AGGREGATION, AUTOMATION AND ROBOTISATION WITHIN THE INDUSTRIAL SYSTEMS OF YARN PRODUCTION OF COTTON TYPE

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INTRODUCTION

The firm advance of the new tehnology, the automation, the robotisation, the computer assisted training have modified the structure and functions of the classical spinning line. In order to analyse how and where these changes have been produced, it is necessary to the concept of the spinning line by the systemic analysis.

The engineering of the systems is a modern interdisciplinary analysing method, generated by the recent developments in the field of science and tehnology.

The specialists define systems as "complex structures of human being-machine type, coordonated and oriented to generate some distinctive objectives."

The specialty literature considers that "a total system"is characterized by 4 types of functional systems namely: the operational system, the maintenance system, the transport system and the supply system.The next levels are for coordination 2 control systems that harmonize the global functioning of the whole total system.

In fig.l schematically is presented the interaction type of the above mentioned systems within the total system.

The functional systems can be divided according to same scheme up to a level that could precisely identify the purpose and the function of each analysed element within the total system.

In this way we can identify a spinning line, the subject of our analysis, with an (industrial)system of human being-machine kind, composed of a number of subsystems found in permanent interdependency in view of generating (making) the general function of the system, the one of producing yarns.

In order to make the basic function,the system is in a permanent link with the environment from which it takes information, raw material, materials, energy, etc. which transforms them into a finished good.

In the context of the systemic analysis, the spinning line becomes a system that includes people, values and technology similar to the cybernetic systems.

To continue the proposed analysis there are necessary 2 basic notions in the systemic analysis, related to the classification and namely: the open system and the system with inverse connexion (with reaction or feed-back).
An open system is caracterized by outlets (outputs) that corespond to the inputs but the outputs are insolated by the inputs and have no influence on them.

The inverse connexion system (or close) is influenced by the own behaviour. This one has the structure in the form of closed loops that uses the results of the passed action of the system in order to command the future actions.

The cotton classic card functioning in a independent regime without any intervention upon the tehnological adjustment is an open system.

The modern card with the autocontrol unit and a command of microprocessor, is a closed connection system. The input values are permanently controlled and adjusted according to the quality of the sliver delivery.

THE TOTAL SYSTEM SCHEME

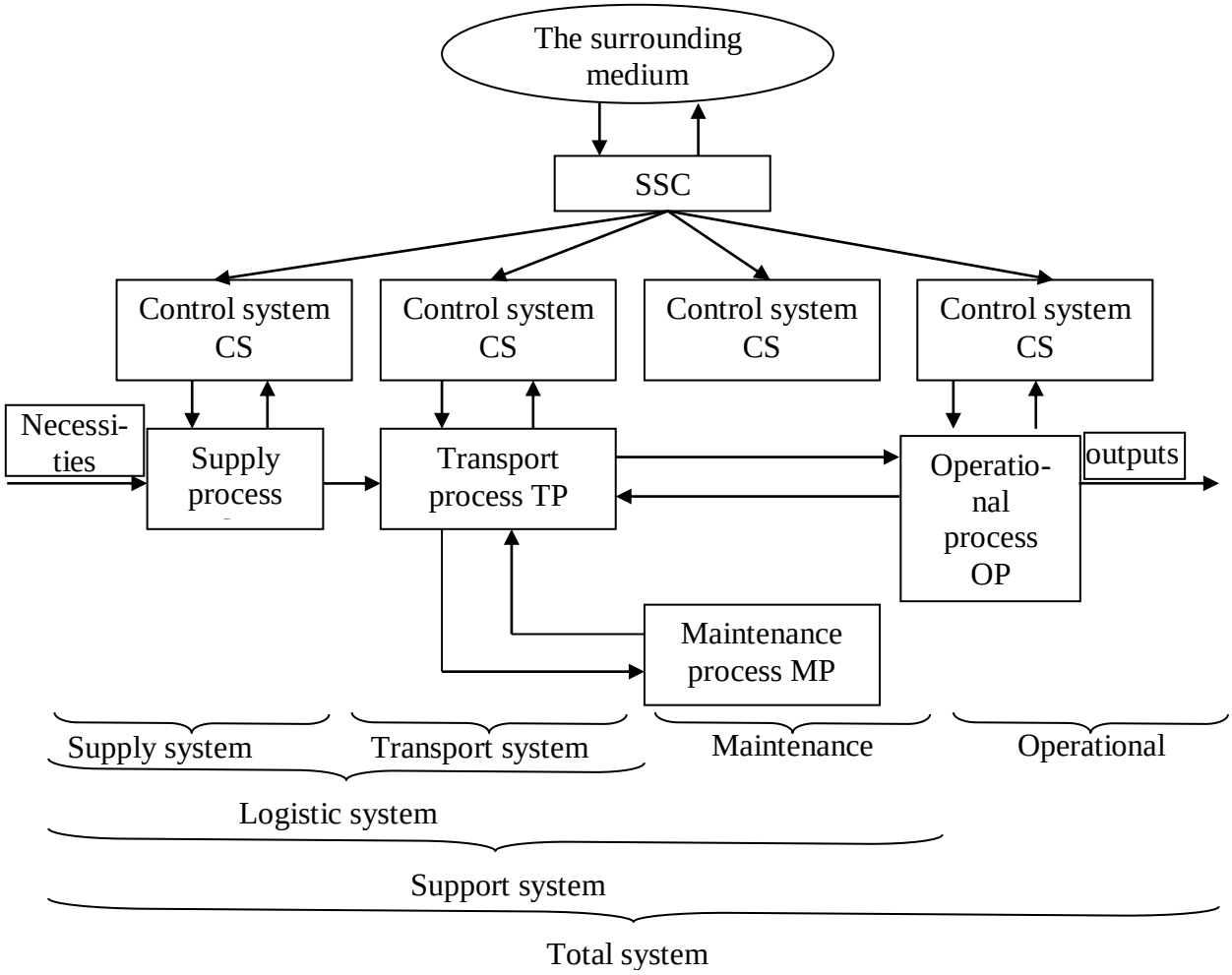

Figure 1.

1. THE MODEL OF THE CLASSICAL SYSTEM OF SPINNING - THE CARDED COTTON YARNS.

In the analysis of the system we choose as model the classical technological line for spinning the carded cotton yarns (fig. 2).

We assimilate the tehnological line as a system defined by a subsystems sum, utilities and equipment that together with the human factor and the resources introduced in the system, act in conformity with the systematic theory, coordonatedly carrying out the activities (functions) in a order to get the defined purpose (the yarn).

On the basis of the presented model we shall present the functions and functions support in different functional subsystems, especially the technological functions of the functional systems and logistical ones,functions that were pointed out by designers and equipment builders.

In fig. 2 there are presented 12 type functions on technological basis, all of them being located in the functional subsystems (operative, logistic and control).

In order to simplify the analysis, the maintenance and central control systems have been taken into consideration as independent ones.

Seeing the functions support we can emphases 12 functions 7 technological phases, respectively 84 functions supports. Function's support:

- technical support, with the equipment and the equipment useful for depositing and transport ;

- human being type support that fulfills the functions the system asks for either alone or helped by a technical support.

Out of the 84 functions supports within the classical system, more than 70 are of human type factor. Taking into consideration the restricted level for the analysis, without the totality of the subsystems maintenance and centralised leading be considered, results what we actually know: a high quantity of human power necessary for operation and the link realisation and reactions that make the system working (functioning).

Technological phases		Blow-room line	Card	Drawing frame	Drawing frame	Roving frame	Spinning	Winding frame
Function system	Function	The type of support of the function						
Operational system OS	Production	□	□	□	□	□	□	□
	Following	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Serving	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Feed system FS	Reception	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Stocking	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□
	Feeding	Δ	Δ	Δ	Δ	Δ	Δ	Δ
Transport system TS	Delivery	□	□	□	□	Δ	Δ	Δ
	Stocking	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□
	Transfer	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□
Maintenance system MS		-	-	-	-	-	-	-
Control system CS	Quantitative	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Qualitative	Δ	Δ	Δ	Δ	Δ	Δ	Δ
	Technic	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□	^{84} Δ+□
Central control system CCS		-	-	-	-	-	-	-

□ - human support Δ - technical support

Figure 2.

2. THE INFLUENCE OF THE AUTOMATION, ROBOTISATION AND COMPUTER ASSISTED WORK UPON THE SPINNING SYSTEM

Development levels:

1. The growth of the technological performances through the productive function performance.

2. The reduction of the watching function at the human level and the transfer to a technical support.

3. The delivery function transfer, stocking, transfer from the human factor to the technical support through automatisation and agregatisation.

4. The transfer of the operating function from the human factor field to technical support through robotisation.

5. The integral transfer of the human functions of the control systems in the central control and command system through computer assisted guidance.

In fig. 3 it is presented the model of spinning system to which to modernisation levels 2 and 3 have been operated. These levels consist of the agregatisation and the automatisation of some technological phasis including the sensor setting that display the operative unit state.

To this spinning line the blowroom machine is automatically supplied and set of cards.

The cards have a autocontrol units, control systems and quidance for production.

The spinning machines are agregate with winding frame, the doffing transfer being made automatically as the winding operation.

In this model it is seen that out of 60 position of function support type distributed along the spinning line, 40 includ the human factor.

Technological phases		Blow-room line Card	Drawing frame	Drawing frame	Roving frame	Spinning Winding frame
Function system	Function	The type of support of the function				
Operational system OS	Production	[1]□	□	□	□	□
	Following	□	□	□	□	□
	Serving	Δ	Δ	Δ	Δ	Δ
Feed system FS	Reception	Δ	Δ	Δ	Δ	□
	Stocking	Δ+□	Δ+□	Δ+□	Δ+□	□
	Feeding	Δ+□	Δ+□	Δ+□	Δ+□	Δ+□
Transport system TS	Delivery	□	□	□	□	□
	Stocking	Δ+□	Δ+□	Δ+□	Δ+□	□
	Transfer	Δ+□	Δ+□	Δ+□	Δ+□	□
Maintenance system MS		-	-	-	-	-
Control system CS	Quantitative	Δ	Δ	Δ	Δ	Δ
	Qualitative	Δ	Δ	Δ	Δ	Δ
	Technic	Δ+□	Δ+□	Δ+□	Δ+□	[60] Δ+□
Central control system CCS		-	-	-	-	-

□ - human support Δ - technical support

Figure 3.

Technological phasis		Blow-room line Card	Drawingf rame	Drawingf rame	Roving frame	Spinning Winding frame
Function system	Function	The type of support of the function				
Operational system OS	Production	[1]□	□	□	□	□
	Following	□	□	□	□	□
	Serving	Δ	Δ	Δ	□	□
Feed system FS	Reception	□	□	□	□	□
	Stocking	□	□	□	□	□
	Feeding	□	□	□	□	□
Transport system TS	Delivery	□	□	□	□	□
	Stocking	□	□	□	□	□
	Transfer	□	□	□	□	□
Maintenance system MS		-	-	-	-	-
Control system CS	Quantitative	Δ	Δ	Δ	Δ	Δ
	Qualitative	Δ	Δ	Δ	Δ	Δ
	Technic	Δ+□	Δ+□	Δ+□	Δ+□	[60] Δ+□
Central control system CCS		-	-	-	-	-

□ - human support Δ - technical support

Figure 4

In fig. 4, the model of industrial spinning system to which the developments of level 4 are operated.

These ones consist of the robotisation of the last functions within the logistical and operational system.

In the spinning line, in the preparation,zone special robots are introduced in taking over, transfer and the feeding of card's can, drawing frame, roving frame.

At the roving the serving robot and doffing removal with transfer function for the roving bobbines to the spinning machine.

Two specialised robots in the feeding the roving bobbines and cutts removal are adapted.

The robots in the whole line are conducted by own programmes having possibility to be compled to superior level (central computer for process).

In this conditions, the spinning through succesive phasis conditioned by the human factor becomes an integral spinning where the human factor almost entirely retires from the functional systems (S.O.S.A.S.T.) remaining 3 phases without physical power.

In this model out of 60 positions of the function support type the human factor appears in only 18 with 80% less than in the classical model.

This type in the tehnological line is made around 1988 by the most advanced machine building companies in Europe and Japan.

In fig.5, the industrial spinning model system is presented to which the developments of level 5 are operated the system being lead on computer process.

In this case the microprocessors and the microcomputers set on each equipment or groups of equipments are guided by a central computer situated in the level of the command system and control.

In this conditions the human factor from the functional control level is replaced by the microcomputers guided by the central system.

The human factor remains in the functional system only in symbolic volume for control and accidental operating device.

Technological phasis		Blow-room line Card	Drawingframe	Drawingframe	Roving frame	Spinning Winding frame
Function system	Function	The tipe of support of the function				
Operational system OS	Production	1□	□	□	□	□
	Following	□	□	□	□	□
	Serving	□	Δ	Δ	□	□
Feed system FS	Reception	□	□	□	□	□
	Stocking	□	□	□	□	□
	Feeding	□	□	□	□	□
Transport system TS	delivery	□	□	□	□	□
	Stocking	□	□	□	□	□
	Transfer	□	□	□	□	□
Maintenance system MS		-	-	-	-	-
Control system CS	Quantitative	□	□	□	□	□
	Qualitative	□	□	□	□	□
	Technic	□	□	□	□	60□
Central control system CCS		-	-	-	-	-

□ - human support Δ - technical support

Figure 5.

The spinning lines are equipped with robotsof feeding the cage and having the microprocessor, the blowroom line feeding pneumatically the cards and the electric autocontrol units are introduced in cards and drawing machines.

The winding machines are automatic type and a new generation of spinning machines is prepared and will have an automatic doffing removal.

For optimisation and modernisation of the technological lines, special programmes have been elaborated in different types of the technologies and data basis have been made with technological dates that permit a new approach for conception and design.

The efficiency of the new projected or modernised units is substantially increased, being seen the functioning of a system with less people.

3. CONCLUSIONS

Each equipment has been turned into a subsystem of close type (with reaction) unconditioned by the human presence, all being interconnected in a general close system where the decission and the reaction is guided by the computer.

We can draw the conclusion that future spinning will today is already made and the spinner notion can be assimilated for the modern factories with the one assisted by computer.

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