I.

SYNTHESIS REPORT

FOR PUBLICATION

CONTRACT N° : 0394

PROJECT No : 4104

TITLE : QUALITY ENHANCEMENT AND PROCESS AVAILABILITY IN LLDPE STRETCH FILM OUTPUT BY MULTISENSORS AND COMPUTERIZED SYSTEM.

PROJECT COORDINATOR : DR - ING - CESARE FORNI

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STARTING DATE: 1.4.1991 DURATION : 48 MONTHS

PROJECT FUNDED BY THE EUROPEAN COMMUNITY UNDER THE BRITE/EURAM PROGRAMME

DATE: 10.5.1995

II. TITLE , AUTHORS and ADDRESSES

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QUALITY ENHANCEMENT AND PROCESS AVAILABILITY IN LLDPE STRETCH FILM OUTPUT BY MULTISENSORS AND COMPUTERIZED SYSTEM.

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III. ABSTACT

The aim of the project has been the development of an integrated manufacturing system to enhance the performance of LLDPE stretch film production.The consortium being well structurated with a strong participation of SME'S and including raw material supplier, end product producer and dealer, with a very good balance between industries and research centres, has allowed to reach the results proposed with particular attention to costs reduction and quality improvement.
The innovative aspect of the project, concerning the factory integration, has led to the application of the CIM concepts to a very competitive production process with a considerable contribution of the advancement of the extending technique.

IV INTRODUCTION

In order to enhance "quality " and " availability " both of the product and of the process, in a multisensory and computerized system the CIM - Computer Integrated Manufacturing, in term of complete automation of the factory, has been implemented at the end of the projet applied to the industry.

The product : stretch film in LLDPE (Low Linear Density Polyethylene) for packing and wrapping every matter enclosed foods, had its mechanical features improvement after a number of tests and lab proofs , with the employment of new raw materials as:
D-2247; D-2291; D-2237; D-2288
XZ - 87129; XZ -87127
both by microstructure analysis as :

- crystallinity degree
- amorphous phase fraction
- orientation of the chain in the amorphous phase
- structure of the interface

and by increasing melt homogenisation in extrusion process.

The process : or cast - extruder line and robot performed by a mechanism for top - down planning and bottom - up implementing in an orderly modular fashion, was divided in five levels:

- process
- station (sensors)
- cells (PLCS)
- Center (supervision node)
- Factory (LAN and DBMS)

Inside this mechanism a few critical areas were analyzed:

- extruder " cascade" temperature control
- chill roll new design
- three layers thickness measurement by FTIR set
- new extruder screw design
- CIM data base engineerisation

This piecemeal approach has allowed to design a system able to auto eliminate defects , process risks and turn out all manual or half - manual procedures rnto automated procedures . As the integration is not complete considering only "product" and "process".
The main factory actions were analyzed:

- raw materials flow
- orders entry
- stocks and warehousing rationalisation
- factory communication
- products distribution
- administration

With all these amount of problems the way followed by the research was on the wake of the more up to date technique for each subject .
In particular :

- undergone product on quality cycle
- carry out availability of the process at every level
- performe tests and proofs by a well defined model
- add value to the production rather then costs
- improve software quality
- fix defects at the source as much as possible finding a solution
- favore integration by modularity.

V TECHNICAL DESCRIPTION

GETTING STARTED

There are a series of prerequisites which have to be recognized and met before CIM implementation can be expected to be successful.

The first and perhaps most critical was to have the commitment and ongoing support of the Prime Proposer top management to perform a research even if funded at 50 % by Rite European Commission.

The second was the participation of all Partners, user managers and systems groups in a central coordinating committee . In fact, the CIM system designed is the joint product of those who will operate it. Therefore a leader committee has been formed as soon as CIM arises as a product with Brite approving the project , in order to create a " user - driven " system design with operation management as dominant force through the Coordinator , and the responsability for CIM was resided at the same as the authority needed to make the change necessary to implement the new system.

The third was to provide training in computer science to the firm employees to build basic computer skill and remove to the greatest extent possible any fears of computer individuals might have.

The forth was to analyze the strenghs , weaknesses and traditions of the Prime Proposer firm and recognize them for highlighting and strengthening or correcting or eliminating,

The fifth was to solve real problem meant, of course that the coordinating committee was aware of all problems covering the CIM implementation,

COST - BENEFIT ANALYSIS

The cost - benefit analysis was performed in order to know what benefits might have the introduction of an improved manufacturing technology. Therefore, a matrix was prepared of as - is costs vs. performance (efficiency and effectiveness) of existing manufacturing fictions on facility wide basis. The model identified all significant manufacturing cost categories:

- Direct labor
- Material utilisation (unplanned scrap)
- Material handing
- Machinery and equipment ammortisation (including tooling)
- operation supports
- Engineering support
- Plant and facilities ammortisation
- Information system support
- Inventory financing
- General and administrative support

In order to know the impact of the project on the value added identified a cost - benefit tracking was imposed to measure the " actual impact of advanced manufacturing technologies " on total function groups - facility wide manufacturing costs and related performance measurements as compared to be base line of forecast by the cost - benefit analysis process.

PLANNING

The planning which is based on assessments of the business operations of the Enterprise as Prime Proposer the product as LLDPE stretch film and the possibility of CIM growth , leads to CIM program that ensures a competitive manufacturing performance improvement. The plan had four phases:

1. Feasibility study
2. Launching (lebels identification - product analysis)
3. Control areas identification and their optimisation
4. Transition to full scale CIM

During phase 1 - The Prime Proposer assessed its manufacturing competitiveness in the related market segment, evaluated now its existing manufacturing automation tools contribute to its competitive manufacturing performance; identified operation management , technology , and personnel requirements for CIM environment with high competitive potential BRITE PROJECT PRESENTATION FOR SUPPORT AND FUNDING .

During phase 2 - Actually initiated the practical development of a CIM program starting from :

- Process : Cast extrusion, chill - roll; dragg line; pallet robot
- Station : Sensors zone by zone along the extruder, die, chill - roll, dragg line a pallet robot - Analyzing their performance and accuracy in T e P measurement
- Cell : Groups of data for parts and gathered them in PLC programrne to control T; P; S ; t.
- Center: As a supervision node to perform an Object Orientated software to link the different WS and to control raw materials, stretch film features, extruder temperatures and pressures.

During phase 3 - A few critical areas analyzation

Extruder cascade temperature control : the extruder temperature , zone by zone were compared to die temperature with a system thus called " cascade " which allows to line immediately the data required by "RECIPE" for each stretch film.

Chill roll new design : the chill - roll parameters correlated to speed, die distance, and surface "t" in order to evoid crystallisation.

Three layers stretch film measurement by FTIR set and product quality improvement : the lab. proofs on different layers composing stretch films have allowed to determine and improve mechanical features.

New screw design : the screw new design has been needed to increase line speed and optimize melt homogenisation. The extruder screw through a simulation process and SW is the first in Europe.

Software quality improvement: the SW quality control was reached through five levels: system requirement; system architectural design; system detailed design ; system integration ; system validation.

Pareto and Markov model to control failure : the models used were related to deterministic and stochastic failures in order to control the process and the electronic circuits that rule the process phases itself.

During phase 4- CIM DATA BASE ENGINEERISATION AND IMPLEMENTATION

IMPLEMENTATION AND MANAGEMENT

The implementation of a total system has been carried out as the development of the CIM in a single product has been carried out . Therefore, first of all , with all data acquired by tests and proofs on raw materials, different " RECIPES " were performed to identify product with high quality experimentated . These products engineerisation were optained-through CAE. -

As the RECIPES contain besides the stretch film mechanical features also the main process data to produce with high availability, the CAM was carry out to monitor the process itself.

Then a Data Base was performed to link all data coming from the SUPERVISION CENTER and a LAN was implemented to link the different extrusion lines placed into the factory.

In particular the management coming exclusively from this Data Base Management System sees both orders entry and stocks exit and manages the " IN " data and the " OUT " data in logical schedulation steps allowing the factory to reach the highest goals both for quality of the product and availability of the process.

VI RESULTS

The key to successful CIM project implementation has been the " break down " the tasks in deliverables that have been logically united and completed with a PERT chart showing the time dependencies of all work packages . Validation of project budget and schedule has been obtained bysumming assigned resources (Prime Proposer and Partners) of each of the work packages results optained and then comparing the sum in ECU and worker days to that for the total project.

The essence of effective CIM system control has been the method used for managing the project, through the Coordinator and leader research team, the six monthly and yearly assessments and, very important, the MID - TERM and FINAL TECHNICAL ASSESSMENTS.

Routine feedback of actual progress against planned implementation milestones has been essential to keep the project under control. In this way , critical areas analysis , new screw simulation ; DBMS implementation have had a regular time development. However recognition that a milestone could not be reached has triggered corrective actions while the problem was still small enough to allow recovery. The benefits reached have been both" hard" and " soft".

Hard benefits

	Reduction
Lead time for product	50 %
Required number of machine tools	60 %
Required personnel	50 %
Labor costs for product	90 %
Required machining hours	45 %
Tooling costs	30 %

Soft benefits

Higher accuracy
Lower scrape rates
Closer advance to production schedule
No order chasing
Decreasing incident risks
Increased challenge
Increased flexibility
Increased personnel "moral"

VII CONCLUSIONS

After four years of research applied to the industry we can say, with certainty that CIM is a reality. It is implemented in MANULI STRETCH factory at Isernia (I) . This is a pratical example of collaboration among different countries where a different cultural preparation of researchers has allowed to reach the result by uniting the efforts and boosting the wish to create something very important and useful for european SMEs.

VIII ACKNOWLEDGMENTS

This acknoledgment refers in particular to :

- Coordinator for his experience and Partners for their collaboration
* BRITE / E W for support in project N. 4104, contract N. 0394 which has allowed to reach this technical results.

And in particular an high acknowledgment to BRITE / EURAM Commission Representative who has costantely followed, adviced and addressed the researcher team in performing the : CIM SYSTEM .

IX REFERENCES
