THE ASSESSMENT OF THE AUTOMATION DEGREE FOR OFFSET PRINTING MACHINES

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Rezumat. *Necesitatea automatizării domeniului poligrafic derivă din necesitatea creşterii competitivităţii produselor tipărite. Această lucrare prezintă o analiză a gradului de automatizare identificându-se prin calcule matematice indicatorii nivelul şi coeficientul de automatizare. Aceste valori sunt utile pentru compararea fiecărei unităţi de maşini de tipar offset întrucât automatizarea înseamnă o mai mare coerenţă şi o eroare mai mică din partea factorului uman, ceea ce duce la o calitate superioară, viteză şi costuri mai mici.*

Abstract. *The necessity of automation of the printing domain derives from the need to increase the competitiveness of printing products. This paper presents an analysis of the automation degree by identifying by mathematical calculations the indicators as level of automation and coefficient of automation. These metrics are useful for comparing each unit of offset printing machines because automation means a greater consistency and less human error, which results in a higher quality, speed, and lower costs.*

Keywords: automation, printing machines, offset printing, level of automation, coefficient of automation.

1. Introduction

Automation is a component of the technical and scientific progress aimed at the machines and installations to work automatically, so independent a continuous and / or direct intervention of human labour [3].

The need for automation in the printing domain derived from the need to increase the competitiveness of printed products, which includes:
• reducing or eliminating hazardous labour or drudgery;
• economic workforce;
• searching the constant of quality;
• increasing the production with limited investment;
• saving raw materials and energy [1].

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The main objectives of the process of automation are shown in Figure 1.

Fig. 1. The main objectives of automation

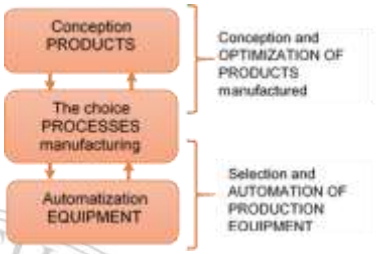

Fig. 2. Steps to optimize manufacturing processes

Automating processes are one of the key steps that help optimize manufacturing processes (Figure 2). Optimization is a priority objective of maintaining the industrial market enterprises polygraphic. This requirement concerns an increasing number of enterprises specialized in this field and thus it creates fierce competition in the activities of this industry.

So far, the majority of printing companies in the country went through stage design and optimization of printed products due to the partnership that we have with companies, which produce printed materials from abroad, and due to the need to ensure user requirements. Improving the efficiency of manufacture both technologically and economically determines printing enterprises to achieve a rigorous selection of their production equipment, multi-criteria to assess their degree of automation.

The evaluation of automation is necessary for the accurate and objective information on the operation of machines, identifying technological reserves to enhance production, improve efficiency, increase quality and reduce the costs of energy and materials [2].

The initial research was focused on analyzing the degree of automation of printing offset printing and arises from the fact that they have a significant demand in the country.

2. Method of assessment automation of the machines offset

The methodology for assessing the degree of automation of the offset printing machines involves the following steps:

• selecting the printing machine to be analysed;
• determining the type of automation of offset printing machines;
• collecting the data on the time for a certain print run and the machine preparation time for the technological process;
• identifying the number of automated operations specific to each machine analysed in relation to the total number of technological operations;
• calculating the coefficient and the level of automation.

Table 1 presents the technical characteristics of the offset printing machines that were involved in the study.

Table 1. Technical characteristics of the offset printing machines analysed

No.	*Name of equipment*	*Maximum print size, mm*	*Groups of printing (colour)*	*Production capacity, sheets/hour*
1	Heidelberg SpeedMaster SM74	500x700	4	15,000
2	Heidelberg SpeedMaster CD74	500×700	5	15,000
3	MAN Roland 205	500×700	5	13,000
4	MAN Roland 504	500×700	4	16,000
5	Heidelberg SpeedMaster CX 102	710×1010	4	16,500

The indicators such as the type, the coefficient and degree of automation were used for the evaluation of the automation quality [2]. Some of the most relevant indicators, involved in the evaluation process, are the coefficient of automation of the equipment. The automation coefficient is the ratio of time to achieve the automatic technological process and the total realization process. The formula for calculating the indicator - the coefficient of the automation (K) shows the relationship 1.

$$K = T_{aut.} / (T_{aut.} + T_m) = T_{aut.} / T \quad (1)$$

where: $T_{aut.}$ – the time of the automatic performance of the technological process (example: $T_{aut.} = 1$ hour);
T_m - the time of the technological process with the involvement of the worker;
T - the total time of the technological process.

The automation level (α) represents the ratio between the amount of automated technological operations ($E_{aut.}$) and the total number of technological operations (E_{tot}) specific to the operation of the machine. The formula for calculating the indicator - the automation level is presented by relation 2.

$$\alpha = E_{aut.} / E_{tot.} \quad (2)$$

The activity of the equipment, with which the whole study is concerned, was studied for the purpose of identifying the number of technological operations performed on the printing machines and their type (automatic or manual), so they are shown in Table 2.

Table 2. The type of technological operations on the printing machines analysed

No.	*Technological operations*	*Heidelberg SpeedMaster SM74*	*Heidelberg SpeedMaster CD74*	*MAN Roland 205*	*MAN Roland 504*	*Heidelberg SpeedMaster CX 102*
1.	Paper feed	M	M	M	M	M
2.	Ink supply	M	M	M	M	M

3.	Food / preparation of the dampening solution	A	A	A	A	A
4.	Remove printed sheet	M	M	M	M	M
5.	Remove remaining ink	M	M	M	M	M
6.	Left guide	A	A	M	M	A
7.	Right guide	A	A	M	M	A
8.	Head feeding	A	A	M	M	A
9.	Lifting the food table	A	A	A	A	A
10.	Lowering food table	M	M	M	M	M
11.	Start vacuum/air feed sheet	A	A	A	A	A
12.	Starting strip feeders (friction / vacuum)	A	A	A	A	A
13.	Set the format of the side guide	A	A	A	A	A
14.	Front guide opening	A	A	A	A	A
15.	Introduction the plate	A	A	SA	SA	A
16.	Taking over/ transport the sheet	A	A	A	A	A
17.	Monitoring the sheet (missing sheet, double sheet or sheet inclined) and stopping the machine	A	A	A	A	A
18.	Monitoring the presence of the sheet	A	A	A	A	A
19.	Pressure inlet / outlet	A	A	A	A	A
20.	Lowering ink and dam-penning roller on the plate	A	A	A	A	A
21.	Adjusting inking zones	A	A	A	A	A
22.	Temperature control of the inking device	A	A	A	A	A
23.	Stabilization of pH indicator of dampening solution	A	A	A	A	A
24.	Change the rotating speed of the ink feeder depending on the speed of the machine	A	A	A	A	A
25.	Wash ink roller	A	A	A	A	A
26.	Change the rotating speed of the dampening feeder depending on the speed of the machine	A	A	A	A	A
27.	Wash printing plate	A	A	M	M	A
28.	Wash offset blanket	A	A	A	A	A
29.	Wash impression cylinder	A	A	M	M	A
30.	Starting with the presence of the sheet	A	A	A	A	A

31.	Setting the format left guide	A	A	A	A	A
32.	Setting the format right guide	A	A	A	A	A
33.	Cama format setting opening sheet release	A	A	A	A	A
34.	Setting the format stopper	A	A	A	A	A
35.	Triggering anticopia powder to the presence of sheet	A	A	A	A	A
36.	Climb elimination table	M	M	M	M	M
37.	Descending elimination table	A	A	A	A	A
38.	Counting sheets	A	A	A	A	A
39.	Sheet monitoring	A	A	A	A	A
40.	Vacuum supply of the sheet straightening system	A	A	A	A	A
41.	Quality check	M	M	M	M	A
42.	Pre-set inking	A	A	M	M	A

The data referring to the temporary (time) parameters of the offset printing machine activity process involved in the study are presented in Table 3.

Table 3. Working parameters of the printing equipment analysed

No.	*Machine name*	*Average machine preparation time, min*	*Total number of technological operations*	*Number of automated operations*
1	Heidelberg SpeedMaster SM74	22,5	42	35
2	Heidelberg SpeedMaster CD74	25		35
3	MAN Roland 205	30		28
4	MAN Roland 504	12		28
5	Heidelberg SpeedMaster CX 102	5		36

The results of the calculations identified by mathematical formulas for the determination of the level and the offset printing machine automation coefficient are shown in Table 4.

Table 4. Coefficient and level of automation of the offset printing machine analyzed

No.	*Automation indicator* / *Machine name*	*The coefficient of the automation (K)*	*The automation level (α)*
1	Heidelberg SpeedMaster SM74	0.72	0.83
2	Heidelberg SpeedMaster CD74	0.70	0.83
3	MAN Roland 205	0.66	0.66
4	MAN Roland 504	0.83	0.66
5	Heidelberg SpeedMaster CX 102	0.92	0.85

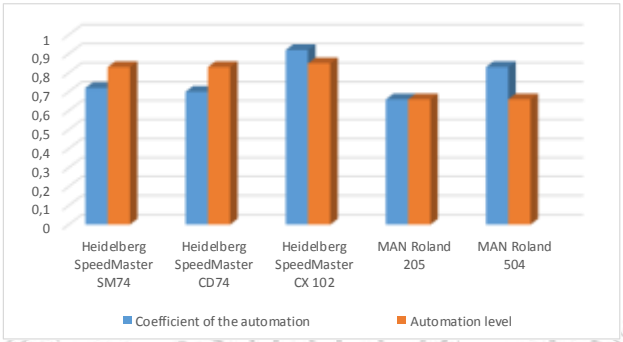

Fig. 3. Coefficient of the automation and the automation level on the printing machines analysed

Conclusions

The coefficient of the automation of the analysed printing machines varies within the range of 0.66-0.92 and the level of automation - within the limits of 0.66-0.85. These values indicate that the printing machines that are found in the companies known on the polygraphic market in the country have a degree of automation above the average, which allows these printers to compete at the quality level of the printing products and terms of realization.

One of the advantages of automating production is that you can remove the possibility of error introduction by the operator into the process. In order to do that successfully, it is necessary to improve the technical characteristics of the machine, thus, raising the level of automation. The high level of automation of printing machines, under equal conditions, increases significantly their productivity.

Abbreviations

M- mechanic, A- automatic, SA- semi-automatic.

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