical and economic requirements of agriculture;

Conclusions and Recommendations

1. Current issues and critical view on Egyptian farm mechanization multifarm use

(Keynote speaker; M.A. El Hossary - Egypt)

The paper addressed the use of contractors in agriculture, discussed at the 4th meeting held in 1992. The analysis essentially confirms the conclusions reached at the meeting. The following recommendations are shared for many developing countries:

- agricultural co-operatives play an extremely important role in the development of agricultural mechanization. This role should be clearly defined, and future strategy should seek to keep co-operatives within the boundaries of that definition and prevent them from hindering agricultural mechanization in other sectors. Co-operative mechanization should continue to be aimed at the farming communities to encourage equality of mechanization. Hire rates for co-operative machinery should reflect actual costs, and the quality of their operations should be carefully monitored;
- village councils must appoint agricultural engineers directly concerned with the on-farm use of machinery with regard to the establishment of contract hire rates and, most importantly, the establishment and control of minimum quality standards for farm machinery operation;
- in contract service work, all the farmers in a given area must organize their operations so that the same type of work is performed during the same period, before the machinery is moved to another area. A standing order can be applied so that machinery will not be moved excessive distances to serve small areas;
- farm machinery dealers should be encouraged to establish contract services at the village level to perform the following tasks:
  - demonstrate to farmers the benefits of using farm machinery properly and how the machines should be operated and managed. This will promote dealer sales;
  - provide on-the-spot spare parts and maintenance service to farmers and contractors;
- properly managed hire holding companies will generate individual machine ownership and other types of multifarm use alongside the hire service, which to some extent can be complementary to each other. This form of privately owned hire service facilities should continue on a larger scale.

2. New agricultural machinery design concepts to meet the technical and economic requirements of agriculture

The subject was divided into four topics, each examined separately. During the discussions, the participants reached the following conclusions:

2.1 Component flexibility and co-operation as strategic objectives in tractor development

(Keynote speaker: L. Fisher - Germany)

Acknowledging that the world-wide tractor market is relatively small - in western Europe the units sold will be reduced by 60% from 1980 to 2000 - and that there is a growing need to offer tractors capable of coping with farmers' increased technical and economic requirements, the participants concluded that:

- component flexibility can help in coping with rapidly changing world-wide farming conditions, even though a reduction of the components is replaced with improved technology, this doesn't influence the price of the tractors;
- since it is very difficult to convert tractor performance in real income for the clients, component flexibility helps to react to market trends driven by customer expectations caused by political constraints, pedo-climatic conditions and competitive pressures. This means creating appropriate strategies to deal with differentiated markets;
- component flexibility allows for constant technological improvements through applied research and development. This is especially true for electronics and hydraulics. These components are frequently realized by specialized manufacturers linked to the tractor industries;

– component flexibility makes it possible to fill the last market niche, in an effort to keep production volumes above the trend line of shrinking markets.

One of the best ways to guarantee production flexibility is to shift to modular, frame-type tractor design.

The application of this concept could produce the following benefits: inventory reduction (up to 30%); materials handling reduction (up to 60%); lead time reduction (up to 75%); spare parts reduction (up to 50%); floor space reduction (up to 40%).

This could help expand the market and meet farmer's expectations, although this concept is only one important part of the total process. Another contribution towards lower prices should come from a rationalization of logistics and parts dealers run by wheel fitters directly in contact with customers' needs.

The GATT agreement should favour the largest international firms thanks to the elimination of the customs barriers.

The participants stressed how the "industrial approach" to the problem, though technologically shared by all, doesn't take into account the real and varied farm realities.

To achieve this goal, co-operation must be increased between competitors, in connection with suppliers and university research institutions.

The latter must work towards defining the real economic and technical needs of the various agricultural systems in terms of tractor typology, considering suppliers and the individual needs of farmers running their own machines.

2.2 Component flexibility and co-operation as strategic objectives in farm machinery development

(Keynote speaker: W. von Allworden - Germany)

The participants acknowledged that one of the current trends - in the developed countries - is the replacement of tractor-towed implements with specialized self-propelled machines. The purpose is to permit farmers to utilize the technical and economic benefits of modern high technology, often run by suppliers. This has long been a factor in the areas of combine-harvesters, of root and tuber harvesting machines and big balers, while it is beginning to affect the areas of moving, tedding, turning over and swathing of forages.

From the industrial standpoint, this makes it necessary to favour:

- maximum component standardization;
- manufacturing concentration on fewer machine models;
- co-operation with outside firms specialized in assembling the machinery and producing simpler parts especially suited to local requirements;
- manufacturing flexibility to quickly adapt the various models to the specific requirements of contractors and/or farmers.

Still the agricultural machines market is subject to considerable variations during the year with peak periods 2-3 times greater than the average demand.

Up to now we tried to solve the problem by using large storage areas whose costs, however, are passed on to the farmer. To reduce any negative aspects, it is recommended that industries stipulate variable weekly working contracts: reduced hours in idle periods and increased working hours in busy periods. In some cases, two-weekly schedules have been adopted, respectively, 30 and 50 hours per week.

This has resulted in a savings of 10-12% due to reduced storage costs.

The participants agree with the speaker's conclusions and recommend a consolidated effort, including political strategies, to promote this broad industrial transformation to benefit the development of the industry itself, maintain employment levels and reduce the costs of agricultural production.

Industries are invited to be more sensitive towards environmental problems (in particular soil compaction and deformation) giving farmers more flexibility (in field operations) and therefore in production, increasing yields.

2.3 Component flexibility and co-operation from the standpoint of a component supplier

(Keynote speaker: P. Röttgen - Germany)

The development of self-propelled farm machinery can only cover a portion of the numerous farm operations. The problem, therefore, is to improve the production of components for tractor-towed farm machinery and, more specifically, the drive and coupling system. This can be achieved through intense standardization, automation and monitoring of the various operations.

Some examples in this regard were discussed concerning drive line systems and transferable modular design concepts.

A widespread application of these concepts would be consistent with appropriate innovations and standardization of farm machinery manufacturing and international co-operation among machinery manufacturers and component suppliers to optimize the various mechanization chains.

The need to reduce costs is strong enough to favour these new industrial prospects which farmers must bear in mind in order to verify whether the standardized solutions are sufficient to meet the specific requirements (technical and economic) of agricultural production areas.

The participants underline the need for the industry to accept the agricultural requirements and the economic and technical objectives that individual agricultural machines must satisfy. Bearing in mind the absolute need to simplify farming operations, increase productivity, and optimize the organization of labour, it is also recommended the production of environment-friendly machines able to meet the needs of the land.

To achieve this, the participants recommend: closer co-operation between industry and research; allowing improved comprehension of agricultural needs and better design of the tractor-implement system.

2.4 Problems affecting the quality of new food production demand

(Keynote speaker: B. Cheze - France)

In general terms, there is a growing demand to:

- improve the quality of farm products;
- reduce production costs;
- increase value-added at the farm level.

This is due to the growing tendency to view the agro-industrial system (from farm production to processed end product) as an increasingly interconnected whole, hence the need to supply agricultural raw materials particularly suited to subsequent processing operations.

The above is essential to perform the various field operations on a more timely basis, reduce product damage and loss and improve quality.

Consequently, the design of farm machinery must be revised, conceived with specific "itineraries of techniques" in which information technology, modelling, the use of sensors and high technologies play a growing role.

Studies in this field are still at the initial stages, but the participants unanimously recommend that every effort be made to develop them rapidly in order to better meet the requirements of agriculture.

Quality and production standards normatives are of growing importance at the agricultural and the industrial stage. In agricultural terms, improved research of harvesting machines in order to reduce damage and loss is of utmost importance to give the industry products of the highest quality. In industrial terms, in a market that will continue to be conditioned by consumer demand, great benefits can be obtained by imposing quality standards also in terms of homogenization. New industrial "processes" like those recently used in fractionation and recombination are thus essential.

The participants recommend developing activities to meet the above goals.

CONCLUSIONI
E RACCOMANDAZIONI

Il Club di Bologna si è riunito il 2 settembre 1994 a Milano, in occasione del XII C.I.G.R. World Congress of Agricultural Engineering (Congresso Mondiale di Ingegneria Agraria), con la partecipazione di 53 esperti di 23 paesi e ha discusso approfonditamente i seguenti argomenti:

i) uso comune pluriaziendale della meccanizzazione in Egitto;

ii) nuovi criteri di progettazione delle macchine agricole per soddisfare i requisiti tecnici ed economici dell'agricoltura, raggiungendo le seguenti

Conclusioni e Raccomandazioni

1. Analisi critica dell'uso comune pluriaziendale della meccanizzazione agricola in Egitto

(Relatore: M.A. El Hossary - Egitto)

La relazione si inquadra nel tema dell'uso del servizio in conto terzi in agricoltura discusso nel corso del 4th meeting svoltosi nel 1992. L'analisi svolta conferma sostanzialmente le conclusioni raggiunte in detta riunione. In particolare, per molti paesi in via di sviluppo vengono condivise le seguenti raccomandazioni:

- le cooperative agricole giocano un ruolo estremamente importante nello sviluppo della meccanizzazione agricola. Tale ruolo deve essere chiaramente definito. La strategia futura dovrà cercare di mantenere le cooperative entro i limiti di tale definizione ed esse non dovranno impedire la meccanizzazione agricola di altri settori. La meccanizzazione in cooperativa deve continuare ad essere promossa per la parte più povera delle comunità agricole, al fine di incoraggiare l'uguaglianza della meccanizzazione stessa. Le tariffe di noleggio delle macchine in cooperativa devono riflettere i costi attuali e la qualità del loro funzionamento deve essere attentamente controllata;
- i consigli di villaggio devono avvalersi di tecnici agricoli direttamente responsabili dell'utilizzo delle macchine agricole in base a tariffe di noleggio contrattuali ben definite e, più importante, della autonormazione e del controllo degli standard qualitativi minimi nel funzionamento delle macchine stesse;
- un'attività di assistenza clienti deve essere promossa e incoraggiata. Tutti gli agricoltori della stessa area devono organizzare le cose in modo che tutti eseguano lo stesso lavoro nello stesso tempo e prima che le macchine vengano spostate in altro villaggio o tornino alla base. Può essere, in merito, adottato un ordine permanente per evitare che le macchine vengano spostate in aree fra loro poste a distanza eccessiva;
- i commercianti di macchine agricole devono essere incoraggiati a creare servizi di assistenza meccanico-agricola a livello dei villaggi con i seguenti compiti:
    - mostrare agli agricoltori i vantaggi di utilizzare le macchine agricole nel modo giusto e il tipo di funzionamento e manutenzione corretti delle stesse. In tal modo verranno incentivate le vendite;
    - garantire agli agricoltori e ai contoterzisti l'approvvigionamento delle parti di ricambio e i servizi di manutenzione;
- quando le società di noleggio sono gestite in maniera corretta, le macchine di proprietà individuale nonchè altri tipi di utilizzo comune a più aziende appariranno presto in aggiunta al servizio di noleggio e, in una certa misura, le due attività potranno essere intercambiabili e complementari. Queste forme di strutture di noleggio private dovranno svilupparsi su larga scala.

Tali conclusioni sono trasferibili a molti paesi emergenti.

2. Nuovi criteri di progettazione delle macchine agricole per soddisfare i requisiti tecnici ed economici dell'agricoltura

L'argomento è stato suddiviso in quattro sottotemi, discussi separatamente e approfonditamente, allargando il discorso a tutta la problematica della meccanizzazione agricola. Al termine dell'esame i partecipanti hanno raggiunto le seguenti principali conclusioni.

2.1 Flessibilità dei componenti e cooperazione come obiettivi strategici per lo sviluppo dei trattori

(Relatore: L. Fisher - Germania)

Riconosciuto che il mercato dei trattori a livello mondiale è relativamente ridotto e va restringendosi - nell'Europa occidentale si passera' dalle 300.000 unita' vendute nel 1980 alle circa 100.000 dell'anno 2000 - e che crescente è l'esigenza di offrire trattori capaci di far fronte alle aumentate esigenze tecniche ed economiche degli agricoltori, i partecipanti concordano sulle seguenti affermazioni avanzate dal relatore:

- la flessibilità produttiva dei componenti di un trattore è in grado di far fronte alle condizioni in rapido cambiamento dell'agricoltura a livello mondiale, anche se alla riduzione delle componenti stesse fa fronte un aumento della loro sofisticazione, il che non influisce sulla riduzione dei prezzi di vendita dei trattori;
- essendo, comunque, molto difficile tradurre le specifiche dei trattori in valore reale di reddito per i clienti, la flessibilità dei componenti contribuisce a reagire alle tendenze del mercato regolate dalle aspettative dei clienti stessi dovute alle costrizioni politiche, alle condizioni pedo-climatiche e alla pressione della concorrenza. Cio' comporta l'esigenza di realizzare mezzi diversi e appropriati per aree di mercato differenziate, realizzati da piccole unita' produttive locali;
- l'applicazione del concetto di flessibilità produttiva dei componenti dà spazio per costanti miglioramenti tecnici e tecnologici attraverso lo sviluppo della ricerca applicata e di sviluppo. Questa, allo stato attuale, viene tendenzialmente affidata all'esterno, cioe' alle ditte fornitrici di componenti. Cio', in particolare, vale, a esempio, per l'elettronica e l'idraulica;
- l'applicazione del concetto di flessibilità dei componenti consente di coprire nicchie di mercato e contribuisce a mantenere i volumi produttivi al di sopra della linea di tendenza, in via di ridimensionamento, dei mercati.

Una delle possibilità più importanti per garantire la flessibilità della produzione è quella di orientarsi verso una progettazione modulare dei trattori.

L'applicazione di questo concetto potrebbe essere vantaggiosa per la riduzione: del magazzino (fino al 30%), della movimentazione dei materiali (fino al 60%), del tempo impiegato (fino al 75%), dei ricambi (fino al 50%) e degli spazi (fino al 40%).

Ciò potrebbe contribuire ad ampliare il mercato e a far fronte alle nuove aspettative degli agricoltori, anche se questo è solo un aspetto, pur molto importante, del processo totale. Un contributo alla diminuzione dei prezzi, inoltre, dovrebbe derivare da uno sforzo di razionalizzazione della logistica e da magazzini ricambi gestiti da piccole imprese locali (wheel fitters) piu' a contatto con le esigenze degli utenti.

Per quanto riguarda le conseguenze dell'applicazione dell'accordo GATT, questo dovrebbe favorire le grandi imprese internazionali per la progressiva eliminazione delle barriere doganali.

I presenti, tuttavia, hanno rilevato come l'impostazione "industriale" della soluzione del problema, pur tecnicamente e tecnologicamente condividibile, prescinde in gran parte dalla definizione delle reali e specifiche esigenze di campo e produttive delle varie realta' agricole.

Per superare questa carenza, è necessario rafforzare la cooperazione: fra produttori; fra questi e gli agricoltori; fra costruttori e istituti di ricerca, universitari e non. Questi ultimi devono impegnarsi a definire le reali necessita' tecniche ed economiche dei vari sistemi agricoli in termini di tipologia di trattori, tenuto conto sia dello sviluppo dei contoterzisti, sia delle esigenze di gestione in proprio delle macchine da parte dei farmers.

2.2. Flessibilità dei componenti e cooperazione come obiettivi strategici nello sviluppo delle macchine agricole

(Relatore: W. von Allwörden - Germania)

I partecipanti riconoscono che una delle tendenze attuali - almeno per le agricolture dei paesi sviluppati - si manifesta nella sostituzione di macchine agricole operatrici accoppiate a trattori con macchine agricole semoventi e specializzate. Ciò, al fine di consentire agli agricoltori di usufruire dei benefici tecnici ed economici derivanti dall'uso di moderne tecnologie avanzate spesso, peraltro, gestite da contoterzisti.

In particolare, ciò si è già da tempo verificato nel settore delle mietitrebbie, delle macchine da raccolta di radici e tuberi e delle raccogli-imballatrici mentre - a esempio - si sta avviando in quello delle operazioni di taglio, fienagione e raccolta dei foraggi.

Dal punto di vista industriale ciò comporta l'esigenza di favorire:

- la massima standardizzazione dei componenti;
- la concentrazione produttiva verso pochi modelli di macchine;
- la collaborazione con ditte specializzate esterne per l'assemblaggio delle macchine stesse e la realizzazione delle parti più semplici, particolarmente adatte alle esigenze locali;
- la flessibilita' produttiva al fine di poter adattare in breve tempo i vari modelli alle specifiche esigenze di contrattisti e/o agricoltori.

Il mercato delle macchine agricole operatrici, tuttavia, e' soggetto a ampie variazioni nell'arco dell'anno con periodi di punta che possono anche superare di 2-3 volte la richiesta media. Sinora a cio' si e' fatto fronte con un ampio magazzino il cui costo, tuttavia, si ripercuote negativamente sugli agricoltori. Al fine di ridurre l'influenza negativa di questi fatti, il relatore ha auspicato che le industrie possano stipulare coi propri dipendenti contratti di lavoro a impegni settimanali variabili: minori nei periodi di morta e piu' elevati in quelli di punta. In alcuni casi sono stati adottati due orari settimanali, rispettivamente, di 30 e

50 h/settimana. Cio' ha consentito di trarre benefici valutati in riduzioni di costi dell'ordine del 10-12% per riduzione del magazzino scorte.

I partecipanti, concordando col relatore e con le sue conclusioni, non ritengono tuttavia possibile pensare di convertire tutta la meccanizzazione in soluzioni semoventi. Raccomandano, conseguentemente, che si operi, anche a livello di strategie politiche, per favorire comunque questa ampia trasformazione industriale a beneficio sia dello sviluppo dell'industria stessa, sia del mantenimento dell'occupazione, sia della riduzione dei costi della produzione agricola.

Invitano la componente industriale ad una maggiore sensibilita' dei problemi ambientali e, in particolare, dell'esigenza di riduzione del compattamento e della deformazione del terreno, onde fornire anche all'agricoltura una maggiore flessibilita' negli interventi di campo e, quindi, nella produzione, esaltandone le rese.

2.3. Flessibilità dei componenti e cooperazione dal punto di vista del fornitore di componenti

(Relatore: P. Röttgen - Germania)

Lo sviluppo di macchine agricole semoventi non può che coprire alcune delle numerose operazioni agricole. Si pone, pertanto, il problema di migliorare anche la produzione di componenti relativi alle macchine agricole operatrici accoppiabili ai trattori e, in particolare, del sistema di trasmissione e collegamento reciproco. Ciò è ottenibile attraverso forme spinte di standardizzazione, automazione e monitoraggio dello svolgimento delle varie operazioni.

Alcuni esempi, in merito , vengono forniti dal relatore relativamente a "sistemi di guida in linea" e a "concetti modulari di disegno trasferibili".

Le loro applicazioni generalizzate richiedono, tuttavia, una evoluzione costruttiva delle macchine agricole e strette forme di cooperazione internazionale fra i costruttori di esse e i fornitori delle componenti sopracitate al fine di ottimizzare il sistema.

L'esigenza di riduzione dei costi è tale da tendere a favorire tali nuove prospettive industriali delle quali gli agricoltori dovranno tenere conto al fine di verificare se soluzioni standardizzate incontrino le esigenze specifiche (tecniche ed economiche) delle varie produzioni agricole.

I partecipanti, nel concordare sulle conclusioni sopra riportate, sottolineano, tuttavia, l'esigenza da parte dell'industria di comprendere le esigenze agricole e, quindi, gli obiettivi tecnici ed economici che singole macchine agricole devono soddisfare. Cio' anche tenendo conto dell'imprescindibile esigenza che ha il mondo agricolo di semplificare le pratiche colturali, di aumentare la produttivita' del lavoro, di ottimizzarne l'organizzazione del lavoro stesso. A cio' va aggiunta l'esigenza di fornire macchine rispondenti all'obiettivo di protezione ambientale ed alla gestione del territorio rurale.

Anche da questo punto di vista, pertanto, una piu' stretta collaborazione fra mondo industriale e mondo della ricerca e' vivamente da raccomandare, consentendo di pervenire a una migliore comprensione delle esigenze agricole ed alla conseguente piu' approppriata progettazione del sistema trattore-attrezzo.

2.4. Problemi relativi alla qualità di nuove produzioni alimentari

(Relatore: B. Cheze - Francia)

In termini generali si assiste ad una crescente domanda di:

- miglioramento della qualità delle produzioni agricole;
- riduzione dei costi di produzione;
- aumento del valore aggiunto a livello aziendale.

Ciò, in quanto, crescente è la tendenza a considerare il sistema agro-industriale (dalla produzione alla realizzazione dei prodotti trasformati) come un insieme sempre più interconnesso, dal quale deriva l'esigenza di fornire materie prime agricole particolarmente adatte alle successive operazioni di trasformazione.

Quanto sopra incide sulla necessità di svolgere le varie operazioni di campo con: maggiore tempestività; riduzione dei maltrattamenti e delle perdite; miglioramento della qualità.

Da qui l'esigenza di ripensare al disegno delle macchine agricole da concepire all'interno di specifici "itinerari tecnologici" nei quali le tecnologie dell'informazione, la modellizzazione, l'uso dei sensori e, in generale, le tecnologie avanzate sono destinate ad assumere ruolo crescente.

I partecipanti, nel fare proprie le su riportate conclusioni, evidenziano che gli studi in materia sono ancora agli inizi ma che vi e' la necessita' di fare ogni sforzo per svilupparli rapidamente dal punto di vista dell'ingegneria.

Crescente, peraltro, e' l'importanza della normativa di qualita' e degli standards produttivi a livello sia agricolo, sia industriale. In termini agricoli, lo studio piu' approfondito delle macchine da raccolta si' da ridurre i maltrattamenti e le perdite e' da supportare in ogni modo, al fine di offrire all'industria materie prime di piu' elevata qualita'. In termini industriali, poi, in un

mercato che sara' sempre piu' condizionato dalle esigenze del consumatore, grandi benefici saranno ottenuti con l'imposizione generalizzata di standards di qualita' anche in termini di omogeneizzazione. Da qui l'esigenza di utilizzare nuovi "processi" industriali come quelli recentemente applicati di uso del frazionamento e ricombinazione.

Tuttavia, i partecipanti concordano di non poter trarre alcuna raccomandazione di tipo generale se non quella dell'invito a sviluppare attivita' al riguardo.

After the welcome address by Mr. **A. Celli**, President of UNACOMA, prof. **G. Pellizzi** opens the meeting by asking prof. **A.M. El Hossary** and prof. **G. Singh** to act as chairmen. Then gives the floor to prof. El Hossary for his special lecture on contractors.

Prof. A. M. EL HOSSARY

Ministry of Agriculture

Egypt

CURRENT ISSUES AND CRITICAL VIEW ON EGYPTIAN FARM MECHANIZATION MULTIFARM USE

1. Background

1.1 - Different organizations and local institutions were involved in establishing various methods of providing mechanization services to small holders.

1.2 - Individual contractors, small group of farmers and direct ownership by farmers, are providing machinery work to their neighbours.

1.3 - Multi purpose co-operatives with machinery components which started these activities before 1965, played an important role in the development of` agricultural .mechanization in its initial stage.

1.4 - An autonomous government hire service programme has been established to practice deep ploughing, ditching and laser land levelling. The organization is divided into several field amelioration units to improve drainage conditions in areas affected by the Aswan high dam.

1.5 - In 1982 the Government of Egypt launched an ambitious farm mechanization multifarm use program. 97 farm mechanization stations have been inaugurated since 1983.

1.6 - In the last decade, Egyptian agriculture has been injected with large dozes of mechanization activities.

1.7 - The International Agricultural Mechanization Conference held in Cairo from April 27-30, l986, rationalized that years of experience show that the Government tractor hire scheme has failed to be effective or economically viable over the long term.

2. Evaluation of farm machinery hire service activities in Egypt

A wide range of experience has been recorded, during the last twenty years. Here a summary is made on five selected existing custom service forms: Agricultural co-operatives, Government enterprise, Family partnership, Share holding companies and The Nile Valley Renting station, established by FAO/UNDP Project EGY/81/040. This review should not be taken as criticism to anyone in particular concerned with mechanization, but as a guideline to correct any diviation.

2.1 Agricultural co-operatives

The role that the co-operatives have played and continue to play in the development of agricultural mechanization is extremely important. Current hire charges for seed bed preparation involving ploughing twice, levelling, ditching and furrowing are L.E.12.8 per feddan by the co-operative.

The actual cost of these operations using tractor power has been calculated at more than L.E. 20 per feddan.

Among other factors, low utilisation of farm machinery and uneconomic machinery hire charges contributed to the loss in many co-operatives (**Table 1**).

In fact, less than 10% of the total cultivated area is practised by co-operative machinery.

The working of the village level co-operative is not generally satisfactory. The Government is aware of the position and is considering measures for the reorganisation of village co-operatives.

2.2 Government enterprises

2.2.1 Soil Amelioration Authority

After the construction of the Aswan high dam, drainage and soil amelioration programmes increased to control the rising water table and salinity, which are affecting the fertility of the cultivated area. Soil deterioration is being tackled in part by current soil amelioration projects. An autonomous government hire service has been established to practice deep ploughing, ditching and land levelling. The organization is divided into several field units in order to serve different areas; however, the rate per unit of work does not cover the cost of operation (**Table 2**) due to difficulties of administration. The difference between cost and expense is covered by a heavy subsidy granted by the Government.

2.2.2 Public machinery hire service network

Different Organizations and countries have participated in financing a public machinery hire service network. Ninety seven hire service farm machinery stations have been inaugurated since 1983.

The farm machinery hire service network was mainly oriented to the production of strategic crops such as wheat, rice, cotton and sugar cane. Most of the equipment introduced was sophisticated, imported from many sources. this in turn caused repair and spare parts availability problems, and hence many machines are parked in corners of the stations for the want of attention.

Due to technical, economic and administrative reasons, the renting operations were not able to justify crop farm gate prices. The most serious symptoms of the administrative dysfunction are: excessive regulations; surplus employment; poor pay and cost overruns.

They are factors which inevitably lead to pervasive corruption and poor performance. There is a more or less justified feeling that the public sector schemes concerned with machinery hire service are practised without any declared philosophy or clear vision.

Unless the mechanization system is financially profitable for the farmer and economically justified for the country, it cannot be sustained. This is probably why specific reform measures are taken by the Government to keep the size of renting service to the appropriate level. The most important measures taken recently by the government are based on economic privatisation programmes, where priority has been given to agriculture. More than fifteen farm machinery renting stations have been auctioned off and have been sold to the private sector.

2.3 Family partnership

Family partnership is the most common type of custom service existing in Egypt. About 60% of tractors in Egypt are managed by private individuals holding less than 15 feddans. They generally operate the tractors by themselves as a result they are able to perform the work at a reasonable price (**Table 1**). Because hire charges for primary cultivation are presently comparatively unprofitable, most new tractors have been purchased to be used for transport and stationary operations.

2.4 Share holding companies

The Egyptian Government reached the conclusion that the introduction of farm mechanization without flexible, sound management will lead to disaster, and the multy-farm system in particular might be made available through private enterprises. The role of the government is to encourage them technically by offering long term soft loans. In the initial stages government contribution could be as follows:

- offering land to build maintenance and repair facilities at a nominal price;

- training managers, operators and mechanics;
- help to select the suitable tractors and farm machinery;
- provide loan guarantee to the international financing agencies;
- tax exemption for a period of 10 years.

The main purpose of the government supported scheme is the performance of field work. The best results of the scheme have been achieved by the Aswan Company for Mechanised Agriculture (ACMA).

The ACMA is actually providing farm machinery hire service in an area consisting of approximately 50,000 feddans; the main field crops are broad beans and sugar cane.

The ACMA Board of Directors has established a unique base from which to continue the evaluation of mechanized services and its impact on crop production and the farming community. Consequently, results of mechanized production of sugar cane practised by the company showed a reduction in labour time requirements and costs per ton. Mechanical planting reduced the labour requirements by 80% and time needed for planting by 59%.

Consequently, costs of planting per feddan were reduced by 36% as compared to manual planting. Mechanical harvesting resulted in a reduction of 72% in labour requirements per ton of harvested cane and up to 54% of costs of harvest. Mechanical planting resulted in saving of about one ton in seeds (cuttings), used per feddan. Assuming that half of the area of plant crop which represents 25,000 feddan is planted mechanically, the savings in cane cuttings amount to 25,000 tons cane equivalent to 250 tons of sugar.

2.5 The Nile Valley farm machinery hire service

The main purpose of the FAO/UNDP supported project is to establish a village-level farm machinery hire service unit, to serve as a model for private contractors and farmers to follow. The project activities started at Naway village in 1981. Naway is a typical village in Egypt with farm holdings averaging one feddan in size, low farm family income and a very low level of farm mechanization. Decisions were made by FAO and Government officials to test whether such a hire service system could be successful to transfer mechanization technology to a village agricultural production area. The success was to be measured in terms of farmers acceptance, economic viability and the effect of such technology in the production capacity of the village farms.

2.5.1 Farm machinery utilization

The machinery line delivered to the project was similar to the equipment which had been identified as suitable by the Agricultural Mechanization Research Institute (AMRI) (Ministry of Agriculture). This machinery line included heavy duty chisel ploughs and rotary cultivators for tillage, land development equipment, row crop planters and grain drills plus sprayers and inter-row cultivating equipment. Harvesting and threshing machinery were provided on a limited scale in the first two years.

2.5.2 Field operations

All machinery activities are planned on the basis of 10 hours per day. Generally planning is initiated 6-8 weeks prior to the start of the crop season. The local agricultural authority provides information on the projected areas of the crop to be produced and also supplies detailed plans of the field areas in each section of the village which is involved. Hire personnel uses this information to establish preliminary goals for the area to be served, and considers machinery and personnel requirements. All equipment maintenance and repair is scheduled so that the hire machinery is field ready. As soon as the farmer requests are known, final plans for machinery and man power needs are developed. Individuals requesting services are required to sign an agreement to insure that both parties are aware of all requirements that must be fulfilled. The credit needs of each farmer are considered.

2.5.3 Machinery system evaluation

Evaluation of all farm equipment with reference to performance, field efficiency and energy requirements are as follows:

- **Table 2** shows the comparison of convention tillage performance and the combined system offered by the unit at normal circumstances; however, the original tillage programme for cotton called for two chisel plough operations thus required horsepower was 210, time per feddan becomes 3.1 h, energy required increased to 25.2 litres/feddan and costs totalled 36.20 LE.
- **Table 3** shows the reduction of tractor power, time and cost resulting from combining herbicide application and incorporation. The fertilizer application was changed from broadcasting to banding the material adjacent to the rows. Time savings amounted to .66 h/feddan and cost was reduced by 6.24 LE/feddan.

An important aspect of machinery operation was to formulate suitable packages of farm machinery for given local situation in terms of land areas and machine availability.

3. Conclusions

Not all of the farm machinery hire operations being carried out in Egypt are highly effective. This is usually due to unmotivated and poorly trained staff, inadequate facilities and absence of sound planning. More stress has been put on acquiring farm equipment than on the development of an effective hire service system, based on a well organized implementation plan.

The role of the hire service farm machinery schemes owned by the government is vague and still far behind their actual capabilities.

3.1 Efficient management, the key to successful mechanization hire service

The Egyptian experience shows that hire service activities, practised without sound management, lead to catastrophe. A serious lack of trained managers could offset all the benefits that might be gotten from the system. The need for personnel, both technical and professional, must be accurately estimated and management criteria must be formulated.

3.2 Appropriate adoption of transferred mechanization technology

The high import of farm equipment has been for a long time a source of heavy burden on Egypt's economy. Agricultural mechanization is highly location specific, what is useful in a developed country is often not directly transferable to a developing area. Yet more and more sophisticated machines have been introduced in the Egyptian hire network. One of the major components of a comprehensive machinery hire system is the introduction of tested and proven farm mechanization technology packages at the farm level. Applied adaptation of transferred mechanization technology requires fundamental engineering knowledge and information on the product to be handled. The effective planning of a machinery hire service system requires sound knowledge of the agronomic character of the hire service area, characteristics of machine performance and capabilities, as well as economic understanding of the crop production pattern of the area.

3.3 Careful planning of individual farm contact, insures delivery of high quality and profitable farm machinery service

Farm mechanization promotion activities being carried out as services rendered to Egyptian farmers are burdened with low productive time as seen in **Table 1**. As previously mentioned the primary consideration in recommending a farm machinery package is the allowable time frame within which any crop may be established. In the case of the Egyptian conditions the time frame is 30 days. In order to gain maximum utilisation of the equipment every effort should be directed towards working all machines l0 hours per day during the season. Thus an operational time of 300 hours must be used in operating all farm machines during one season. A minimum of 900 operating hours for each tractor have to be devoted for soil and crop conservation every year. The most important activities of the planning phase are listed.

3.3.1 Farm contacts

The individual contact with the farmer-client which is performed by the hire service crop production personnel is considered the most important activity of the planning phase. Farmers are to be advised for the proposed hire service mechanization programme, and various operations and recommendations have to be discussed. All cost information has to be made available to him. Finally those individuals requesting services are required to sign an official request and agreement to insure that both parties are aware of all requirements that must be fulfilled. The interaction between the hire service representative and farmer is crucial.

3.3.2 Operational planning

As soon as the farmer requests are known, operational planning must be initiated 6-8 weeks prior to the start of the crop season. All equipment maintenance and repair is to be scheduled so that the hire service machinery is field ready. Target dates are to be set for starting field operations and a suitable operation period is to be established. Normally an operational calendar is developed for the field operation for the entire season.

3.4 Efficient machinery utilization, substantially reduces a sizeable volume of fuel consumption

As previously noticed most new tractors of 48 kW are used by private entrepreneurs for light transportation and stationary operations which require only 3-6 kW. A sizeable amount of fuel could be saved if more appropriate power were used for such operations. Reduced tillage and combined tillage as practised by The Nile Valley Hire Service Unit - instead of expensive and unnecessary trips over the same land must be encouraged. This type of operation will save both time + fuel consumption.

4. Recommendations

4.1 - While this paper recognised that agricultural co-operatives play an extremely important role in the development of agricultural mechanization, future strategy should not hinder agricultural mechanization in other sectors. Co-operatives mechanization should continue to be aimed at the poorer section of the farming community to encourage equality of mechanization, hire rates for co-operative machinery should reflect actual costs and the quality of the operations should be carefully monitored.

4.2 - Village councils should appoint an agricultural engineer who would be responsible for on farm machinery use, contract hire rates and, most important, the establishment and control of minimum standards of quality of farm machinery operations.

4.3 - In custom service work, all the farmers in the same area have to make arrangements so that they all have the same kind of work carried out at the same time before the machines are moved to another village or return to their base. Standing orders can be applied to prevent machines from being moved excessively long distances to serve a small area.

4.4 - Farm machinery dealers should be encouraged to establish farm machinery custom service at the village level to perform the following tasks:

- demonstrating to farmers the benefits of using farm machinery in the right way and how the machines should be operated and managed. This will promote sales;
- farmers and contractors will be able to get spare parts and maintenance service on the spot.

4.5 - When hire holding companies are correctly run proper way, individually owned machines as well as other types of multifarm equipment will also operate in addition to hire service. This form of privately owned hire service facility should continue on a larger scale.

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Table 1 Cost of tractor work by different enterprises compared with actual hire service rates (February, 1993)

	A	B		C	D
Tractor power (HP)	--------	--------	60	--------	--------
Annual average use (h)	700	820		1,400	1,200
Tractor average life (h)	5,600	6,560		11,200	9,600
Tractor average cost (LE)	--------	--------	35000	--------	--------
Cost/Working hour	--------	--------	LE	--------	--------
Depreciation	6.25	5.33		3.13	3.6
Interest	4.00	3.40		2.00	2.33
Fuel & Lub.	4.32	4.32		4.32	4.32
Repair & Maintenance	6.87	5.82		4.88	3.46
Operator	0.90	0.95		1.20	1.50
Overheads	1.00	1.82		--	0.73
Total Cost	23.34	21.64		15.53	15.94
Actual Hire Rate	13.30	14.00		17.50	17.75
Amount of Subsidy or loss	10.04	7.64		--	--
Profit	00.00	00.00		1.97	1.81

Table 2 Summary of comparative performance of conventional and improved, combined tillage, Naway Village

Maize, Broad Beans			
	Conventional Tillage	Combined Tillage	Reduction
Horsepower (HP)	135	110	25
Machine time (h/fed)	2	0.8	1.2
Fuel (l/fed)	16.2	10.6	5.6
Cost (LE/fed)	23.16	13.27	9.89
Cotton			
Horsepower (HP)	210	110	100
Machine time (h/fed)	3.1	0.8	2.3
Fuel (l/fed)	25.2	10.6	14.6
Cost (LE/fed)	36.20	13.27	22.93

Table 3 Reduction of tractor power and cost resulting from combining herbicide application and incorporation

	Conventional Operation Sprayer, Rotary Tiller	Combined (Sprayer/Incorporation)	Reduction
Horsepower (HP)	100	40	60
Machine time (h/fed)	1.06	0.4	0.66
Cost (LE/fed)	11.66	5.4	6.24

Session 1

New Agricultural Machinery Design Concepts to Meet the Technical and Economic Requirements of Agriculture

Chairman: A.M. EL HOSSARY

Dr. LOTHAR FISCHER

Deutz

Germany

COMPONENT FLEXIBILITY AND CO-OPERATION AS STRATEGIC OBJECTIVES FOR TRACTOR DEVELOPMENT

1. Introduction of the Company

Why we need flexibility?

1.1 Manufacturing in Germany

PROS

Well educated workmen

Central location for western European markets

Highly demanding customers require innovative tractor manufacturers.

CONS

World champion:

- in high labour cost and overheads
- in low working hours
- in high absentee rates

Union and management behaviour

Trends of farm economy are vague

Manufacturing in Germany needs to concentrate on core business.

Component flexibility helps to cope with the rapidly changing conditions in world-wide supplier environment.

1.2 Future customer expectations

How much do we know about future customer expectations?

Generally, Mr. Customer tells us to be better than competition is today.

How well can we match customers' economic expectations?

Markets and conditions are fragmented. Many times, specifications are sales advantages rather than cash for the customer.

Component flexibility helps to react to market trends driven by customer expectations due to political constraints, weather conditions, competitive pressures.

1.3 Engineering development cycles

How many tractor manufacturers can afford to design and build a complete new product line?

A new tractor generation needs years of engineering and a huge amount of money to restructure the facilities.

In shrinking markets, it becomes even more difficult to achieve an acceptable return for the investment.

Consequently, tractor manufacturers tend to improve the products in constant steps.

Component flexibility gives engineers room for constant improvements.

1.4 Competitive environment

How many tractor manufacturers earn enough money to invest in the future?

As long as there is over production, no one can expect relief in the price war.

Cost reduction by manpower cuts and outsourcing of material into lower cost countries is not at an end.

Closing of manufacturing plants as well as the rearrangement of marketing activities are slow going, but necessary steps into the right direction.

Component flexibility fills the last market niche by trying to keep production volumes above the trend line of the shrinking markets.

Unfortunately, this flexibility creates an additional burden of increasing specifications.

A concept of component flexibility is demonstrated on the 6000/7000 Series tractor design concept.

Why did John Deere move to a **modular frame type** tractor design concept? (**Fig. 1**)

Flexible ordering system

> 70 to 120 CV tractors to be delivered world-wide with minimum inventories and made available in about 100 different countries.

Assembly flexibility

> Single order process at the assembly line.

Manufacturing flexibility

> Core components are produced on flexible machine tools or in process related cells (**Figg. 2, 3 and 4**).

Throughput-time reduction

> Cut through-put time by 80%.

Cost comparison

> Total costs to be reduced in spite of sophisticated specifications in base tractor such as (**Fig. 5**):
>
> Engine performance
>
> Power on demand hydr. system
>
> Noise level at 72 (dBA)
>
> Automatic ventilation inside the cab
>
> Fold-away passenger seat
>
> Tiltable instrument pod
>
> Tiltable cab
>
> Poly V-belt automatic tensioner

The second part of my presentation deals with a new world for us. For a long time, Deere was proud in being able to handle all our issues ourselves. We now say: can co-operation be an answer to handling the issues even better?

1.5 Co-operation with competition

Next to our feelings, our brain should tell us that alliances are necessary to cover the wide range of products for the many fragmented markets all over the world.

The biggest hurdle for a marketing division is always parallel marketing.

Over the last decades many tractor manufacturers have become leaders in their core market (Ford in the U.K., Fendt in Germany, Renault in France). By concentrating on the strength of a product line and co-operating with competitors on the short, mostly non-profitable end of ones' own products, improves both sides' situation. A component flow chart (**Fig. 6**), prepared by France Agricole, clearly demonstrates today's activities among competition. Phase-out of some tractor manufacturers may ease this situation in the long run.

1.6 Co-operation with suppliers

Compared to the automotive industry, the agricultural machinery manufacturers never had the power to act the way some managers with billions of purchase volumes do. A large percentage of our industry relies on suppliers' production and engineering know-how.

Quantum leaps in material specifications, in hydraulics and electronics lead our limited engineering resources to co-operate even more with suppliers.

Purchasing managers learned that long term relationships with certified suppliers are of more benefit to a total quality environment than the short term rush for the lowest bidder.

Know-how transfer on quality, logistics and engineering is necessary, especially when dealing with lower cost countries (**Fig. 7**)

1.7 Co-operation with institutes

There is no question that the agricultural machinery industry and institutes such as universities need to work closer together. The limited engineering resources of the companies, the limited funds for development of institutes and the growing demand for changes will link the partners closer together than ever before.

Many companies also have to cut engineering costs which results in lower budgets and less engineers employed. On the other hand, the qualification of the engineers must be improved.

An early involvement of students and engineers from universities in the development processes allows manufacturers to make sound decisions in hiring new engineering talent.

Without doubt, John Deere has committed itself to be a flexible, customer oriented agricultural machinery manufacturer.

Component flexibility is only one, but important part of the total process.

An even more important aspect of flexibility is to change the attitude towards employment. However, this is another difficult task.

I hope my paper has demonstrated the necessity and the benefits of a **flexible manufacturing environment.**

Fig. 1 - John Deere 6000 Series: modular design

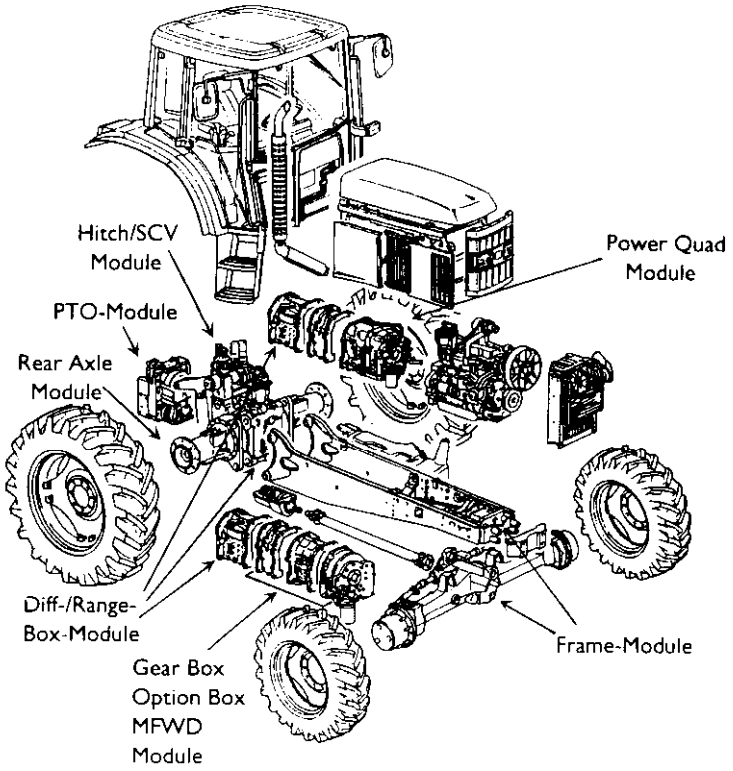


Fig. 2 - Module manufacturing benefits

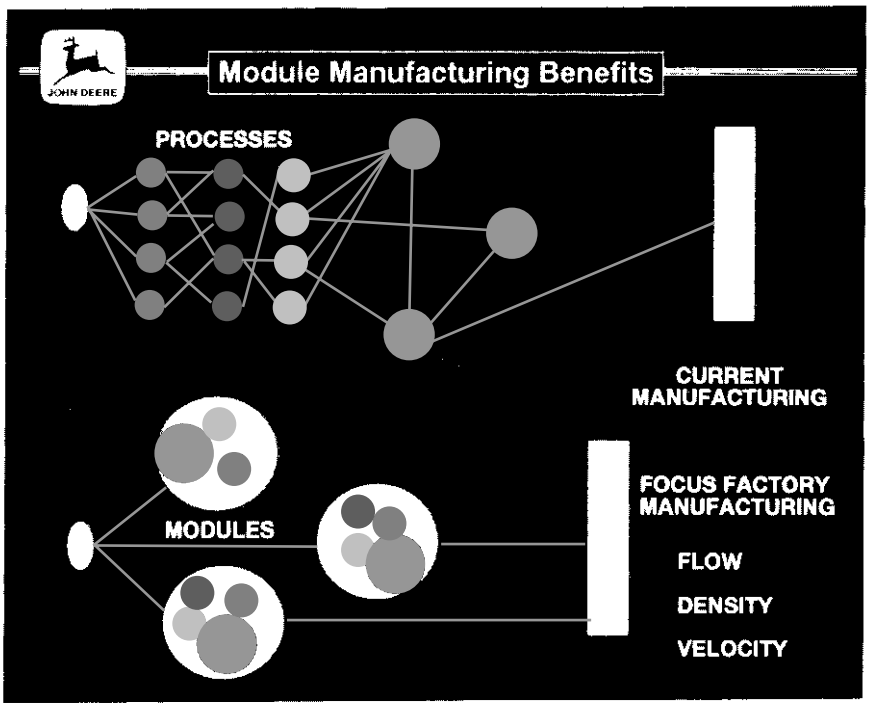


Fig. 3 - Interfaces: the example of PTO shaft

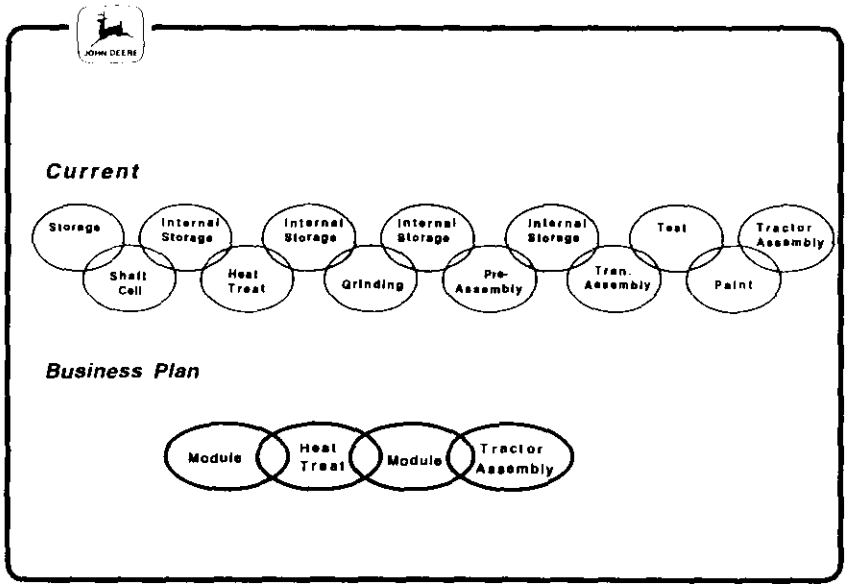


Fig. 4 - Reduced complexity

	50 Series and 6000	6000 only	Change (%)
Manufactured parts	2,445	640	74
Operations	14,500	3,800	74
Assemblies	6,500	1,430	78
Purchased parts	12,500	3,600	71
Suppliers	624	291	53

Fig. 5 - Benefits of a modular focused factory

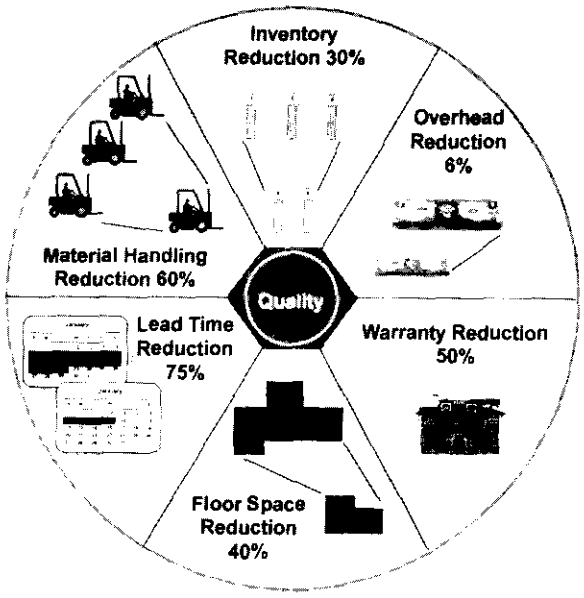


Fig. 6 - Flow chart concerning tractor manufacturers and their relations

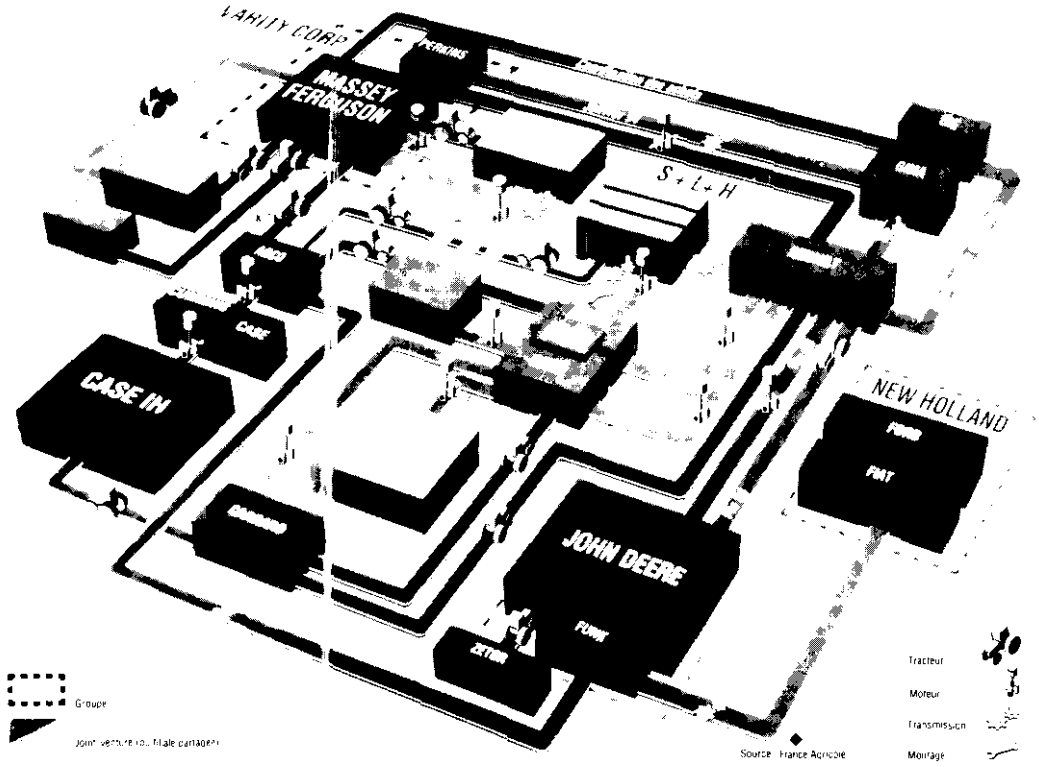
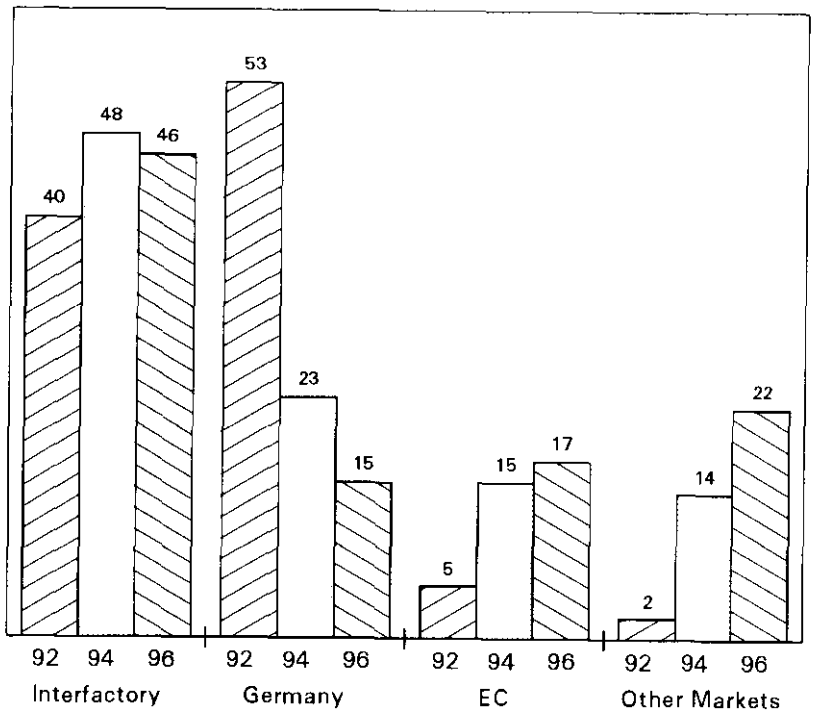


Fig. 7 - Global sourcing development (1992-1996 as a percent of total)

Fig. 7 - Global sourcing development (1992-1996 as a percent of total)



G. PELLIZZI

I am very glad to hear that you are reducing complexity and increasing flexibility, but I wonder what is the impact of such action on the cost of equipment. Nowadays farmers are not always able to buy very expensive equipment. So, my question is: has the reduction of the complexity by 74% in manufacturing parts, a positive impact on the production cost, as well as on the selling price?.

L. FISCHER

Yes and no. Together with this reduction in complexity, we have an increase of requirements from the market (at least in Western Europe): the customer demands higher, more sophisticated specifications. I personally believe that Western European manufacturers have to define their niches - and a niche may be 20,000 tractors a year - to live with or to learn to live with. I have serious doubts that we will be able to produce a low-cost tractor in Mannheim. The labour costs are too high and there are other countries which have lower-specified tractors that are the right technology for other, non Western European, countries. They can handle a low- cost tractor better than we can in Germany.

Prof. Gayendra SINGH

Thailand

We talk a lot about close relationships between industry and academic bodies and politicians. Can you tell us how the Deere company has travelled with this relationship, what level, and is it functioning?

L. FISCHER

The relationships of farm machinery industry to politicians or to institutes which guide the situation in a specific country are so different that I would say in Europe Deere has been able only in a few cases to discuss or to change or to be part of the trend of what will go on in farm industry.

We do have contacts with developing countries where we can say "we would propose to do this or that". We make an offer and we bring in a variety of machine tools, from various manufacturers not only Deere. I think this is beneficial for both sides.

With a 50% market share, we are dominating the North American market; but I have serious doubts that in the Western world a farm industry manufacturer can influence the political situation. We are always surprised at how one political decision can harm our results.

As far as contacts with the academic world are concerned, Deere does not do that, and it hasn't done it in the past. I see a need to have closer contacts with Universities and Institutes, but I would not go as far as saying that we pay professors in Universities to exchange information. I think that there are other ways to have contacts to do that. In our case, in Mannheim, hired a professor about three years ago, and I did it not only because when I met the man the first time I felt good to hire him but also I had in mind to get in closer contact to the universities by hiring one of your colleagues.

Prof. Jaime ORTIZ CAÑAVATE

Spain

You have mentioned that the modularization of the tractor is positive for manufacturing because you have less parts in the tractor. I think this will also reduce manufacturing costs. But what about the spare parts? When the parts have to be replaced maybe they are more expensive because they are more complex.

L. FISCHER

You are definitely right. We have started a process to engineer spare parts. I don't know how other companies handle that, but Deere designed new products and, since it was always under pressure for time or costs, we didn't pay much attention to spare parts. As long as a farmer could pay for it we were happy, and this was good business. I strongly believe - and we have started this process - that we have to design spare parts. We have a procedure to supply spare parts for fifteen years, but we are also supplying parts even up to 20 years. In many cases those parts also become so expensive, for us as a manufacturer, that we will redesign spare parts. We will select families, redesign them, and we will also redesign in a way that in many cases spare parts can be exchanged for old types. We are dealing with about 20,000 spare parts, so we can improve.

Prof. Kyeong Uk KIM

Korea

You said the customers in Western European countries demand specialized specifications of tractors. Is there any reason why the farmers need so many specifications for their tractors?

Another question: how many customer orders do you need to change the production system to the modular type? And, compared to the conventional production system, if you want to change the production system to modular type then you have to have a minimum number of customer orders to adjust your production systems.

L. FISCHER

As I mentioned before, I have some doubts whether all the specifications we offer on the market - some of them are often due to the fact that competition is offering them (we are fighting for the last percentage of the market) - pay off for the customer. It is very difficult to demonstrate the savings for the customer. The customer in Western Europe on the other hand can only make money if he produces more. So he was willing to pay more for the product, if he could harvest more.

There is a trend also in standardization, especially in the lower end of the tractors. On the upper end of the tractors we are dealing with professionals as customers, and they really calculate what and when they are investing and the output.

As for Korea. I would say that we deliver a standardized tractor to Korea which is not standard at all in other countries of the world. Your rice application is quite difficult and we had to design special axles for the kind of tractors you use in the rice fields. When you deliver to a hundred different countries in the world, the variety of needs changes very much. Even in Western Europe you will find that basically the Dutch farmers and the German farmers are pretty much alike, but once you go to the UK or to the Southern countries you have a different situation.

The advantage of a manufacturer like Fendt, who basically concentrates his efforts in Germany, Holland and parts of France, is that he can relate more to the needs that are there; but manufacturers like us, who are acting worldwide, we have to respond to the various needs of the markets.

Prof. H. GOELICH

Germany

As we are here also to talk about strategic developments in our society and while we have a lot of participants here that are responsible for education, I would like to underline one point you mentioned in your last sentence: i.e. the flexibility of the people, the flexibility of the employees.

Maybe you could add some additional words to this little remark you made.

L. FISCHER

I fully agree with your point. I only mentioned it in one sentence because I wanted to demonstrate that product flexibility is one thing - and this was the topic of today. It was not a topic of discussion to talk of flexibility within our workmanship. I personally spend about 90% of my time dealing with our people, trying to change their attitude. It is a very difficult subject and in many cases it is an impossible task. Based on my personal experience I would say that 30% of management is not capable of changing anymore. This is not just a question of age, it's a question of mentality in many cases.

One-third are really progressive and go for these new ideas. The other third go along with us, buth these are not the inventors.

Yes, we have to lay off about 30% of our management, for they cannot cope with the future requirements of our employees. This was part of the other aspects I mentioned, that we have to work more closely with you, with the institutes, to have the ability to hire excellent people. We will only hire a few people, this is the problem; but those we hire have to be excellent.

Dr. Adrianus RIJK

FAO

Italy

What we see also is that for the developing world the Western European and the North American-designed tractors are far too sophisticated. Now I would have assumed that with the modular type of design there could be packages offered which would be less sophisticated, easier to maintain, easier to operate, etc. for the developing countries. But I understand that you'd rather recommend these countries to go to another supplier because your product is too sophisticated. For example, Colombia acquired John Deere from Mannheim until recently and they were told "Sorry, we cannot supply you any longer because we don't want to run a batch without the cabin on it" (which for the Colombian farmer is just too expensive).

My first question is whether indeed the situation is such that you say "The developing world should not look at John Deere anymore, they'd better look to India or to Argentina (who produces a John Deere model), or Brazil, or China coming up, or Eastern Europe".

My second question relates to Indonesia. We have finalized a study ("Mechanization Policy and Strategy Study") for Indonesia and one of the findings of the consultant team is that local assembling of tractors is something which is totally out of rap with the volume a country like Indonesia buys on that size of tractors. In terms of cost effectiveness I wonder whether it was for John Deere cheaper to have tractors shipped in containers to Indonesia to manufacture locally, or whether you just cater for that market because of political reasons.

My third question is relating to cost. You said that Germany is becoming a high-cost country. Are you looking to Central-Eastern Europe as a possible place for starting manufacture?

L. FISCHER

The concept allows to reduce specifications and functions up to a certain point. This willl not become a "cheapie" system. But we are despatcing this type of tractor to an extent where especially in South America these tractors will be used very much. We also have liaisons with a Czeck company (ZETOR). They supply components on our behalf, to Mexico as an example. So we will have various families available for those kinds of markets - and they are, again, fragmented. Besides cheap tractors, you also need some sophistication in various countries. Brazil and Argentina are pretty much the same, but even Mexico is quite different from Brazil. I think we can have an answer pretty soon for those markets.

An answer to your question regarding Indonesia, whether it is worthwhile to build tractors there or to ship components there and assemble the tractors, I cannot give you a really clear-cut answer. Let me say that the Asian market is a very important one for us. We do have a know-how contract with Chinese companies on combines and tractors, and we are in contact with them for the exchange of components. We have delivered the know-how, now they start production and we will buy lower-cost components with, most probably, the same quality as we have here in Germany. But there will be an exchange of components: there are components they have difficulties manufacturing. In many of these countries there are still problems to poor good cast iron. So the exchange of components will be possible. But it is my belief that in the longer run it doesn't make sense to try to deliver goods out of Western Europe into Asian markets. We can't compete on price. I believe parts and/or components should be produced within the market environment. This gives you direct information of what you need in these markets.

We have close contacts with India. With India it is not a question of quality, I think they are as good and in some cases even better than we are. We have to define and make decisions on logistics; I think this can be handled by having stores over here in Europe. On one side, once you go to just-in-time concepts and direct delivery to point of use, those markets further East or in Brazil are a little more difficult to handle. But we are dealing with this confrontation and we will find ways.

As far as the third question is concerned, we are already doing business with manufacturers in Eastern Europe (in Poland, in the Czech Republic, in Slovakia) and we will do more of it.

The situation is completely different in the former Soviet Union. I think all of us have been there many times and talked to people. The political situation, the management you can work with, the financial aspects are so difficult that we believe that we have to stay in contact with these companies. We can't produce here in Western Europe and just ship products to these States. We have to bear in mind that those competitors in former years, like Bielorussia or Kiev, etc. all employ between 30 and 50 thousand employees, they want and need to work. I think the way to do business with the former Soviet Union in the future will be joint ventures, to transfer know-how and to exchange components and to get into the market. Financially it is a risk you can't take today.

Dr. Brian J. LEGG

UK

In some other industrial sectors there has been a positive policy of reducing the amount of in-house research and development and increasing the amount of research and development that is contracted to outside organizations. The reason for this is that where technology is changing very quickly it gives flexibility in research, because you can go to the centers that are at the forefront of a new technology. Are you or other tractor manufacturers likely to adopt this policy?

L. FISCHER

We are going in that direction, for two reasons. Our Chairman clearly spelled out that he isn't willing to pay 270 million US $s every year anymore and he is questioning the output of our engineering environment. In a big company it tends to become bureaucratic.

There is another reason: we can't follow the pace of change in areas such as hydraulics, electronics and systems and therefore we are buying shares of small entrepreneurial-type engineering companies. Recently John Deere bought shares in three

electronics companies; sometimes small companies having only 50 employees, and we participate in their development. We don't necessarily have to buy the majority packet, sometimes 10% of their stock is good enough to prepare a workmanship, to prepare an ownership and to be more flexible in the future and deal with a state-of-the-art development.

Mr. Yoshisuke KISHIDA

Japan

I doubt that the tractor demand in developed countries is saturated and the biggest potential demand could be in the developing countries or in less-developed countries. What kind of general strategy are you thinking of to develop the market in developing countries or in less-developed countries?

L. FISCHER

I don't think we can generalize about developing countries. It's different in South America, different in Africa, and even within these big continents it varies very much. There are bonded markets (like Pakistan or up to recently India). I think we cannot give a general answer to that. We have to investigate that case by case. But as I said, to a certain extent we have to get closer into the market and Deere's philosophy for the future is to get away from these huge factories employing up to 10-13,000 people. The Americans especially think big is better. We are changing that idea and focusing on special markets, special products, to be flexible and more efficient. Everyone who has ever handled a big factory, I would say above 1,000 employees, knows how difficult it is to guide. It is much more pleasant - and I have had a chance to work in both kinds of factories, the small ones and the big ones - to deal with small enterprises. On the other hand it is impossible to say: will we build production facilities or will we build a joint venture in every developing country? The quantities, at least for now, are too low.

Prof. Brian D. WITNEY

UK

My question relates to an earlier question, on effectively, repair costs. System liability is governed by the total number of components. If you go to modularization, will the improvement in reliability offset the increase in the cost of repairing a complete module?

L. FISCHER

Yes; definitely. We have invested in the design for better repair capabilities and into lifetime components (we have lifetime brakes and lifetime clutches), we have a wet-clutch system, which is more expensive than the dry-clutch; we do not get anything from the market, we have to compete on the complete price of a tractor, but the customer knows that after 500 or 5,000 hours of work he doesn't have to replace the clutch. We have a tiltable cab, so that we can exchange the complete drive train much faster than we could do before. Also, replacing filters is much easier to do than before. It was an objective for our engineers and service engineers to reduce service time by about 50%. I think we have more or less achieved that.

Ing. W. von ALLWÖRDEN

Deutz Fahr

Germany

COMPONENT FLEXIBILITY AND CO-OPERATION AS STRATEGIC OBJECTIVES FOR AGRICULTURAL MACHINES DEVELOPMENT

1. Introduction

The decrease in demand in the agricultural technology markets of Western Europe resulted in 1993 from the known structural changes in agriculture. This will also continue in the future. The GATT resolutions increased the pressure on the farmers to intensify efficiency and productivity. These resolutions determine the disutilization of land and the adaptation of manufacturers` prices to the standards of the world market. This accelerated the process of concentration in Europe. For example, the number of farms in the former Federal Republic of Germany - where the average size of a farm is less than 20 hectares - has decreased by more than 25% to below 600,000. At the same time the number of farms with more than 50 hectares increased by 67% to more than 50,000; while in the former GDR the 20,000 farms had an average size of 275 hectares in 1993.

Total demand has decreased again in Western Europe

Although the share of professional and efficient machinery increases, the total number of sold tractors and combine harvesters continued to decrease throughout 1993 in Germany as well as in Western Europe. In Western Europe total demand for tractors dropped by 8% and for combine harvesters even decreased by 19% or over 50% during the last 4 years (**Fig. 1**).

2. Agricultural machinery cannibalism by self-propelled machines

Under the term "product-cannibalism" we mean the replacement of tractor driven implements by self-propelled harvesting machines. In this manner the self-propelled machine "cannibalizes", i.e. eats or devours, the pulled machinery. Self-propelled harvesting devices will increasingly dominate, in order to eliminate unnecessary process steps and high personnel costs and thus enable the employment of a qualified crew during the harvesting season.

The self propelled machinery in mainly employed on large farms and by subcontractors. This enables smaller farms to enjoy the benefits of modern, high-tech. machinery in order to work more efficiently. The structural changes and the plus on productivity results in decreasing volume.

The change from tractor-driven to self-propelled machines is already completed with the self-propelled corn chopper and the combine harvester.

Moreover, tractor-driven balers will be replaced by the self-propelled big baler, which will provide a significant increase in efficiency. One self-propelled square baler replaces the output of more than two tractor-driven balers. (One tractor-driven square baler replaces roughly three round balers, each round baler has replaced three conventional balers).

The next change will be the grass-liner which replaces a number of operations such as mowing, tedding and multiple turning over and swathing. In addition, this technique results in fewer losses or wastes since the expensive labour processes in the field are eliminated and the hay or silage is deposited in a single process, in a homogenous mat on the field (**Fig. 2**).

3. System of equal components for different harvesters

As a manufacturer of combines, we have recognized the change and the need for more self-propelled harvesters. We noted that the quantity to be produced will be very low compared to the conventional machinery.

We set up a system of interchangeable components as shown on **Fig. 3**.

By standardizing these components it was possible to increase the production number on these parts. This resulted in low production cost and flexibility in timing of the individual product-steps. Nevertheless development time in the engineering department is much shorter and concentrated on the typical functions of the harvester which has to be developed. Standardized parts are designed in a CAD-system, with this they can be recorded and placed around the main frame easily.

4. System of equal headers for harvesters

There are 8 standard adapters for self propelled harvesters, which are interchangeable for different harvest operations. The component system reduces the part variants. This reduction again produces the same effect as described in the components section (**Fig. 4**).

5. Production to replace the component system

A variety of harvester-types and lower production volumes have a negative effect on production. Therefore it is necessary to avoid a mixed production of various products.

The part production has to be concentrated on know-how parts and parts which are transportable only by high costs. The components around the know-how parts are distributed among system suppliers (specialists).

The mixed assembly becomes possible as shown in **Fig. 5** thus the assembly line and the supplied components are always at the same place of assembly.

Fig. 1 - Change of relative increase by shifting performance classes in Western Europe (combine harvester)

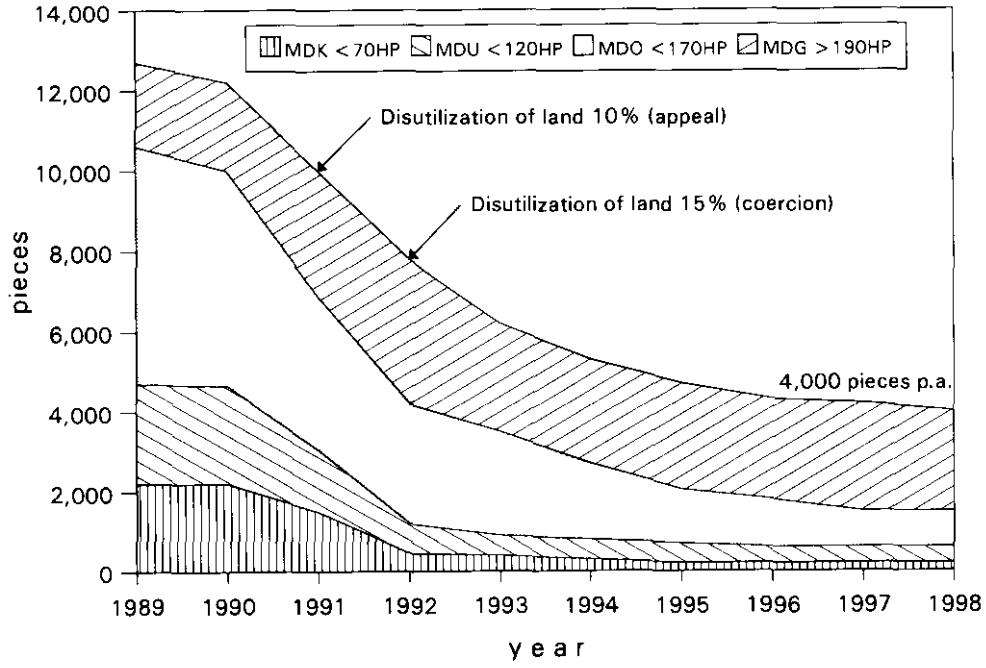


Fig. 2 - Farm machinery product-cannibalism

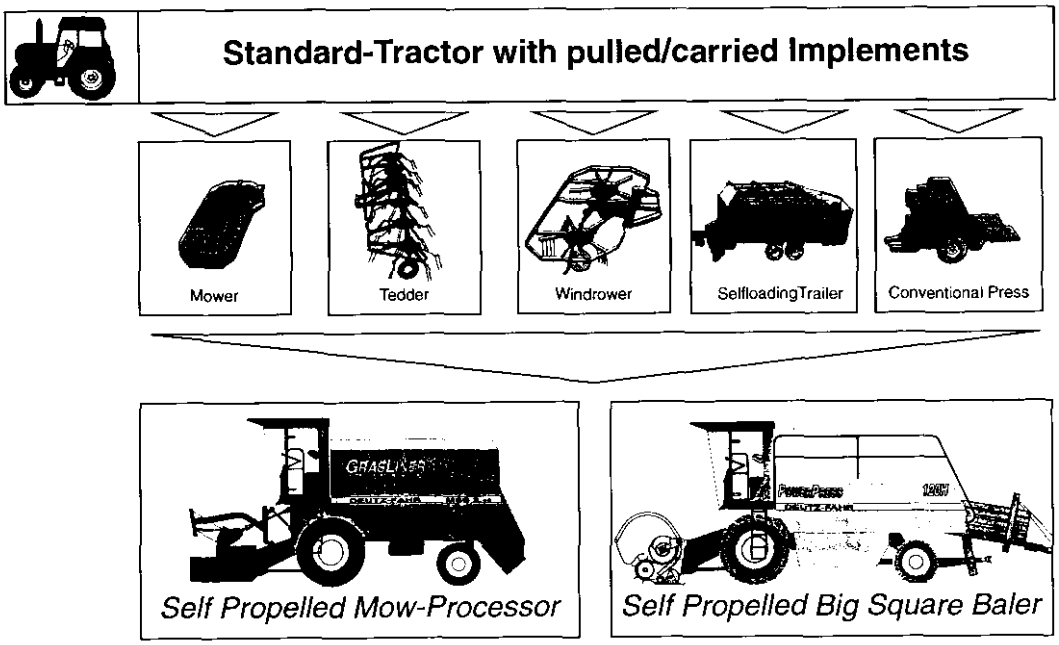


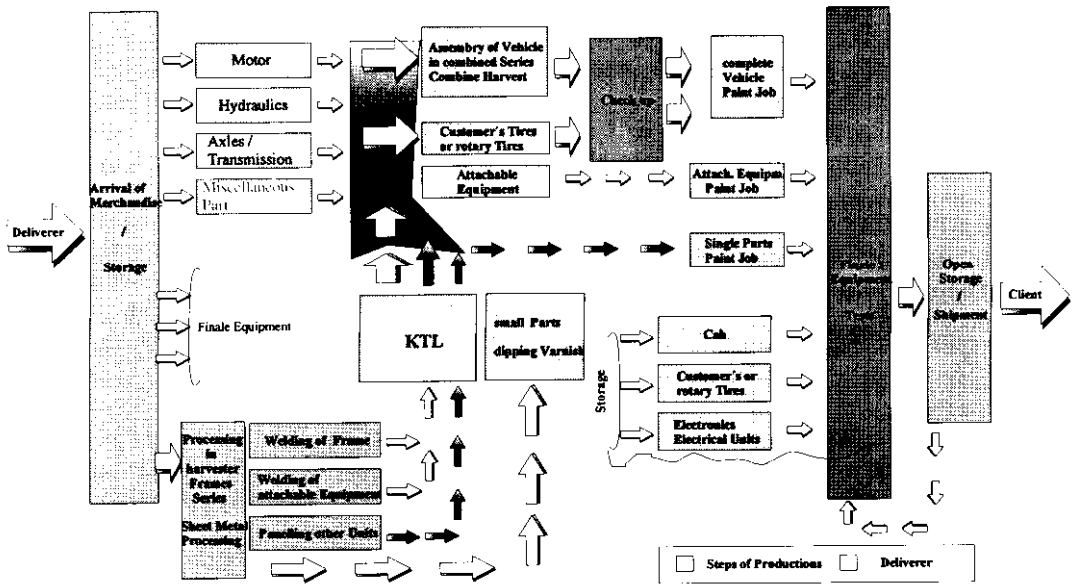
Fig. 3 - Components for self-propelled machines

Group	Name	Number	Combine Harvester	PowerPress	Forage Harvester	Gras-Liner	Mower Conditioner
	Engine	3	1013 R6/1015 V6	1013 R6	1013 R6 1015 V6 / V8	1013 R6	1013 R6
	Axle Transmision	3 2	2 2	1 1	2 2	1 1	1 -
	Tyre	1	1	1	1	1	1
	Hydraulics	3	2	1	2	1	1
	Feed Passage	2	2	Parts	-	1	-
	Frame Lettering	7	2	1	2	1	1
	Cab	1	1	1	1	1	1
	Electr.Equipm.	Kit	←	←	90% ident.	←	←
	Air Condition	1	1	1	1	1	1
	Tools	1	1	1	1	1	1

Fig. 4 - Adapter for self-propelled machines

Group	Name	Number	Combine Harvester	PowerPress	Forage Harvester	GrasLiner	Mower Conditioner
	Cutting Table for Grain	6	6	3	3	2	-
	Cutting Table f.green Crop	3	-	1	2	2	3
	Cutting Table for Gras	2	-	-	2	2	2
	Corn Picker	3	3	-	-	-	-
	Corn Picker	2	-	2	2	-	-
	Crusher	1	-	1	1	-	-
	Pick-up	3	3	3	3	-	-

Fig. 5 - Combine harvester production process



B. WITNEY

The self-propelled machinery market is a top-of-the-range part of the market. How much of the expansion of your machinery range in this area has been influenced by the development of contractors, rather than sales to individual farmers?

W. von ALLWÖRDEN

Today approx. 80% of our production is going to subcontractors or large farms; we sell 80% of the combines 200 HP and up in Western Europe.

Mr. Bernard CHEZE

France

You indicate with two arrows the decrease linked to the fallow land (10-15%). But how do you explain the first, and the others?

W. von ALLWÖRDEN

When this started to be discussed everybody stopped buying combines to see what really happened. We think now as the weather was dry and the price per ton from beet raises that we will not go as fast as it went in the last three years. But it can. We know it. Our customer farmers can live one year without buying one machine.

Prof. H.D. KUTZBACH

Germany

I know you have different specifications in the combines too, to react to the customers' demands. Do you have them on mixed assembly line? And how can you react to customer needs with your different specifications?

W. von ALLWÖRDEN

We have different specifications. The specifications start with a typical North-African combine which still has up-track possibilities and does not have a grain tank. But we can assemble this in a mix because of our component system.

We are able to produce customer-specified machines in two weeks. But our problem is that too few customers ask at the right time for a combine. They ask in May-June but we have workers to pay around the year. We could overcome this problem with a new contract with the Unions, which would allow us to go up to 50 hours before the season and go down to 30 hours behind the season, and the time remaining spent on holidays (another two weeks). That means that when the threshing season starts and the combines are supplied to the customers, the 1st of August, we start with six weeks' production holiday.

Prof. Làszlò LEHOCZKY

Hungary

I would like to ask you whether you made some similar analyses on the different categories of tractors. Was the trend of tractors sold near to the number of combine-harvesters sold?

The second question: what is the impact on the whole value of the agricultural machinery market?

L. FISCHER

In 1980 the Western European market bought 300,000 tractors per year. In 1990 we were at about 200,000 tractors. In 1994 we are at about 140,000 tractors. We believe that the requirement for the year 2000 will be something around 100,000 tractors per year in Western Europe. It is even a little bit more dramatic on the combine side than it is on the tractor side.

Mr. Peter ROTTGEN

GKN Walterscheid GmbH

Germany

COMPONENT FLEXIBILITY AND COOPERATION FROM THE VIEWPOINT OF A COMPONENT SUPPLIER

1.Introduction

The agricultural machinery and tractor industry are still relying on the increase of productivity, because the structural change experienced in agriculture promotes the trend towards large farms and the farm-overriding use of machines with focus no longer being placed on output in volume but on cost of production (**Fig.1**).

High harvesting and collection capacity must be provided to ensure that the crop is brought in at the optimum time. High capital cost demands longer utilization periods thus imposing more stringent requirements on service life, maintenance and machine safety.

The involvement of the human factor demands focal orientation towards functionality, controlled processes, safety and ergonomics. This has led to further automation and monitoring of processes (**Fig.2**).

In view of the expense involved in the development work and also due to shrinking quantities, basic machines are increasingly designed to constitute supra-regional concepts - so-called world machines -with regional niches being covered by specialists.

Tractor chassis construction and modular concepts for agricultural machines allow the demand for variance to be met through extension of identical base units by the required specific criteria.

For reasons of flexibility and with a view to obtaining extremely short throughput times, the agricultural machinery and tractor industry has confined itself to the area of assembly and few individual component lines. Existing development capacities are being focussed on the optimization of working processes and consequently also on the optimization of tools and implements. Sub-systems are further developed in cooperation with competent partners or bought out. This means that central units are increasingly manufactured by component suppliers or within the scope of cooperation between competitors.

The market's stronger differentiation into low cost, standard and professional products has resulted in supra-regional splitting of manufacturing lines and also in licensed production and subcontracting abroad which allows benefit to be obtained from the low cost levels in such countries for less complex engineered products. This gives rise to most diverse forms of cooperation.

2. Which part does the component supplier play?

The component supplier no longer constitutes an outside link of the supply chain but has become an integral part of a development and logistics process. Like the agricultural machinery and tractor industry, he has to find answers to declining quantities and changes in terms of both structure and value. Through internal standardization, quantities, which have become too small and thus economically unbeneficial for the individual, can be reunited via machine categories and customers. Nevertheless, appropriate solutions which are specifically adapted to individual problems are required.

Even more important, overall integrative development activities have been started to combine individual components. This newly created system provides the advantage of harmonized performance, streamlined interfaces and the creation of base modules, which can be used in a lot of applications. New concepts involving functional extensions can be worked out (**Fig.3**).

In the following, Walterscheid products will be referred to explain the particulars of system development.

3. System approach

In the automotive industry and in the agricultural machinery industry an approach extended towards complete systems rather than on individual products opens up additional possibilities in terms of both cost reduction and development potential.

This basically leads to more standardization, a reduction of suppliers benefiting cost efficient handling, quality assurance and sharing of development tasks (**Fig.4**).

The Walterscheid "Driveline System" is an example of how almost all problems can be solved which arise in the mechanical driveline between tractor and agricultural machine. By combining the driving components PTO drive shaft, clutch, gearbox and electronically operated elements for both controlling and steering functions, losses from interfaces are minimized.

Moreover, solutions comprising standardized base modules can be worked out for the relevant machine type. Base elements are thus being incorporated in the relevant machine, but the interfaces towards the actual and characteristic working processes can be adapted individually. In addition to the already integrated electronically operated elements for the control and steering of torque and slipping action, the integral connection of hydraulic driving elements is being initiated (**Fig.5**).

Traditionally a gearbox installed in the agricultural machine has supporting functions in that frame/body system. The driving functions which are developed in cooperation with agricultural machinery manufacturers and component suppliers will be able to assume many more synergies in terms of support and chassis and also help to reduce cost (**Fig.6**).

The hardware concept is complemented by a wide range of services such as application engineering, field and lab measurements and an operational spare part and workshop facility.

The second connection system in the Walterscheid range of activities is the tractor attachment system into which all components are combined thus permitting three-point attachment of agricultural machines. Moreover, the functions automatic coupling and system stabilization have been newly developed (**Fig.7**).

System development is an approach providing more flexibility in defined clearance zones. The development of such integral systems also covers adjacent areas such as hydraulics.

The system supplier in the field of driveline engineering is to play an additional role. He does not only assume the function of a connector of agricultural machine and tractor but also acts as an intermediary.

Since tractors and AG machines have developed into operational, interactively connected systems, particular importance is being attached to existing interfaces that can be optimized by the specialist who knows and is able to cover the characteristic features of both systems.

This is particularly important if, owing to the automatic coupling of both areas, interfaces must be defined to fix standards for the coupling of different machine types. An example of this is the PTO drive shaft coupler where an interface exists in the profile mating (**Fig. 8**).

4. Modular design concept

The present agricultural PTO drive shaft is a typical example of a modular design concept (**Fig. 9**).

Here, a multitude of connecting variants are being set up on the basis of few PTO drive shafts of defined performance (depending on horsepower and torque requirements). The integrated range of clutches covers many requirements in terms of both function and connection (**Fig. 10**).

The PTO drive shaft can be considered a standardized product which has been adapted and further developed to fit certain machine types and fields of application. Possible PTO drive shaft and clutch configurations allow the machine to be used in either traditional or professional areas. Traditional areas include, for example, medium and small-sized farms, owner-operators, countries with traditionally small

area structure such as developing countries and countries on the verge of economic development. Professional areas comprise large farms and sub-contractors.

A transferable modular design concept also exists in the gearbox line.

From a standard gearbox range developed in 1987, specifically adapted solutions, such as the pivot gearbox, have been derived combining both the advantage of a specific functional solution and extensive use of mass-produced modules.

Such modules are encountered in many application-adapted configurations. Examples: mower conditioners, fertilizer spreaders, manure spreaders (**Fig. 11**).

On an internal scale, the advantage of this modular design concept is seen in the routine uninterrupted line manufacture of basic modules which are subsequently completed in the assembly line by special components set up in flexible workshops.

This can, of course, also be effected within the scope of supra-regional concepts.

At Walterscheid, for example, large-scale manufacture to cover worldwide demand is concentrated in Germany, whereas market-specific and customized parts are manufactured locally in the U.S.A., Brazil and Japan.

As regards the low power range and parts with less complex functional content, there is an advantage to subcontract components or parts of the system from outside manufacturers. Based on their existing production facilities and in terms of cost incurred, they must meet the requirements imposed in the standard and low-cost areas.

Today, Walterscheid has adopted this scheme for cooperation with partners in Slovenia and the Czech Republic. The gearboxes are provided by a Walterscheid subsidiary in East Germany. Owing to its close proximity to the procurement markets in East Europe, the production depth is intendedly kept at a low level.

5. Licensing and local production

For a component supplier doing business worldwide the question of licensing and manufacture abroad arises as soon as the market becomes a global market and the agricultural machinery manufacturers become active in different regions of the world. Compared with other market sectors, the agritechnical market is small and the heavy decline in business experienced in the past forced the major manufacturers to internationalize. At the same time the agritechnical industry experienced a strong trend towards integration and merging to keep its international position and to further expand it (**Fig. 12**).

For the component supplier Walterscheid, the task on an international scale is characterized by the need to cover spare part requirements and to adapt the product range to specific local requirements. As already mentioned, the modular design concept allows such adaptations to be effected on the spot. Licensed production involving local assembly and manufacture is also in the interest of the developing countries and the countries on the verge of economic development and opens up the possibility to re-export standard-type individual components manufactured at a favourable cost level (called buy back requirements).

In the 70s and 80s, Walterscheid built manufacturing facilities in the major industrial states with substantial agritechnical production, i.e. North America, Japan and Brazil.

This has always been achieved in cooperation with existing local partners who were either incorporated in joint ventures or eventually taken over (**Fig. 13**).

The market could thus be supplied with the local standard product and sufficient time is gained to transfer this local standard into a worldwide standard. The counter-movement experienced in Europe consisted in the concentration of all production lines in Italy, France, England and Germany in one single location, which had been Germany - due to existing capacities and the growing effectiveness of logistics.

In the developing countries and also in the countries on the verge of economic development a ranking in terms of the stage of development must certainly be taken into account.

Pursuant to such priorities, Walterscheid has set up licensed production for local supply. According to the order of production line built-up these are South Africa, Russia, Iran, Turkey, Korea, India and China to follow. In the existing political environment some partners have problems in surviving economically, whereas others are strongly advancing.

Licensing and international cooperation in terms of production thus do not only have a real marketing background but also a procurement background.

They serve the purpose of international diversification of labour by bridging distances of supply and lead times on the one hand and by allowing developmental tasks to be subdivided into standard and high-tech products on the other.

Fig. 1 - Factors of influence

Trend towards large farms
Farm-overriding use of agricultural machines
Higher efficiency
Process automation
Modular configuration of tractor and agricultural machine
Development focused on process optimization
Licensing, production in low-wage countries

Fig. 2 - Agricultural machines structural changes in Germany (1970-1993)

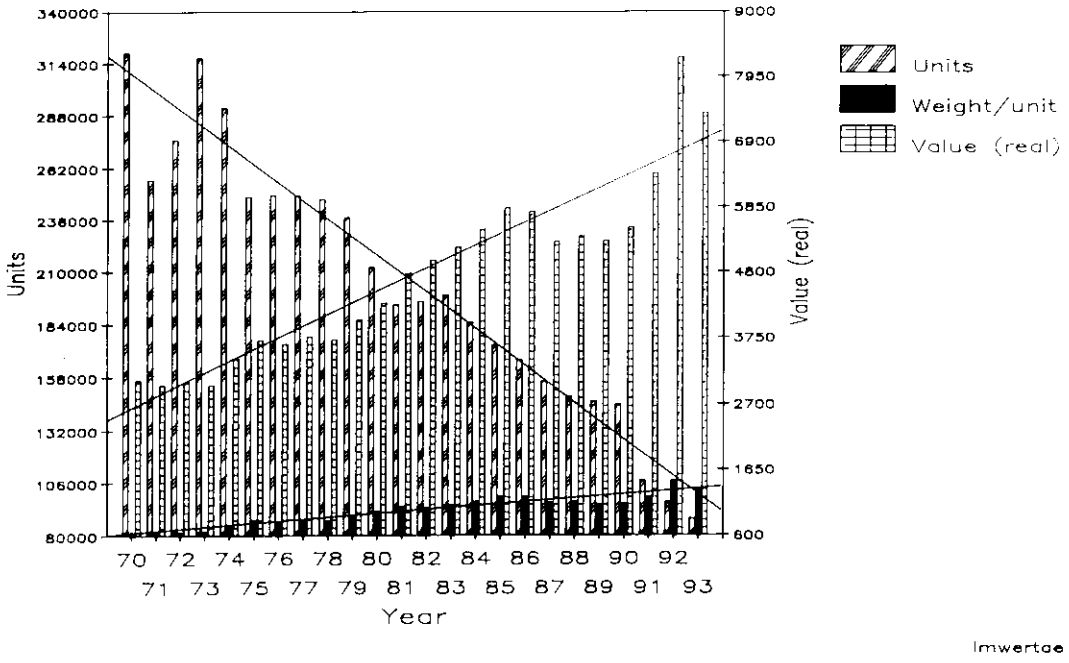


Fig. 3 - Component supplier

Retrieval of lost quantities
Internal standardization covering external problem solutions
System approach
Parallel development in drive line engineering

Fig. 4 - Walterscheid Drive Line System (DLS) and Tractor Attachment System (TAS)

Walterscheid Drive Line System – Reduction of losses from interfaces – Extensive application of modules – Integration (electronics, hydraulics, chassis) – Service
Walterscheid Attachment System

Fig. 5 - Drive Line System DLS

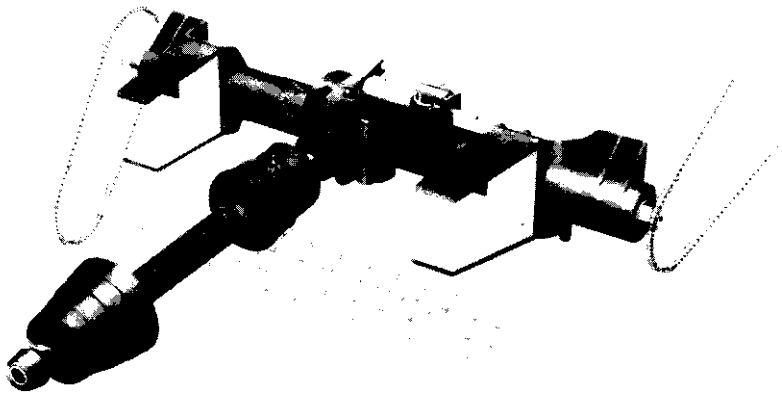


Fig. 6 - Drive Line System in the AG machine environment

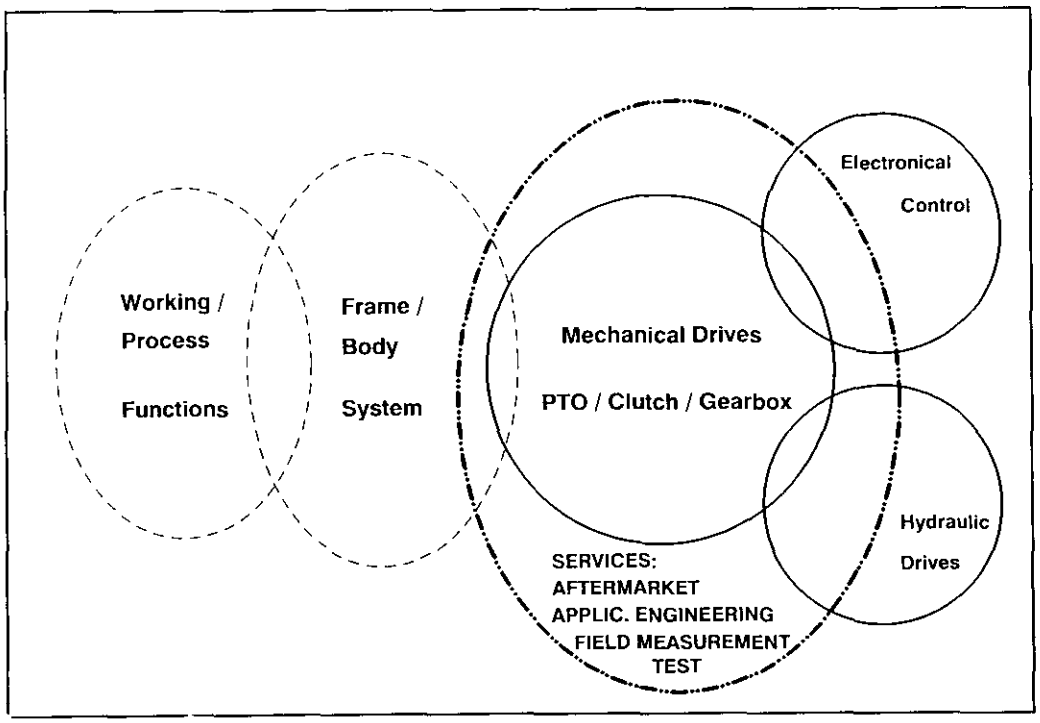


Fig. 7 - Tractor Attachment System

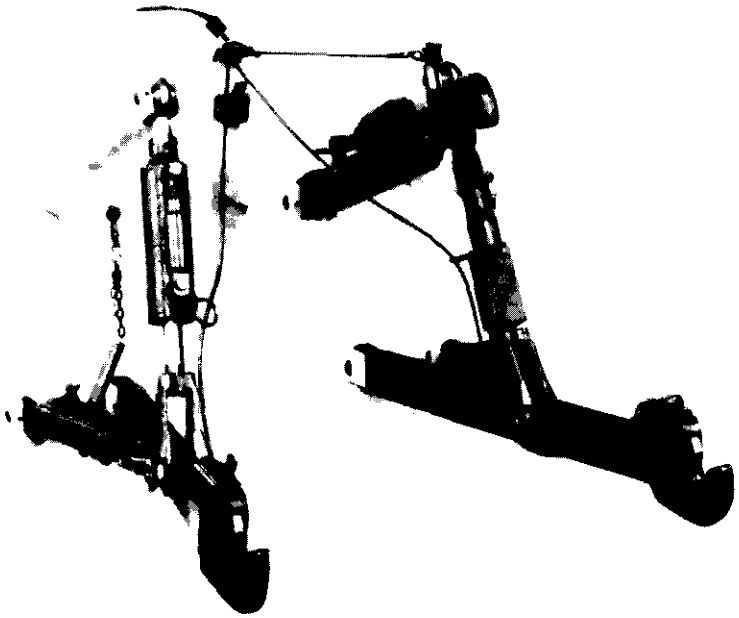


Fig. 8 - Drive Line System: PTO drive shaft coupler

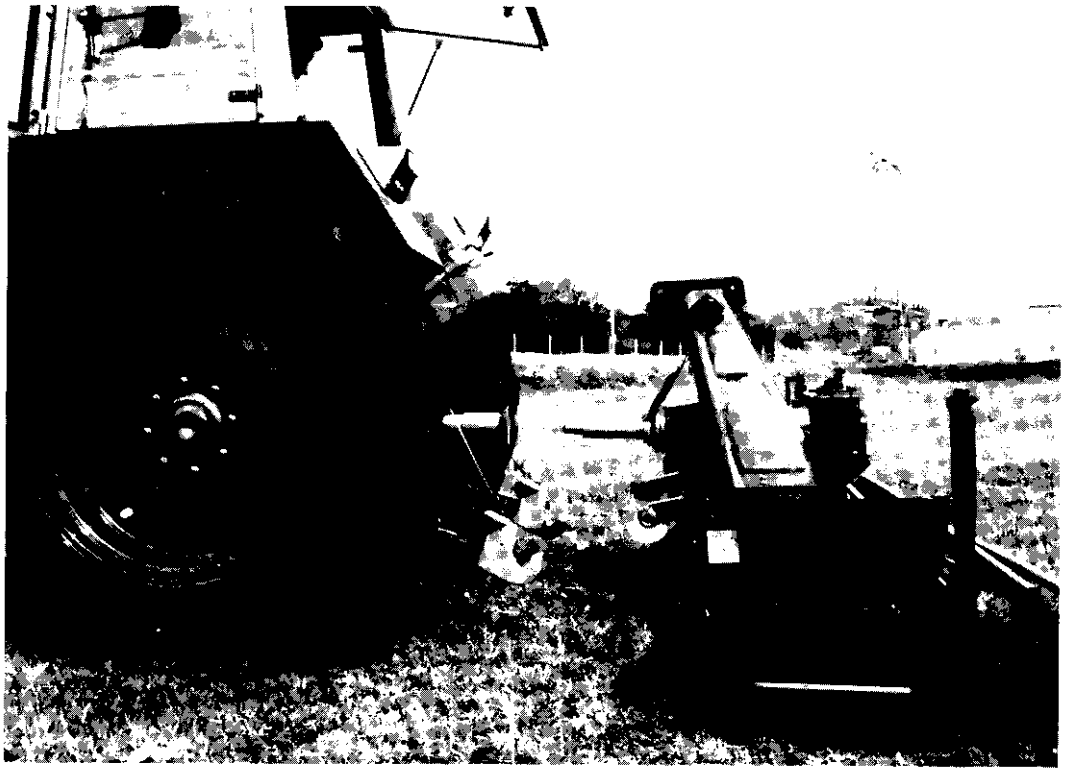


Fig. 9 - Modular design concept

Product design
Standard/Professional products
Manufacturing advantages

Fig. 10 - Modular structure of PTO drive shaft

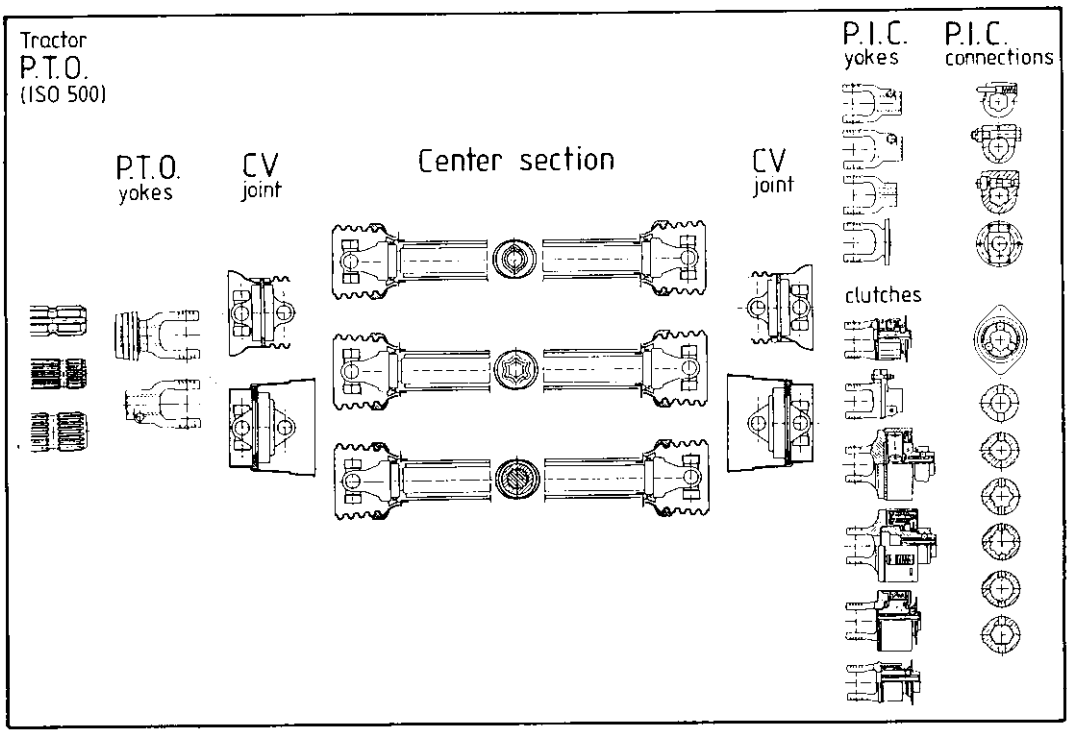


Fig. 11 - Pivot and standard gear box

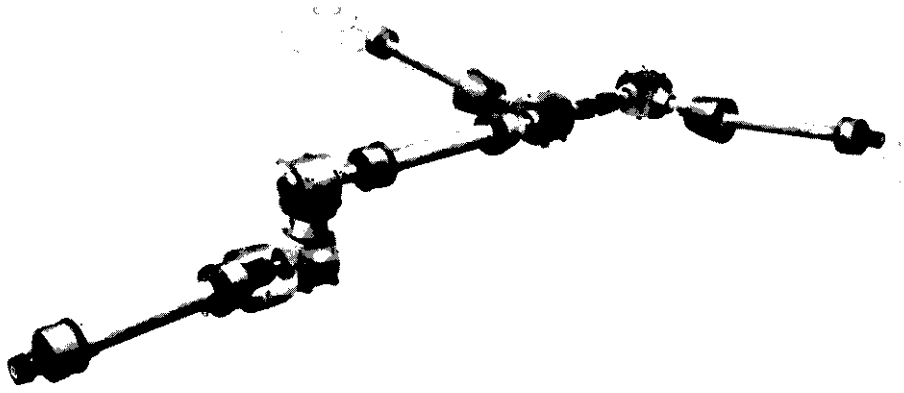
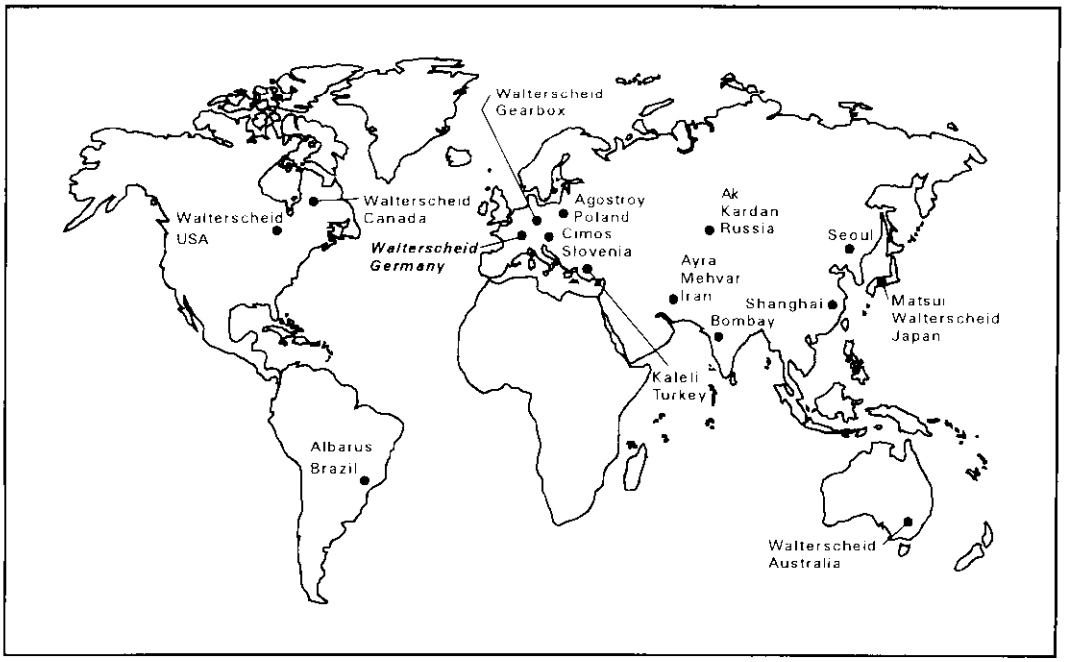


Fig. 12 - Licensing and local production

Global market
Adaptation to local requirements
Manufacturing exchange

Fig. 13 - Walterscheid world-wide



J. ORTIZ-CAÑAVATE

I would like to ask you a question about the relationship between these component suppliers and the customer. When a customer asks you to improve a specific kind of component, and this is an innovation of the component, is that kept secret so that competitors don't take advantage of this proposal? This is something we have experienced with one supplier. We developed a machine and we asked for some improvement in a component, then it happened that this was also offered to others.

P. RÖTTGEN

This is a very sensitive matter, and a question of survival for a supplier that this will not happen. We had this experience when entering the gearbox market. You are, let's say, at the very beginning in terms of development stage; you are touching frame/body questions and other functional elements etc. What we are trying to tell - this I think is a question of education - the agricultural machinery manufacturer is the following: the quality and the market approach in agricultural machinery does not depend on drive lines or the way you combine working functions in a machine. Please, agricultural machinery manufacturers, concentrate on what your machine should achieve in technical terms for the customer and we are then able to concentrate on combining these individual working stations or working processes with something which we feel we should standardize. In Germany, 75% of all gearboxes are still produced in-house. With the declining volumes and declining units I think there is a question of survival as well.

K. Th. RENIUS

I think we can admire how you do your business, because I think a supplier has to do a great amount of planning activities to get things done. My question is: if you set the engineering cost at 100, what is the approximate percentage for engineering planning activities, i.e. for planning the systems together with the companies you deliver to?

P. RÖTTGEN

Mr. Fischer mentioned the expense for engineering costs at John Deere: let's say ours is about 6%. A good share of that 6% is application engineering, i.e. being on the spot to discuss new developments. This is I think one of the functional areas which we felt success is coming from. I would say this "man on the spot" accounts for 30% of these total costs; then we have the engineering people sitting in Walterscheid and designing what he has brought back. So we feel it is a very important share. We had the same discussions which Mr. Fischer mentioned with regard to John Deere: reduce your costs, so why not also engineering costs?

A. RIJK

I recently had a meeting in Belgium with one of the biggest suppliers of spare and replacement parts for the agricultural machinery industry. I think there are very interesting developments going on. As Dr. Fischer said, for the industry it is very profitable to sell spare parts, but for the individual dealer, or repair shop, it is also very costly. He has to keep stocks, it costs interest, capital and so forth, and at the end of the day he has to throw away some products because that type is out of production. What is now happening in Europe is that some companies (at least I know of one) directly deliver spare parts to dealers on request. They are not in the business of manufacturing, it's just a distribution centre. Some manufacturers cooperate and in fact deliver directly to the Crump company. Others try to resist as much as possible (I believe including John Deere). What is the philosphy of the manufacturers? To try to boycott it or resist it? Or to say "this is the way to go"? I know for example that Greenland tried to resist but in the end he gave up; I think they saw it was very beneficial: beneficial for the customer and beneficial for the dealer. Crump in the Netherlands has a system which delivers overnight: you call them before 4 o'clock and the next morning you have the part in-house - what are the views of the three speakers on this system? Do they see this is something they should try to resist? Or do they say "this is the way to go"?

L. FISCHER

It's true. Some companies depend on the spare parts business for survival. For us, driveline and spare parts are either promoted on the market as bits and pieces or as components, as a lot of today's farmers are able to maintain their machines themselves and subcontractors have their own workshops. For other countries where this doesn't apply, then you have components, joints, clutches, which they can then build in.

What's important is that agricultural spare parts be readily available e.g. within one or two hours. Complexity is a problem. I think we are selling 4,000 different spare parts. So it's a question of having stocks available. I think Crumb is working on 50% of the annual sales in terms of stock and their argument is "What I don't have I cannot sell", because there is a need to be prepared within an hour or so. Therefore I don't see at the moment other possibilities, except using modern logistics to overcome one step of distribution. We all know we have one step too many in Germany, and elsewhere in Europe, so as to get

closer to the customer by using new logistic systems. I think this is one task, and then to have this margin cost advantage available for the customer.

A.M. EL HOSSARY

Are you aware of the production of cheap copies of components and supplies which are available now in the Third World? This affects the efficiency of the machines. Have you got any measures of protection against this?

P. RÖTTGEN

We are aware of this for drive shafts. There are some legal aspects which we have to follow. Simply, you cannot advertise with the same part number and the look- alike original equipment or genuine part approach. This is the only thing which we can do. But it is much more important to have the right people in the marketing and the distribution line. I think this is the biggest protection which you can have. Price difference doesn't count very much: to the farmer it costs the same. I know the dealers who are taking this additional margin for their own so the farmer is not benefiting from this. Therefore I think it is the distribution chain which must educate to loyalty in this regard.

L. FISCHER

I have a different view. The delivery time is not a problem with our company. We have spare parts depots, with a central depot in Brussels and we have several depots in major countries where we have branches. So we can deliver 97 per cent of all parts or items, they arrive at 2:30 p.m. and they will be delivered the next morning anywhere in Europe. So I think this is not the problem, at least for our company.

What is more of a problem is that these wheel fitters pick the raisins and don't care about the rest of the spare parts. As I said before, on tractors we deliver 20 years after phase-out of a series.

Personally, I am fighting the wheel fitters where I can and I am taking them to court. They are violating and infringing patents right and left. They don't care about quality - not all of them, but many try to make fast money. Where they are much better, is service. They are small companies which have a "John Deere Week", then a "Class Week" and then a "Ford Week". They put specific spare parts in a truck and they travel around to see dealers. That's a good service. They are there to discuss things with them. I believe we have to look into the spare parts business in a different way, in a more strategic way for our company. That is not just to sell spare parts but to think about our service. Which is much more than just selling spare parts. It is know-how transfer, it is advising on specific things, it is training our dealers. There is one critical problem with all the sophisticated products we are delivering to the market i.e. our dealers and customers just can't keep up with what is going on. They cannot make use of all the benefits, all the electronics and they are even creating problems with mis-using these things. So, I think we need to view the service to our customer differently. Not to the dealer but to the customer. One problem we have, is that we always talk about "the customer" and in most cases we mean our dealer. That's a different world. So we have established processes to get really at the customer. We are filing, for each tractor we sell in Western Europe (certainly in the four main contries in Western Europe), a questionnaire when we deliver a tractor and again a questionnaire after one year of use. Between 30 and 60% (it varies from country to country and from questionnaire to questionnaire) respond, which we believe is a very high figure. We are investigating these figures, and we are getting a few surprises from what "Mr. Customer" thinks about our product and how he wants to be serviced.

We should think about the mistakes we make and then get something back of the business which we lost. So I will fight the wheel fitters.

W. von ALLWÖRDEN

I agree with what Mr. Fischer was saying but I want to add an experience I had with a wheel fitter. In a company I worked before, we took over a product from another company and we didn't want to handle the spares. We gave that to a company in Germany, similar to Crumb in Holland. The first year all the spares were available. The second year, some of the spares were gone and the Company didn't buy any to refill its stock, so it couldn't supply them. In the end we, as the owner of the product and of the name, had to go and produce the spares immediately to comply with law regulations. I can only warn about working together with such a wheel fitter.

Dr. El Hassan BOURARACH

Morocco

I want to come back to a question that has been addressed before. As developing countries, what can we expect from this new design and manufacturing system? Low costs or possibility of assembling locally? Or simpler machines? That's my first question.

The second question is not really in relation directly with this item, but it seems to me that it is interesting to know if this new design and manufacturing system can help protect the environment; because in the food industry we see a lot of things about "green points", how to recycle the products and the sub-products of the food industry. With this new system is there a possibility of recycling this module? Does this new system protect the environment?

L. FISCHER

Let me answer the first question, as it came up several times before. I think we also have to look into the requirements of these developing countries. I don't believe that we can assemble or manufacture tractors or combines everywhere in the world. The quantities in those countries, many times are just too small. It doesn't make sense to build up a production or assembly plant for quantities of 200 or 500 a year. This must be acknowledged. But the system as such, this componentized, modular system, allows a large exchange of components. I think if we plan to go to former Eastern Block countries or to the former Soviet countries, we have to do that. We can't just supply components; we have to do buy-back. How could they pay? So these kinds of concepts allow exactly these things. But I would say again that we have to be realistic. We can't produce those products everywhere in the world. It just doesn't make sense economically.

To the second question - how about making reuse or recycling of products - we have to differentiate. We have defined in the new product (and we have given part specifications and numbers) the kinds of ingredients present in most of the plastic parts we buy. Some of them are shredded afterwards and are reused for new products - some, not all of them. Some of them can be burned very easily and there is a demand from power plants to burn plastic parts to increase the degrees of the flame. We use asbestos-free components. We use biodegradable oils in the engine and in the transmissions. So there are a lot of possibilities to go for recycling or to protect the environment in case any leakage (and they happen from time to time) occurs. Recycling of metals has never been a real problem besides the costs of transportation: in many countries it is too expensive to ship old products to a place where they can be recycled. But generally the potential is there and we as a company have defined most of the specifications for plastic parts so that they can be recycled. It's not just because we like it: it's a matter of cost, and especially in production you can really make money in doing this and not being moved into the green corner.

Prof. Richard O. HEGG

USA

I'd like to address a question regarding GATT and its impact on the agricultural machinery industry, and I guess I'd like the last Speaker and probably the first Speaker to maybe briefly comment whether it has been a major factor in your decisions in planning for the future or has it been a very minor aspect?

P. RÖTTGEN

I think it has been a very basic aspect. Not so much that, let's say, decisions were taken on "who is making what" in the future and "the Americans are going to benefit", or "the Europeans are going to lose", etc.; I think it was more the aspect of "what are the signs for the future?", and "I wait until the signs are settled".

I think what we really felt is that people waited for this decision and did nothing in the meantime and when it happened it was not only decisions which had been taken in terms of GATT but it was also some money which flowed (I just read the comment of the German agricultural machinery Association, that said that this was the start of a 10 to 30% increase this year). This was the psychological effect on deciding what is going on in the future. This to my understanding was the major aspect.

L. FISCHER

I could repeat what you said on the psychological aspect of the business. It is true. In addition we as an internationally operating company have even more benefits out of the GATT regulations. For us it is very important that we have free trade all over the world. In some areas it may harm us, but globally it is a good decision. But we shouldn't only look at GATT. We should also look at the MERCOSUR and NAFTA. I strongly believe that with the opening of the markets we will get, especially in Germany, a lot of pressure in changing and coping with these challenges, with our cost situation. In general I think this opens new trade.

Mr. Yoshisuke KISHIDA

Japan

Three Speakers mainly stated the direction of the design of new machinery for the developed countries. But now your country, China, is the biggest producer of tractors and machinery in the world and you still have many demands. What do you think about this kind of concept for your country?

Prof. Mao-Hua WANG

P.R. CHINA

I think China has the biggest tractor and agricultural machinery industry. But although we encouraged a joint venture with the Chinese industry because importing tractors from outside is very expensive. China's capability for investment is low. So I think that the main problem is how we can develop joint ventures in China since labour costs are relatively low. If we can promote a Chinese agricultural tractor it would be very competitive in the developing world because I think the cost of a Chinese tractor is at most half and even lower than half the cost of a product from the developed countries. We can use the Chinese environment and low-cost labour, and we have a very good supply system.

Dr. Nokwazi MOYO

Zimbabwe

I wanted to find out from the three Speakers if they have got a policy on rehabilitation of either tractors or combines or components of machinery that they sell, particularly in the developing countries. If so, whether that policy revolves around refurbishing components in the countries that use the equipment or is it done abroad and then shipped to the developing country; and what is the impact of rehabilitation of machinery on their long-term businesses.

L. FISCHER

I don't think that we have a policy to do this kind of business. In the long term I think that companies in our business should be present where a home market is available. A home market is one which consists of a couple hundred combines or tractors. To establish joint ventures and to do business with each other in my opinion is very important. The difficulty is that the development of the various countries is proceeding at different levels and with some countries you can do business, you can start supplying and buying products back, bartering them and producing components there and ship semi- assembled products to these countries. It differs so much that I cannot give you an answer, but a policy we don't have. Deere's policy is that it has to be profitable for both sides. Sometimes it is difficult to demonstrate, but it has to make sense.

W. von ALLWÖRDEN

I agree with Mr. Fischer, but may I explain how that can work? We have a licensed production which started 20 years ago in Yugoslavia. It started by sending complete combines; then they started producing those parts that make transport expensive, i.e. sheetmetal parts, like grain tanklets, and other things. Then they started producing simple parts and they exported them. Today we buy all these simple parts from these companies. When we go to higher-sophisticated places, like South America, where they produce their own engines and gearboxes, we send just the know-how parts (three combines in a container). So the situation, as Mr. Fischer says, always depends on the volume and on what the country is able to produce.

P. RÖTTGEN

Let me add some data which I picked up in North America some months ago. The world population increase in the next 30 years will be around 3 billion, these people will live in Asia, Africa, South America; the amount of food that has to be produced is nearly double what we have today, let me remind you that only 10% of the land is available which can be added to this production; all the rest, i.e. 90%, should come from productivity in terms of agricultural machinery use, fertilizer use and other elements which are necessary. So the music will play somewhere else, not in the industrialized countries, in the years to come; the question is how can we share these activities. No doubt something must be done in this regard. Then let me add an experience which I had some months ago when I visited Korea. There is an agricultural machinery industry which opened ten years ago: there are 60,000 rotary tillers produced at the moment and they are building new big plants which are good for 300,000 rotary tillers and harrows. So they have a tremendous vision of what they can do, with an eye on China and the surrounding countries. So I believe with the right kind of job sharing there is a big potential which can be developed in these countries.

Components suppliers are followers, normally, but there are many steps, as Mr. Allworden mentioned, which can be taken: local assembly is something which everything starts with, then you have standard components, which can be made locally and we can benefit from. This I think is the major aspect. Both partners must have some benefits from what they are doing jointly. It

is not only a question of tractors and combines: there are various kinds of machines of a simple and more complex nature and there is a big opportunity for job sharing.

J. ORTIZ-CAÑAVATE

I would like to mention that in Europe on 1st January 1995 the EEC's Machine Directive will come into force which says that there has to be a certification on all machines on quality and safety. That means a restriction of this market. How do you feel this regulation will affect the agricultural machinery market?

P. RÖTTGEN

In Germany we have always had very strong regulations on machine safety. So the EEC Directive is nothing new for German producers. In the future everyone has to comply on all the machines to be sold in Europe. Therefore the price rise, which is not very high but all the same it is an increase, will burden each producer. In Europe I think there will be no major changes.

L. FISCHER

On the EEC aspect, you are right, there will be additional costs, but it is not a technical problem. Self-certification is another thing. The self-certificate deals with the ISO 9000 aspect or with the Baldridge investigations. We believe that this will improve the quality of the products and the efficiency of the manufacturers.

G. PELLIZZI

I want to remind everyone that the general subject of this session is how new design concepts can meet the technical and economic requirements of agriculture. What are these technical and economic requirements? Certainly reduction of production costs, improvement of product quality and environmental protection and, last but not least, increasing the flexibility of production in the farms. These are the three main points. Important also in light of the GATT agreement. So it is a little bit difficult for me to understand how these strategies of the three companies can help the farmers in reducing cost, improving flexibility, and so on. May I ask the Speakers to provide us with an evaluation of this?

L. FISCHER

First of all I believe that the best way to keep costs down is competition. It is very important to keep costs under control. If you look over a ten year period, I strongly believe that most of the companies in our manufacturing field haven't earned the investment they have spent. That's a fact.

The other aspect is what can we do about customers' needs. Again, we have to differentiate between the various markets. A typical product for a West European or North American market is highly sophisticated, and in certain instances quite a few of the customers can't fully utilize the product. Mr. von Allwörden also mentioned that especially on combines and self-propelled harvesters there is a trend to go to corporations or to real business-oriented people who are doing business for the farmers.

I think they are both benefiting from that, i.e. the farmer and the contractor.

However, our farmers have to change practices. For centuries farmers have been ploughing, but is this the best method? Companies, farmers and universities are experimenting with new kinds of systems. Increasing profitability leads to electronics, field mapping, getting control over fertilizers and all the expenses a farmer has; the quality of the product becomes much better, so that the mean time between failures improves, without any question, on most of the products. And one has to consider whether the practices farmers are usign today are the right ones. One has to question whether we have to plough or whether a no-till drill is a better solution. So there are many ways to investigate, to make all our lives - farmers' lives and ours as producers - more beneficial.

P. RÖTTGEN

I remember some comments by Weinstephen, where they said grain production for example could be reduced in terms of costs by 20%, so the question is: where are the opportunities for reducing production costs for the benefit of the farmer? I can recall an example: driveline control (meaning measurement elements in the driveline to signal the driver of a tractor that he can get closer to the load of his equipment, like a big baler for example, or a harvesting wagon) can increase performance by 20%. So there are technical solutions which in the end, can reduce process costs and therefore the farmer can benefit by the cost of his work per hour. So these are the kinds of technologies which we have to develop; and I think, as I said, that the name of the game is no longer production increase but cost reduction.

G. SINGH

In the developing countries we are also moving in the same direction, although we are a bit behind. I can cite the example of threshers, which were very small, for wheat and rice, and all of them now have moved to basically-sized threshers driven by tractor PTO. Thailand is an example, as are Pakistan and India. Previously we were using 5 HP, 7 or 10 HP engines, which were basically used for water pumping, and then to power the threshers. Now the trend is to use larger sizes and these are used by contractors, so they move from one farm to another to do threshing jobs. This is the common trend.

Are the big industries thinking of how to make use of these engines easily in a self-propelled combine - self-propelled combines have a season lasting two-three months or maybe four months in a year and then the whole thing sits idle eight months. In a multi-farm use, as Dr. El Hossary also said, and in other uses, the tractor engine is used for many, many purposes. As in India and Pakistan, where 60% of use of tractors is in transport, which is throughout the year. Only one-fourth of the use is in the farm.

Are the designers or the manufacturers thinking of making this big expensive component more flexible? Can you come up with a modular design, let's say a tractor type? Are there talks going on in this direction, so that we can make use of this economy again but to a larger scale?

W. von ALLWÖRDEN

This problem comes up every month, I think; the farmer comes and says "I have a large combine, can't I use its components on my self-propelled forage harvester?" But history has shown that these multi-purpose units or frames where you could add forage harvesters, and combines are not a good solution because the cost is too high and replacement times are too long. In my opinion it is better to have a highly sophisticated and specialized machine in the hands of a sub-contractor who does a special job for farms and the tractor is then free for ploughing or for other farm work or for bringing the harvester train into the warehouse, instead of having changes in the components of the machines.

In the countries where labour is expensive the sub- contractor comes with a driver, so the farmer can work the farm with his family, without hiring workers.

P. RÖTTGEN

I would like to add another aspect. I have talked a lot about those expensive products we have. If we look at it, it is about 70% materials, the productive labour on tractors is about 2-3%, and the rest is overheads. This is the problem we have in Germany. If we look at farmer incomes, we have to add another aspect, i.e. the farmer gets cents for his product and we, the final customers for his products, pay US $s. Last night somebody offered my wife a pound of strawberries for 10,000 Lira. I bet the farmer got only a few pennies for it. So I think to improve the income for our farmers; they must also look into self- marketing their products differently from what they did in the past.

Dr. Oleg S. MARCHENKO

Russia

I want to point out some features of this system of components used for production. For example, in countries with low wages it is too sophisticated because you need to take into account some special features. First of all, when we deliver components from countries with high labour cost, it's not suitable for farmers because the price of such a machine assembled in countries with low cost really stays high. For example, we had in St. Petersborough a plant assembling forage harvesters. They assemble these forage harvesters fully from German companies. Each cost 4-5 times more than a native forage harvester of the same class. Only if we decrease component price by as much as 35%, will it be suitable, but it will still be twice more than the native. If we think of farmers' possibilities to buy, we should take into account the financing situation in each country.

It seems to me that it is necessary to create a base of production in low-cost countries first of all. In this case we will have a much cheaper technique and for farmers it will be more suitable to buy. Theoretically, I think this system of using companies for regional assembling is very promising.

W. von ALLWÖRDEN

We supplied this year more than 50 combines in the areas of Kazakhstan, Siberia, Omsk. They are all highly sophisticated i.e. air conditioning, including loss control etc. These combines did 100 ha. per day. The competition from Russian production, the NIVA, did about 20 ha. On average, one of our combines did seven times more. So if you take a combine from Rostoff, which costs 25,000 US $s, and multiply it by 7, it is exactly the price of our combines. But you need only one driver! The next thing is the quality that comes from these factories.

The joint venture is OK. If the market is large enough, as Mr. Fischer said, and if there is somebody who manages the joint venture and who wants the joint venture. We are always asked to make joint ventures in these countries but when we really want to start nobody is there, nobody really says "Let's do something. Let's produce something". It's always back to our management again. That is the reason why most joint ventures didn't work and do not work.

O.S. MARCHENKO

Of course, you are quite right that management in our industry should be improved. It is necessary, not only in industrial production but in agricultural production, too. But the situation right now is transitional. Of course it creates additional problems. But I do not agree with you that the grain harvesters that you try to produce in Siberia jointly with our plants are so much better than our own. Of course we have an old model, but it is good enough for grain harvesting.

We have good models and we can create good forage harvesters which are very competitive. I do not agree with you when you estimate your harvesters so highly.

Y. KISHIDA

As Marchenko said on price of machinery produced in Russia or developing countries, the problem is to create the market in the developing countries. Usually they want to establish some production function in the developing countries, with machines designed for the developed countries. In the case of China I observe that already they produce many tractors, but the tractor design is a simplified design. This is one of the ways how the Chinese could succeed in increasing their production volumes of tractors. If they used very sophisticated designs of tractors, maybe they would have failed. I think that if we want to develop more mechanization in developing countries, we require the redesigning of the machinery to make it suitable for the developing country. But this is not enough and today these three Speakers told us only about the future for developed countries. I would like to get more comments about how we can deal with this problem.

Dr. Jürgen ZASKE

Germany

I would like to come back to Prof. Pellizzi's question of whether flexibility can influence cost and environment. I think that a very important aspect is electronics. If you prefer, you can fit machinery and tractors with electronics. I think that is a very important aspect in flexibility. When you can equip a tractor, or a combination of machines and tractors, with highly sophisticated electronics you can save costs because you can reduce seed, fertilizer and chemicals; and it is environment friendly. I think there is a lot of development right now running in the field of site-specific production. I think this is a very important aspect for the future.

Prof. Gajendra SINGH - Session Chairman

Mr. Bernard CHEZE

CEMAGREF

France

PROBLEMS AFFECTING QUALITY OF NEW FOOD PRODUCTION DEMAND

1. Introduction

Before looking at the problems affecting quality, we are going to have a quick look at the new food demand, then go through some examples of relations between food processing and quality of the materials to be processed to show how the agricultural production sector is more and more integrated within the food chain, and how the industrial concept of total quality can also be extended to the food industry.

2. New food production demand

The role played by the new consumer in the development of a new product is more obvious in the food sector than in any other.

But, if a lot of research has been done on the technological know-how for processing new foods, very little has been done to understand the attitude of the consumers.

This is mainly relevant in countries having both a high standard of living and gastronomic traditions rather than those where starvation and bad nutrition represent a daily problem. Our colleagues working for less developed countries could, maybe at a future Meeting of the Club, bring a positive contribution on this topic.

So we are mainly referring to Western Europe in this paper.

The President of the International Commission for Food Industries, Prof. Dr. H.C. Hollo (Academy of Sciences, Hungary), opened recently a symposium on novel foods with a statement by Brillat-Savarin:

"The discovery of a new dish does more for the happiness of the human race than the discovery of a star"

It might not be true if inhabitants are found on the star, but probably sound in countries where gastronomy play a significant role in their Culture.

In most developed countries, food consumption has increased first on a quantity basis, then on quality, thanks to emerging technologies. Even if the percentage of food in the budget of households has decreased from 1970 to 1991, it is still among the most important ones (**Table 1, Fig. 1**). In 1988, this percentage was similar in many European countries.

If the «typical» European consumer does not exist because of the diversity of geographical conditions and of consumer habits, we can find common trends for the development of new types of food:

- high added value products;
- easy to use;
- products known as having a positive effect on health (dietary fibres, sweeteners, favourable or less fat content);
- products taking into account environmental protection (i.e. reduction of by-products and wastes, ecological balance).

Beverages, fruits, legumes, potatoes are likely to have a different future because they remain linked to national food cultures.

In the E.C., demographic limitation in growth and reduction in food use in the budget of the people are not going to increase significantly the volume of food (without forgetting the classical "non elastic stomach" limitation).

But its nature will closely follow the consumer's demand, as far as apparent qualities like satisfaction and use are concerned.

For non apparent quality, like health or security, public services have to protect the consumer from sources of contamination that can only be detected through scientific means, not available at the consumer level.

Table 2 summarizes the basic rules for the food supplier, known in French as the "4 S" (santé, sécurité, satisfaction, service), presented by P. Mainguy, former director of BSN.

3. Importance of food industry

Compared to other industrial sectors of the economy, the food industry represents a great economic weight. In France, it is the first of manufacturing industries with more than 4,000 factories, a production of 120 billion US $ and an added value of 20 billion US $. It employs 400,000 people (in Europe, it ranks second just after Germany with 463,000).

The meat sector is before the automobile sector.

In France, 75% of the agricultural production is processed by the food industry. It is less true in the USA or Northen Europe, in particular in the United Kingdom, which, towards the end of the 18th century, had sacrified their agriculture and developed a powerful food industry.

4. Food and agriculture

The food industry itself has to be situated inside the technological food chain, from the plant or animal genome to the nutrient (**Fig. 2**).

More and more, leading Agricultural Engineering Institutes propose a systematic approach of the relations between agricultural engineering and food processing (read in particular "How Engineering can help the development of the Agro-Industry System" by G. Pellizzi, Director of the Institute of Agricultural Engineering of the University of Milan).

5. Quality concepts

Properties of raw materials coming from agriculture inflluence significantly the characteristics of the food obtained through processing.

The quality chain starts from genetics, goes on in technical ways of cultivation or breeding, and ends in the molecular construction - from which comes texture, aromas, tastes and nutrients (P. Feillet, INRA).

More generally, quality policy covers many aspects:

- qualitative adaptation of suppliers to the needs of the buyers (contracting);
- sanitary quality : minimum required through regulations by the consumer;
- quality labels, to promote certain products following different criterias : zone and means of production (A.O.C), precise quality standards (label, biological agriculture);
- conformity certification and certification of entreprises (control procedure for a better guarantee).

6. The "technological quality" of a crop (B. Houlier, 1994)

It is the aptitude of a raw material to be industrially processed under the best technical and economical conditions to obtain a well defined quality of food.

We will examine successively the aptitude of peas for canning, of cereals to be processed, and for animal productions, the processing of meat into dry ham.

a. peas for canning

a suitable variety of peas for canning should meet the following conditions:

- it must be productive, which excludes dwarf types;
- it should be uniformly ripe in the same field;
- the husks of each head must develop and grow at the same time, which excludes the varieties with long stems. One should prefer, for this reason, the bushy varieties to the varieties with small branches;
- the canned peas must remain green;
- the pea should be neither too hard, nor too soft and it must remain small. Cell walls must be resistant to thermal treatments of appertization (cooking).

b. aptitude of cereals to be processed

It starts with its milling value, then its baking aptitude.

The milling value of a cereal

For a batch of cereal grains, the milling value is represented by the output in flour of a well-defined quality.

The milling value of a cereal such as wheat, the most common cereal, depends on numerous factors :

- content and nature of impurities (inert matters, broken grains, germinated grains, specific impurities, ergot);
- humidity of grains (milling is done with grains whose water content is 16.5% to 17% therefore higher than what is necessary for a good preservation -13% to 15%), which generally draws the miller to wet the wheat grains which are too dry; on the other hand, a batch of grains which are too wet need drying which can be expensive;
- extraction rate (weight of flour obtained from a given weight of grains, expressed as a percentage), which is highly correlated to the specific weight, generally taken as a commercial basis for markets.

A recent ECLAIR programm has established the possibility of using image analysis to predict this value thanks to a marker of the friability of bran, the ferulic acid.

Baking aptitude

For a flour, the baking aptitude is the aptitude given to products such as bread, cookies and toasts) of good and satisfactory quality, in good working and processing conditions giving a high yield in bakery.

The baking value is difficult to evaluate; various methods are used:

- the bread-making test, which is generally, an ideal method, but which supposes, however, judgement criteria of the quality of bread indisputable and a standard bread-making method;
- the appreciation of the dough fermentation quality, and more particularly of the amylasic activity, measured by the Hagberg fall index, or with the Brabender amylograph, which records the variations of viscosity of a very liquid flour dough during starch gelification;

- the appreciation of the plastic qualities of flour, that is to say its bread-making strength. The bread-making strength is the aptitude of a flour to resist more or less to the strain of a kneading machine when one incorporates a certain amount of water.

The above mentioned ECLAIR programme has established, thanks to immunochemistry, links between visco elasticity and glutenines, as well as between gliadin and plasticity.

c. aptitude of pork meat to be processed into dry ham

The physical and chemical characteristics such as pH and water retention capacity have each an influence. pH is an essential factor for it has an influence on numerous other parameters (Jacquet 1982, Monin 1988):

- water holding capacity;
- colour;
- penetration of salt;
- hiding of salts;
- preservation, (better with lower pH).

The variation factors of the pH of the meat of pork carcasses are mainly:

- genetic type;
- age and weight;
- metabolic type of the considered muscles;
- slaughtering conditions which may have a great influence on the technological quality of meat. This is due to the stress which can have serious consequences on the quality of meat : either an increase of the final pH of the meat, which would enhance the intensity of the colour and the water holding capacity ; or through the increase of the body temperature and metabolic acidose, resulting in «pale, soft, exsudative» meats.

The lipids play also an important part in the quality of dry ham:

- first, through the thickness of fat cover layer which has an influence on the penetration of salt;
- secondly, the oxydation of fatty acids induces the production of suitable volatile molecules, but it can also be responsible for unpleasant flavours (rancid) if it is driven too far.

7. From technological criterias to production systems

If the future of agricultural production lies in a better satisfaction of the technological needs of industry processing, it is also expected that the gain obtained by eliminating pretreatments at the industry level, are paid back to the producer.

It seems that, except on special rare contract basis (durum wheat for example), the decrease of prices of agricultural products do not change food prices (at least in France) and do not affect the income of the farmer ! (**Fig. 3)**.

This may explain the importance of the development of the cooperative sector (20% of the total in France) where production and transformation are managed by the same group.

So a better knowledge of the cost and consequences of technical means of production on the quality of the products has to be developed.

This started some years ago. The influence of nitrogen fertilization on the quantity and quality of proteins in wheat, a determinant criteria for baking aptitude, is now well known.

For example, in Germany, the practice of fractionning the Nitrogen supply to the crop, good soil and climatic conditions are crucial for a good protein content in wheat (**Fig. 4)**.

Spatial variability of crops produces the same effect on fruit production as the variation due to different species. Pruning and clearing around fruits may induce better uniformity of the yield.

Most of these new ideas come from Agricultural Research Centres or specialized institutes. It is the case of new management systems (A. Caneill, 1994). They are based on the adjustment of the cultivation practices to the evolution of the crop and to the environmental conditions.

A better knowledge of the multiple interactions existing between the crop, the soil and the climate is necessary. The concept of *"itinerary of techniques"* issued by Sebillotte (1978), as a logical and ordered combination of cultivation techniques applied to a crop in order to obtain a given objective of production, find here an interesting application for quality management.

For industrial crops, for instance, research about cleaner and cheaper "itinerary of techniques" are recent (about one decade). Designing and testing such itineraries is not so easy: simulation models are needed which allow the study of the effects of the cultivation practices over soil conditions and crop growth and development; the classical method of factorial tests being too heavy, because of the great number of interactions to be tested. Building such simulation tools is nowadays possible, thanks to the recent evolution of crop simulation models (Whisler & Al., 1986).

This has been developed for winter wheat (Meynard, 1985). The models have been chosen by this author in order to offer a low number of easy measure variables and parameters. Yield components are the intermediary variables. The life cycle of the crop is then divided in periods during which the conditions acting upon the crop growth are specific (for instance nitrogen during tillering, water consumption during grain filling). For each period the component level is estimated, compared to the level of the previous componenet and to the growth conditions during the period.

Using simulation models, itineraries of techniques are then built, in order to attain objectives (gross margin, post harvest soil nitrogen content) which are not necessarily the highest possible yields. Performances of the combination of techniques chosen are then evaluated in field trials. Such experiments (Meynard, 1985, Limaux, 1989) show that extensive itineraries (with a low input level) have the same gross margins as intensive ones, and offer a better use of the available nitrogen. These trials show that yield variability is not necessarily increased by the lower level of imputs (fertilizer and chemical).

One can notice that, to include a cultivar having specific agronomical characteristics, only a few parameters of the model have to be reevaluated, and that can be done in one year. Furthermore, current wheat varieties can perfectly be integrated in these new management methods; the cultivars having the highest yields in an intensive system are also the best when extensively managed (Gallais, 1992).

In some cases, research on *sensors* for characterization of quality is still needed: quality of a fruit expressed in terms of sugar and organic acid content is independant of its color. Multi-sensing and multicriteria analyses will be more and more needed for harvesting machines of fruits on a quality basis.

A better knowledge of mechanisms of *fruit maturity* is a key to improving quality selection and a better answer to technological aptitude to processing.

New research on *biochemistry* of muscles have shown that a high percentage of fibers having slow contractions, and fibers of small diameter improved technological quality and taste of meat.

Lastly, new conservation or processing techniques may offer new opportunities for sales, e.g. in vegetable production. We can quote vacuum freezing associated with the take off of water by zeolithes (expanded clay) used for mushrooms and apple slices ; high-pressures (pascalization), pasteurization under CO_2 atmosphere, inverse osmotic dehydration, sterilization by induction.

Biotechnologies, equipment engineering, conservation, processing and agronomical engineering are all active contributors to quality funding.

8. Conclusion

We have tried to show, how the understanding of the quality of the end product of the food chain need a long feed-back questioning of many actors, exchanging information only at different knots of this complex network. Each actor has its own responsibility. The complexity of the problems lie in the number of actors, the degree of knowledge and control of the process they are in charge of, and the interactions between all of them (**Fig. 5**).

Information technology systems and modelisation play a great role. Some partial models already mark a link between plant breeders and growers, as the expression of the genotype in a given environment depends on cultivation techniques.

Equipment engineers have to integrate this type of technology to all the components of this food chain, from sensing to decision making systems, to do better, more precise work and better connections between machine/soil/plant and process/equipment/product. By learning procedures, new equipment will be able to help the operators and reduce the number of tedious tasks.

New foods, or traditional ones processed in new ways have to satisfy more precise specifications. New forms of analysis are now available to control these specifications - up to the metabolite or molecular level to check the authenticity of an imported product !

Quality means a high level of professionalism for the producer and the transformer. If you add the inherent complexity, no doubt the problems affecting quality will be a main challenge for our profession - and for some others - for the years to come.

Table 1 Evolution of the household budget (France)

	1970	1991
FOOD	26%	19,2%
HOUSE	15,3%	20,2%
HEALTH	7,1%	9,8%
ENTERTAINMENT	6,9%	7,6%

Table 2 Basic rules for food suppliers

3. non apparent quality
SECURITY

2. apparent quality: SATISFACTION (HEDONIC) - taste - color - odor - texture	**1.** target: THE CONSUMER	**2.** apparent quality: SERVICE (EASE OF USE) - diversity - distribution - storage - conditioning
	3. non apparent quality	

Fig. 1 - Part of food in the household budget (Source: CIAA, 1988)

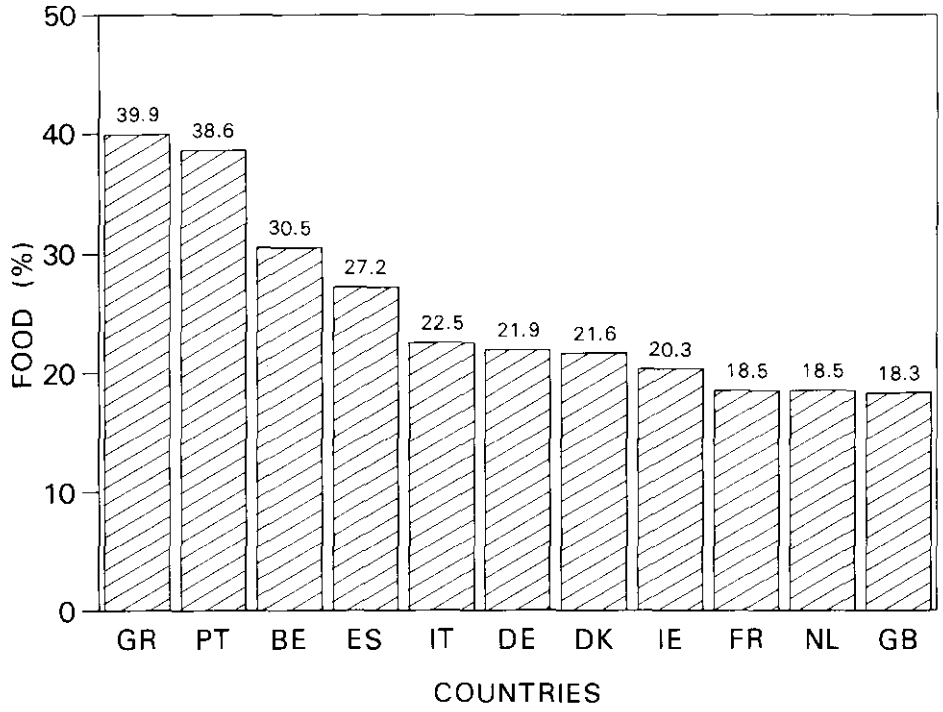


Fig. 2 - From agricultural products to food

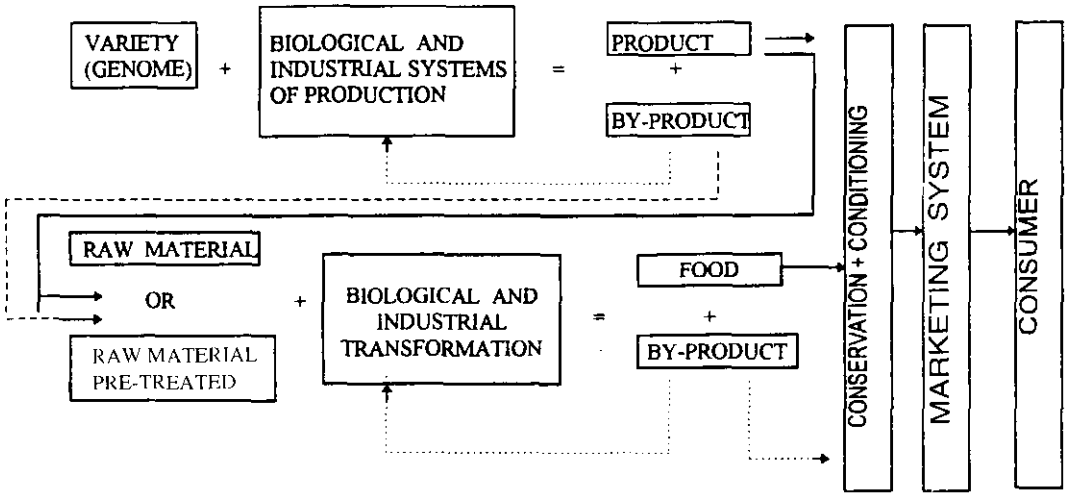


Fig. 3 - Prices since 1955 (Source: APCA, Etudes Economiques; INSEE)

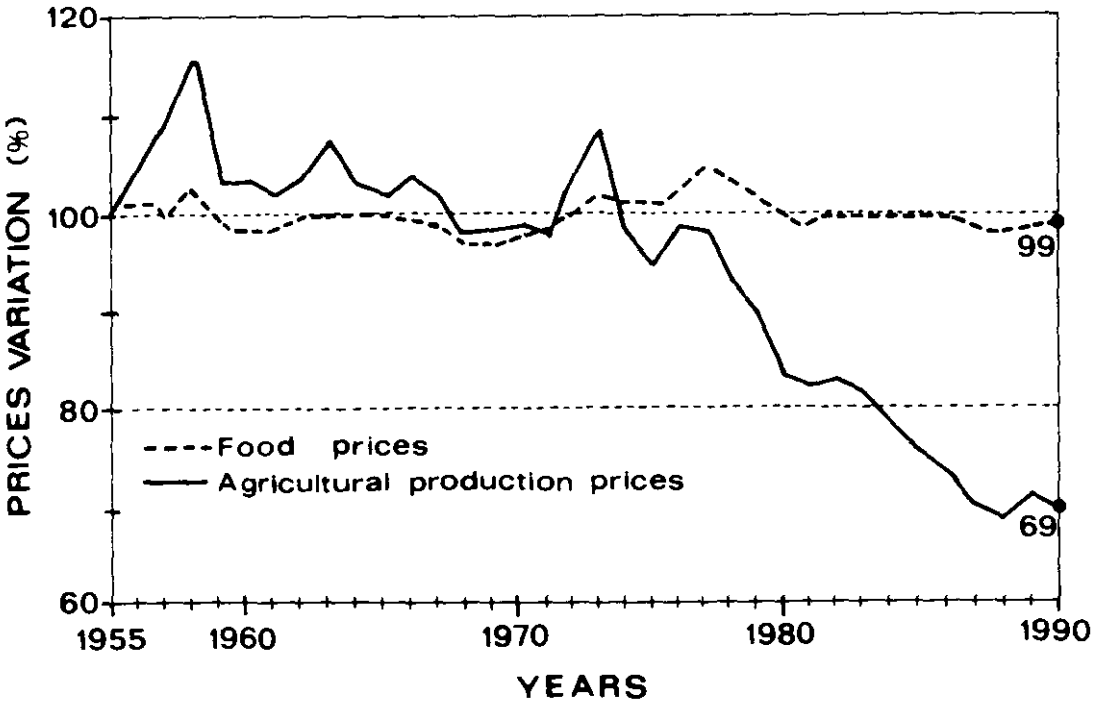


Fig. 4 - Protein content in wheat (Source: ITCF)

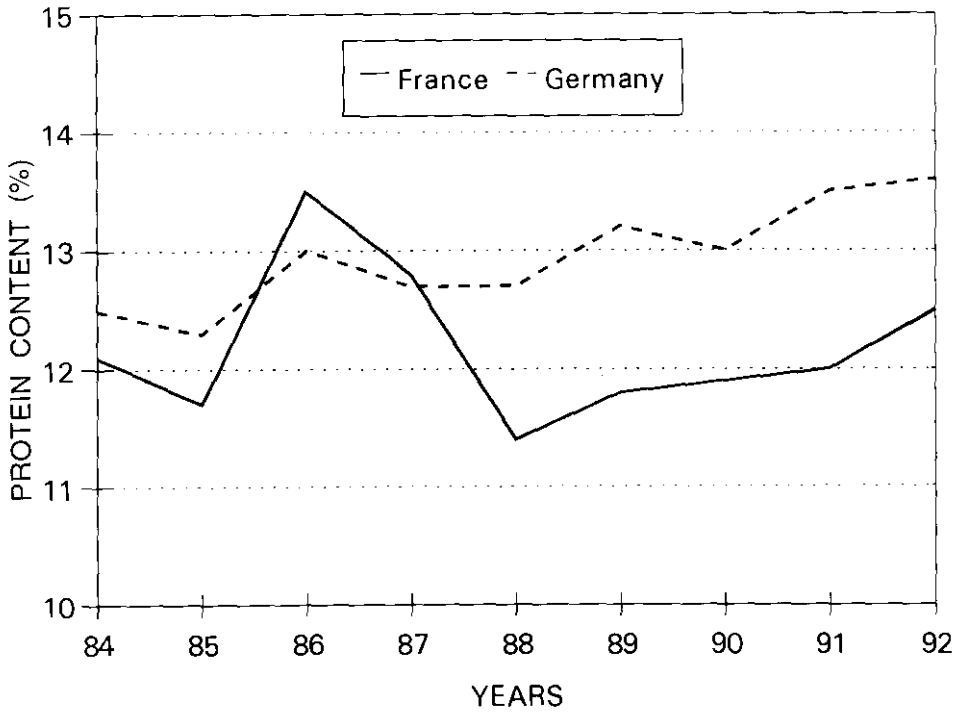
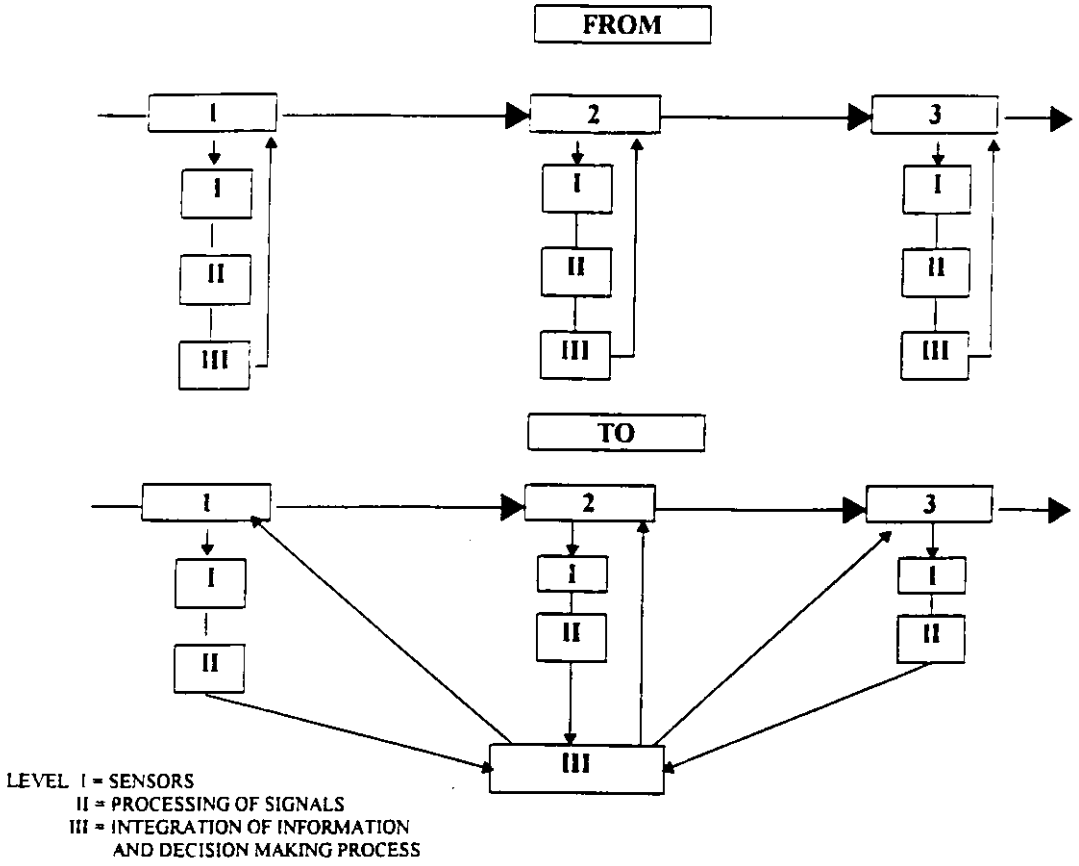


Fig. 5 - Quality of the end product of the food chain needs a long feed-back questioning of many actors



Mr. Robert C. LANPHIER III

USA

I think your paper is excellent. There is no doubt the academic world has come up with sensors and we can engineer many things, but what I think is missing is the importance of how technology is transferred in the industry. My experience is that in the food industry it either has to be economical from an internal point of view or it has to be customer-driven. I just spent two days in Spain where they are looking at how to sort hams so that they can get a better boning yield: probably no benefit to the consumer, but a tremendous benefit to the processor. In meat and grain, they make two very interesting examples. Australia has been a forerunner in utilizing technology because of its large export of beef; similarly Denmark and Holland, with large exports of meat, have been at the forefront in adopting new technologies. The United States, dominated by three companies who control 70% of the red meat industry, are more interested in throughput than product differentiation and are probably five years behind Europe in adopting new technologies. Very, very good at high production, but not at product differentiation.

The national pork producers in the United States tried desperately to push technology through so that farmers can be paid a fair price for hogs (something that the European Union has by legislation) and it just isn't happening because the farmer isn't the one buying the equipment; the processor is, and if there is nothing in it for him he is not going to do it. So I think the technology transfer issue needs to be included in this paper.

A.A. JONGEBREUR

I want to comment on the point which also Dr. Lanphier mentioned. As regards consumer demand we must think of both the quality of the product and the quality of the production systems. That means that we have in our country great problems not only with the quality of the products; but also with animal welfare conditions in the system and how the production system can be environmentally sound. These are very important points for the consumer, I think: knowing that they get products that have been produced in a way that they demand.

H. GÖELICH

My question goes along Dr. Jongebreur's last comment regarding the difference of price between products treated and not treated with chemicals. How is the general politique of your CEMAGREF institution in this sense? Are you going to support and help the development of non-treated products versus the treated products? And how are you now convincing the consumer about the quality? What are the criticisms and the points that make the quality of the product in the mind of the consumer? Can you comment on this?

B. CHEZE

As far as CEMAGREF is concerned, we are mainly trying to work on the relations between the processing equipment, the quality of the processed products, etcetera. Policies to develop labels, quality labels, etc., the negotiations that exist between agricultural producers and food processing people, make up the private sector, organized on a professional level - we have in France what we call the 'specialized institutes', for example on cereal production, beet production, etc. In fact, each institute has a representative inside the different councils, to find among themselves some common agreement. It is true that if you succeed in producing raw materials that completely satisfy the needs of the processing people, it is clear that this is going to cost you something and in the negotiations you must make comparisons between what the industrial people can do by pre-treating (because they now have the means to do what they want with a product and they have also the means not to use agricultural products at all). So, it is really a cost comparison between the two. For the moment I would say that food industry people are obliged to be homogeneous because they receive cereals of different qualities etc., sort off mixes, so they have to work on homogeneity, and of course they have to control the quality adding a special product to compensate and be able to use their processing equipment. correctly. Agricultural production people are looking forward to when they can have a better control of all the parameters of agricultural production and will be able to satisfy the demands. So it's a tendency that the food industry people will appreciate, but the negotiations are something between two private bases. As a public State Research Center we can't actually get into that.

Prof. Irenilza de ALENCAR NAAS

Brazil

I just want to say something about the transfer of technology. Sometimes the customer really plays a major role. For instance right now Brazil is the third largest exporter of pork products, it is also the third largest pig producer in the world; a few months ago some of our major importers called us and said "We are not going to buy anymore of your pork products because you use too much drugs". The reason we use a lot of drugs is because most of the housing system is not adequate. But this leads to

better housing design and better engineering equipment for better production, so we have to use less drugs to keep the market. That's another way around. You do have to transfer the technology because otherwise nobody is going to buy your product.

Prof. Axel MUNACK

Germany

I think we started with a top down analysis, including all the producers and the consumer at the final end, but you also showed a map analysis, coming to the more technical aspects of production. I think I would like to go back again to the top-down analysis and start by saying that quality is defined by the consumer, this is a fact we must live with. I think this can also lead to very unobjective judgements of quality, specifically in Germany some tests have revealed that for tomatoes if the supermarket manager does not have the desired quality he just produced quality by writing another country of origin onto the tomatoes. This shows that quality is very unobjective, but it is defined by the consumer, and we have to bear that in mind. I think also that consumers have devoloped some crazy notions about quality and how quality is produced, like hand-milked cows or something like that. I think that we should take steps to find a solution in the sense that we should either bring or sell the quality to the consumer. We should take active steps, to keep the consumer informed about quality.

B. CHEZE

You are perfectly right, but this is rather difficult because people must be prepared. The problem is, when someone goes into a supermarket, the salesman tries to attract the consumer through different means: - from music, to the presentation, to the colours, etc. - and generally this plays a more important role than the content of the product. I think the more people see the importance of what is inside as opposed to what is outside, things will change. That's partially why you have to use such labelling as "red labels" or special indications. That's the way the Ministers of Agriculture try to promote products that have in reality not only apparently good qualities but also sanitary qualities, because this has to be controlled by many laboratories.

Prof. Francis SEVILA

France

Dr. Lanphier told us that the technology development in the food industry is related to the financial interest of the companies or the consumer. There is another important factor, which has driven technology and change in this industry, related to quality: standardization and regulation. During the Sixties and Seventies most of the contracts and demand we had for new technology, for quality measurements or quality obtention in this industry was related either to the USDA regulation so that we could export food to that country, or to some fancy regulations that our producers were introduced to at each Board meeting. I think that this aspect of standardization and regulation is very important in dealing with quality of food and it definitely applies to all of this morning's discussions.

Dr. Uri M. PEIPER

Israel

I think that in the research phase we have now the ability to help improve the quality of products by trying to understand - mainly in the controlled-environment agriculture - the factors that influence the quality in the first place rather than quality control of the finished product later on. I think a lot of emphasis is to be put on research for developing sensors for environmental control, and on controlled atmosphere, be it in vegetable production, plant production or any production (animal housing, etc.). We have had several papers during the conference on sensors and techniques of this phase of production. I think this is more basic and if we can end up with better procedures for production this will surely benefit the quality of the end product in a much more economical way.

Mr. Roger CASTENSON

USA

I was at a meeting about five years ago, in California, and a Gentleman there suggested that we could look to the future and when you went to the supermarket, whether it was your fresh vegetables or whether it is the bottled water here. I don't know whether it is a regulation in Italy or in the European Community that the water label tells everything about it, but I would suggest to you that with a more health-consciuous public (as Bob Lanphier suggested, things are consumer-driven and we should be responsive to the public) we have the ability today to take that apple or that cucumber and trace it back to the farm of origin and the farmer would guarantee the quality of that product and that that could be traced to what kind of treatments (fertilizers, pesticides, herbicides etc.) the particular product had been subjected to. We may need to look at that. Certainly the

producers of this water have told us from whence it came and what is in it. So it may be something that we need to look at and consider seriously for the very health-conscious public that we serve.

Dr. Graeme R. QUICK

Philippines

This morning our friend from Germany, Mr. Rottgen, showed us a graph which if you projected forward another two years would show zero sales of tractors. This afternoon we saw another one so I am thinking we might as well find some rope to hang ourselves. Bernard, would you like to comment, please, on figure 3 which, if taken to its logical conclusion, foresees zero income for the farmer by the year 2000? Then tell me why you state that you do not think that the farmer's income would be affected.

B. CHEZE

Of course, if you follow the curve there will be a meeting point. Normally all these types of curves do not show the real situation.

In fact, it doesn't start from zero. It starts from 60%. If you take the world price of wheat, no country can produce wheat at the world price. It is nearly impossible. So you have to be very careful when you use these sorts of indications on prices.

What is expected is that some day or other there will be a better situation for the farmer unless he still considers himself as a producer of raw material, then I think there is not much future for him. Even for energy raw materials in the discussions between the people processing this sort of thing, they will always ask the lower price. This is a classical discussion with the products coming from tropical countries: most of the processing units, in developed countries, negotiate with the producers of coffee, etc., from different countries, but the level of discussion is always the same: they want the lowest price so they can make the better profit for themselves. That is the rule.

I think that more and more the farmer has to be involved in the processing itself. For example a producer of chips in France was originally a member of a group of farmers producing potatoes and once they decided to make potato chips they went in full business, now it is one of the most well-known and popular chips producer. They recovered the added value. That's the way it should be. That's why I recommend that a lot of cooperative systems try to have both the production and the transformation side, so that they can recover the money, and then distribute to the farmers.

G. SINGH

I'd like to point out here a very good case in Thailand. Thailand is now the largest exporter of tinned pineapple. I don't know whether or not you are aware of it. Many farmers went broke because the price fluctuation was so high. In the last two or three years the system developed is that the growers and the processing industry have to settle a price before decision. So, farmers will plant an area according to the price fixed, and so the minimum price is guaranteed.

Dr. David J. WHITE

UK

I'd like to make a comment on horticultural crops, which is really stimulated by Dr. Piper's comments. I think here we have a fine example of real quality, which has been made possible by what is called "cold-chain marketing". The produce is cooled immediately it is harvested and it is kept cool all the way to the consumer. As you know, when you pick it up, put it in your shopping bag, it makes everything else wet. But this is actually a real achievement in marketing. But I think there is still a big gap, and that is in relation to seasonal crops. By way of an example I will take early potatoes. The early potato is a very tasty commodity. When it first becomes available in the shops in the United Kingdom (i.e. about the end of April every year) it fetches a very high price. People very willingly pay 1 Pound per kilo for what we call Jersey Royal potatoes. Now, here is a challenge: why can't we have early potatoes of that quality all the year round? You will say to me: well, there are other countries that are harvesting potatoes when you are not. I'm sorry, that's not true: we import so-called early potatoes from Spain, from Cyprus and from Egypt. But they do not have the quality of the potato that can be grown in Jersey. So I think there is a real challenge here. There is a high-value commodity which is not available in the shops all year round. Can we grow early potatoes? Can we store them so that they are available for a much longer season? It is, I think, a challenge principally to the crop physiologist, and also perhaps to the engineer.

Prof. A. KAMARUDDIN

Indonesia

I would like to go back to Figure 3, because it is also related to quality. What we face in Indonesia is the same thing, what we called forward linkages more than the backward linkages. Therefore we'd like in the second long-term development to push the agroindustries so as to put money back to the farmers, to the village. We see also in Europe that forward linking is also happening here. Also you are saying that cooperatives might be the answer but in the morning we saw that cooperatives do not work in Egypt. I don't know in what direction that forward linkage can be promoted so that money can go to the farmers. And we can make sure the quality demanded by the consumers can really be secured and increase the purchasing power of the farmer.

B. CHEZE

The difficulty when you use the word "cooperative" is that it has many meanings depending on the country. But the idea expressed before saying that one of the chances of the agricultural producers in certain countries is that they have special conditions. Dr. White was speaking of Jersey potatoes. A lot of countries have a special climate, special soil (for wine this is typical). So I think these special conditions make products that then you have to make known not only to the neighbours but also to the market. As far as you getting these products appreciated by the consumers is concerned, you can try to bring the farmers together; eventually by building up small local industries to process this type of product; then try to find the means (at the Ministry level, etcetera) to label these quality products.

This is the attempt of many European farmers, who are not doing this mass production of cereal etc., where the competition is very heavy, with the big large producers in the world, they want to focus on these sorts of products. But you are right to say "be careful about the sanitary quality in particular". They have to be very strict on the quality, generally these food producers are joining together to make a sort of association where they have the measuring techniques to control production. You don't have a label if you have not satisfied the regulations - generally they are given by the Ministry of Food or Agriculture. These regulations are very severe because it is a question of the consumers' health. This system has to be built on that. It is not an easy thing and I think that it can be practiced in some countries but maybe not in all.

B.D. WITNEY

We've heard conflicting views round the table this afternoon and I want to try and summarize them because I don't think we've got the whole answer. Some people have said that the market is consumer-driven. The consumer has been encouraged to buy more fresh produce for health reasons. But as a consumer he has no means of mesuring the quality in terms of the presence or absence of agrochemical residues. I think that this is a key area. If we take the UK, we import produce from all over the world. I don't know the standard of potatoes that are stored by English growers, whether they are using storage chemicals or not. But we are encouraged to eat jacket potatoes, in other words, we eat the skins to get the benefit of all the trace elements in the skin, and we may be getting greater "benefits" from some of the other agrochemicals! We certainly don't know what the standard of production is of fresh pineapples in Thailand. And I don't think that a quality label is enough for the consumer to judge adequately. You can judge from a bottle of water what is in it because it is sealed. An apple, an orange, a pineapple is not sealed. If we are going to justify the price premium from fresh produce we have to give the consumer a means of identifying the absence of agrochemicals and a guarantee of quality.

B. CHEZE

I don't see a consumer coming with his spectrophotometric equipment and trying to make tests on the residues. But pest residues is also very important from the processing point of view. When you have some pest residues and then treat at 150 degrees with high humidity temperature plus some fermentation etc., you really don't know what the chemical molecules are going to produce and maybe they are even much more dangerous than the original pesticides. This is also a question that involves many bread producers because they realize that in some cases there are some very bad side-products inside their bread that they didn't expect to be there.

F. SEVILA

The concept of quality is closely dependent on the place you are in. It may be very important according to your standard of living and the way you are eating in the place. It might be very important if you are not starving, but if you are starving maybe you can accept some residues. I think it is like the machines this morning: we have to think of flexibility of the analysis.

Y. KISHIDA

I want to let you know about a big discussion in Japan, on marketing systems for food. Up to now every food market and supermarket should show the price of production, the producer's name and the date of production. But now we are getting a lot of pressure from another country and these people say "Why do you have to show the date of production? Just the limiting time

for eating is enough". Our government got a lot of pressure from outside, then they said: you don't need to show the time of production; but our consumers know that freshness is very important. They want to know when it was produced.

We also talked about quality and for me it is still very vague. What is the concept of quality in food? Taste? Freshness? Wholesomeness? If you have any comments I would like to hear your opinion.

B. LEGG

I think there are many examples where the produce produced on the farm is of very high quality, but that quality is lost before it gets to the consumer. I know that progress has been made through the cool-chain but there are a lot of examples where quality is lost.

A survey was done some years ago in the UK on the quality of apples produced, it showed at the time that over 95% of the apples on the tree were Class-1 quality but by the time they had been harvested, transported, graded, stored, graded again, and transported, the number of Class-1 apples was below 70%, so almost a third were being lost in the handling process, after production by the farmer.

Another example would be poultry carcasses. People from my Institute who have looked at poultry processing plants have commented that you could not design a better system for spreading microbes from one carcass to another. If you've ever seen the plucking thing that's whirling round, and the mist of droplets that comes off, each contaminated with microbes, it is really a disgraceful situation. I think comparatively few chickens are heavily contaminated with salmonella and so forth when they enter the processing plant, but almost all of them are by the time they leave.

A third example. I spoke to a manufacturer of bread-making equipment in the UK. He said it was his belief that because of the poor control in the breadmaking process he believes that about half the loaves that were cooked in the UK were not perfectly cooked - if you looked at the center and the outside they would either be over or undercooked at one extreme. And yet, the wheat used was probably of high quality.

So I think if you are going to take the question of quality seriously, we have got to look, more than we have in the past as engineers, at what happens after production, between production and it arriving at the table where it is eaten.

J.ORTIZ-CAÑAVATE

All this discussion focuses on the importance of measuring the physical properties of the agricultural products and to know what is inside the fruit before you open it. I think this is a very important subject for the future and for research to improve our knowledge on measuring the quality of food.

G. PELLIZZI

I have two questions. First, I have the impression that in this discussion we have not examined sufficiently how harvesting machines, for instance, will modify the quality of the agicultural products and what we can do in order to reduce this modification.

Second question: I don't understand completely what conclusion we can reach on this discussion. Could you kindly try to draw some conclusions?

B. CHEZE

About the harvesting, it is true that harvesting conditions are important: the harvesting period, the status of the plant, etcetera, are rather important of course. The machine may add some good or bad things. Generally some bad things, because it increases the number of shocks, bruises, etcetera. More and more for example for dried seeds you need special equipment in the classical combines in order not to be too harmful to the grains. What is important also is that we know a little more about the evolution of the product, the time when you collect it and the time it is going to the market. It's something important to know so that, backwards, you can say: I have to harvest these apples at this moment because I know the evolution of the maturity, etcetera, and the shocks they are going to receive will play a role in the final percentage indicated by Brian.

As far as the conclusions are concerned, I think that the General Assembly had the impression that we didn't know really which way to go. Some expressed the importance of the final user, but saying "well, we have to take care also of the consumer" because he is the one who buys. So I think we have to work more and more but I wouldn't say it is a linear process. I think you could easily say: OK, I need such quality for consumer needs, then I go backward and say: these are the conditions for the agricultural producer. It would be marvellous to have this simple scheme but probably it is more complex. I just wanted to say that in fact it is not a linear thing, it is something like the introduction of innovations, where you have your circles and when you start to present an innovation, by the time you develop it things change and you have improvement of the innovation, etcetera. So it's really a continuous interactive process.

If I say as a conclusion "it is a complex situation", I don't solve your problem of conclusion, but I am convinced it is a complex engineering problem anyhow.

Dr. Arturo LARA

Mexico

After all this discussion I came to the same conclusion, but I thought in a way that we engineers feel very comfortable when we define what quality is. We talk about quality of tractors: we pretty well can define what variables are going to define the quality of tractors. We talked about the quality of materials: we know what kind of physical properties of materials define the quality. But in the case of food I think that there is still a need for defining what quality really means. There are not enough standards regarding food. I think that in addition to the comment that Ortiz Cañavate made i.e. that it is important to measure the physical properties of food, I think it is also important to define what are the values that define food quality. So I think that there is still a long way to go before defining quality completely regarding food.

Mr. Chak CHAKKAPHAK

Thailand

I'd just like to add to what has been mentioned by Prof. Pellizzi regarding the harvesters. You probably are talking about how to improve the Western harvesting machinery; but in Thailand, and in many agricultural production countries we still do not have machinery to harvest our crops. We have some machinery for rice but for many other crops there is this problem of labour shortage, late harvesting, and so product quality is deteriorated.

I would like to refer also to this morning's discussion, when Mr. Kishida was telling us about some big company trying to work more in the developing countries. I would like to expand on that. We don't need a lot of investment. There are possibilities for joint ventures. There are a number of examples where this has been done; it helped the country and it was also profitable for the company. So, for machinery like harvesting machines, if it can be arranged that would be very useful for both parties.

G. SINGH

I think we have had sufficient discussion. This is such a vast topic that we can keep going on forever, I think we have reached a stage where we are starting to go in circles now. So I suggest that we all realize that it is a very complex topic.

Ladies and Gentlemen, we are at the end of our meeting. I'd like to propose a vote of thanks to UNACOMA, which has helped to organize this session of the Club of Bologna. So please give a big hand to Club of Bologna supported by UNACOMA.

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