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Determining Selection Criteria and Their Importance of Press Lines in Automotive Industry

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Abstract

The increase rate of change in the economic, political and social environments of business today has led to growing competitiveness, uncertainties and risks. These circumstances have led to a dramatic increase in attention given to strategic planning of all kinds. Planning of production method has itself received a good deal of attention in recent years. Under such circumstances, a firm would have a better chance of success and survival by a judicious spread of its resource and investments achieved through production method selection. In this study, information about selection process used for many industrial production areas will be given. After selecting criteria, an expert survey will be implemented to determine the importance of the criteria. Results showed that technical specifications are much more important than general specifications and specification of the suppliers.

Keywords: Press Lines, Selection Criteria, Survey.

Otomobil Endüstrisinde Kullanılan Baskı Makinaları Seçim Kriterlerinin ve Önem Derecelerinin Belirlenmesi

Özet

Bugün ekonomi, politika ve iş dünyasında giderek artan değişim süreci belirsizliklere, risklere ve büyüyen rekabete yol açmaktadır. Bu tür ortamlar stratejik planlamanın her çeşidine ilgiyi büyük ölçüde artırmıştır. Son yıllarda üretim metodunun planlanması da ilgi çekmiştir. Böyle durumlarda, bir firma kaynaklarını ve yatırımlarını doğru üretim yöntemini seçerek akıllıca dağıtıp başarı ve süreklilik şansı kazanabilir. Bu çalışmada, birçok üretim alanında kullanılan seçim yöntemi hakkında bilgi verilecektir. Seçim kriterleri belirlendikten sonra uzmanlara yapılan anketlerden bu kriterlerin önem dereceleri belirlenecektir. Sonuçlar teknik özelliklerin genel özellikler ve tedarikçi özelliklerinden daha önemli olduğunu göstermiştir.

Anahtar Kelimeler: Baskı Makinaları, Seçim Kriterleri, Anket.

Introduction

Today, automotive industry is open for improvement because of the increasing production volumes and customer expectations. Continuously increasing quality expectations with increasing production volumes have to be satisfied. In addition to all these factors, the newly designed models and the new parts for these new models are added and to have continuous productivity become inevitable for automotive industry.

To enable continuous productivity, the automotive parts have to be produced at the most suitable lines for themselves. For the selection of these production lines, certain methods can be used to find the fastest and most suitable selection. After the design of the part is completed, the selection of the most suitable production line has to be completed in the fastest way and production has to begin without losing time. To make the most suitable selection at the beginning is very important for automotive industry in which time is as valuable as money.

There are many studies in the literature on application of selection process. Hanumaiah et.al. used Quality Function Deployment (QFD) with Analytic Hierarchy Process (AHP) to select best rapid tooling process [2]. Rao has worked on selecting best flexible manufacturing system using TOPSIS [10]. Wang et.al. have worked on selecting best machining center [11]. Heriřçakar has worked on selecting ship main engine using SMART [12]. Different methodologies are used on selecting best machining center: AHP [3, 4], Analytic Network Process (ANP) [5], Fuzzy [6, 7], Grey Relation [8] and PROMETHEE [9]. More detailed literature review is completed on machine selection and obtained results are presented as proceeding [1].

The aim of this study is to create a model for the selection of the production line and to determine selection criteria and their importance. In this study, information about selection process used for many industrial production areas will be given. An expert survey implemented to automotive industry will be explained. Detailed evaluation of criteria and selection process could be found at [14].

Press Lines

A stamping press is a metalworking machine tool used to shape or cut metal by deforming it with a die. A press has a press frame, a bolster plate, and a ram (Figure 1).



Figure 1. Power press with a fixed barrier guard [13]

The bolster plate (or bed) is a large block of metal upon which the bottom portion of a die is clamped; the bolster plate is stationary. Large presses (like the ones used in the automotive industry) have a die cushion integrated in the bolster plate to apply blank holder forces. This is necessary when a single acting press is used for deep drawing. The ram is also a solid piece of metal that is clamped to the top portion of a (progressive) stamping die and provides the stroke (up and down movement). This action causes the die to produce parts from the metal being fed through it.

Stamping presses can be subdivided into mechanically driven presses and hydraulically driven presses. The most common mechanical presses use an eccentric drive to move the press's ram, whereas hydraulic cylinders are used in hydraulic presses. The nature of drive system determines the force progression during the ram's stroke. The advantage of the hydraulic press is the constant press force during the stroke. Mechanical presses have a press force progression towards the bottom dead center depending on the drive and hinge system. Mechanical presses therefore can reach higher cycles per unit of time and are usually more common in industrial press shops.

Another classification is single-acting presses versus double- (seldom triple) acting presses. Single-acting presses have one single ram. Double-acting presses have a subdivided ram, to manage, for example, blank holding (to avoid wrinkles) with one ram segment and the forming operation with the second ram segment.

Typically, presses are electronically linked (with a programmable logic controller) to an automatic feeder which feeds metal raw material through the die. The raw material is fed into the automatic feeder after it has been unrolled from a coil and put through a straightener. A tonnage monitor may be provided to observe the amount of force used for each stroke.

Modeling Phase

The modeling phase has two steps. The first one is finding the criteria of the press lines to prepare the expert survey. And the second one is data collection from the selected suppliers.

As will be detailed later, press line specifications are grouped at three main titles. These three main criteria are “general specifications of the press lines”, “technical specification of the press lines” and “specification of the supplier”. Also each main criterion is composed of criteria; each criterion may be composed of sub-criteria. Then an expert survey prepared to obtain data for to select the press lines is given. This expert survey is sent to all potential suppliers for a chosen part. First of all, it is assumed that a new part is designed for The Purchasing Department with the size of nearly 1.900 mm x 1.800 mm, with the material 0,9 mm thickness and cold rolled and with the annual volume of 100.000 parts/year. The part can be considered as medium difficult from its production perspective. This means it has not a very deep drawing form. There are four press operations for the production of this part, which means the press line must have at least four press machines as a line. With the help of these information and the dimensions of the parts, the suppliers decide the most suitable press line. The part is a sheet metal floor panel of a commercial vehicle. The suppliers which have a press line with 600 – 800 tones having appropriate dimensions can be considered as potential suppliers for this part. The expert survey is examined by all these suppliers and the questions are answered by the suppliers.

General Specifications of the Press Lines: The first main performance criterion is “General specifications of the press line”. General specifications of the press line consist of six criteria as stated below.

- ✓ Capacity of the press line
- ✓ Price of the press line
- ✓ Quality of the service

- ✓ Dimensions of the press line
- ✓ Production year
- ✓ General image of the press line brand

“Capacity of the press line” is the production capacity of the press line which limits the production quantity.

“Price of the press line” is the first purchasing investment requirement of the mentioned press line.

“Quality of the service” is the service performance of the press line when it needs to be fixed urgently.

“Dimensions of the press line” is the product availability of the press line when it is evaluated with its dimensions.

“Production year” is the model year of the press line which gives when it is produced first time.

“General image of the press line” is the first impression of the press line brand.

Technical Specifications of the Press Lines: The second main performance criterion of this study is “Technical specifications of the press line”. Technical specifications of the press line consist of three criteria as stated below.

All three criteria also have their sub-criteria as seen below.

- Efficiency of the press line
 - Main engine power
 - Working pressure
 - Press stroke number per minute
 - Tool dimensions and weight
- Plate specifications
 - Lower plate specifications
 - Upper plate specifications
- Bolster specifications
 - Lower bolster specifications
 - Upper bolster specifications

“Efficiency of the press line” is the production efficiency of the press line which limits the production quantity. It is directly related with the main engine power, working pressure,

press stroke number per minute and tool dimensions and weight. All of these four have to be considered to calculate a production program.

“Plate specifications” are the press line’s plate’s dimensions and other details. All calculations have to be related of these specifications. A press line which has not an enough plate for a desired production cannot be used anytime. There are two plates on press lines. Upper and lower ones between them the dies of production will be fixed.

“Bolster specifications” are the specifications of the bolster plates’ of the press lines. The bolster plate is a large block of metal upon which the bottom portion of a die is clamped; the bolster plate is stationary. A press line which has not an enough bolster for a desired production cannot be used anytime as it with insufficient plates.

Specifications of the supplier: The third main performance criterion of this study is “Specifications of the supplier”. Specifications of the supplier consist of three criteria as stated below. Only “Product portfolio of the supplier” criterion has sub-criteria as seen below;

- Financials of the supplier
- Product portfolio of the supplier
 - Current product portfolio of the supplier
 - Target product portfolio of the supplier
- Machine park of the supplier

“Financials of the supplier” is directly related with the supplier and its budget to choose any press line.

“Product portfolio of the supplier” is related with what the supplier produced till today and what they plan to produce after today. Current product portfolio of the supplier is a key to choose the best press line considering the production experiences. Target production portfolio of the supplier is about planning the future capacities.

“Machine park of the supplier” is about to decide if the current press lines are enough or the supplier needs extra investment.

All of these are in the expert survey given at next part. It is answered by all suppliers to select the press lines.

Expert Survey

Survey is prepared considering all ethic rules and privacy of the survey candidate. Why and Who is prepared this survey and where the results will be published are given at the top of the survey. Also, name of the candidate is kept secret. Moreover, a detailed explanation on criteria and how to answer questions and an example evaluation are shown before beginning to answer the questions. All questions are given below.

Question 1: Compare the relative importance of the given criteria pairs with respect “to find the most appropriate criteria on selecting of press line” using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

General spec.of the pressline 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Technical spec.of the pressline

Technical spec.of the press line 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Specifications of the supplier

Specifications of the supplier 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 General spec.of the press line

Question 2: Compare the relative importance of the given criteria pairs with respect to “general specifications of the press line” main criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Capacity of the press line 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Price of the press line

Price of the press line 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Quality of the service

Quality of the service 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Dimensions of the press line

Dimensions of the press line 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Production year

Production year 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 General image of the press line brand

General image of the pressline brand 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Capacityofthe pressline

Question 3: Compare the relative importance of the given criteria pairs with respect to “technical specifications of the press line” main criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Efficiency of the press line 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Plate specifications

Plate specifications 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Bolster specifications

Bolster specifications 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Efficiency of the press line

Question 4: Compare the relative importance of the given sub criteria pairs with respect to “efficiency of the press line” criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Main engine power 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Working pressure

Working pressure 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Press stroke number per minute

Press stroke number per minute 9 8 7 6 5 4 3 2 1 2 3 4 5 6 7 8 9 Tool dimensions and weight

Tool dimensions and weight	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Main engine power
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Question 5: Compare the relative importance of the given sub criteria pairs with respect to “plate specifications” criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Lower plate specifications	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Upper plate specifications
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Question 6: Compare the relative importance of the given sub criteria pairs with respect to “bolster specifications” criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Lower bolster specifications	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Upper bolster specifications
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Question 7: Compare the relative importance of the given criteria pairs with respect to “specifications of the supplier” main criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Financials of the supplier	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Product portfolio of the supplier
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Product portfolio of the supplier	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Machine park of the supplier
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Machine park of the supplier	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Financials of the supplier
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Question 8: Compare the relative importance of the given sub criteria pairs with respect to “product portfolio of the supplier” criterion using the following scale. Please put “X” on the number of your choice.

1=Equal 3=Moderately 5=Strongly 7=Very Strongly 9=Extremely

Current product portfolio of the supplier	9	8	7	6	5	4	3	2	1	2	3	4	5	6	7	8	9	Target product portfolio of the supplier
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Results

Sheet metal part producer suppliers having press-lines answered survey’s pairwise comparison questions and ranked questions for each brand with respect to each criteria. According to survey results, the technical specifications of the press line are more important than the general specifications of the press line and the general specifications of the press line are more important than the specifications of the supplier as seen in Table 1.

Table 1. The importance of the criteria of the press-lines

	Priority grade	Percentage (%)
Technical specification of the press line	1	46,85
General specifications of the press line	2	34,26
Specifications of the supplier	3	18,89

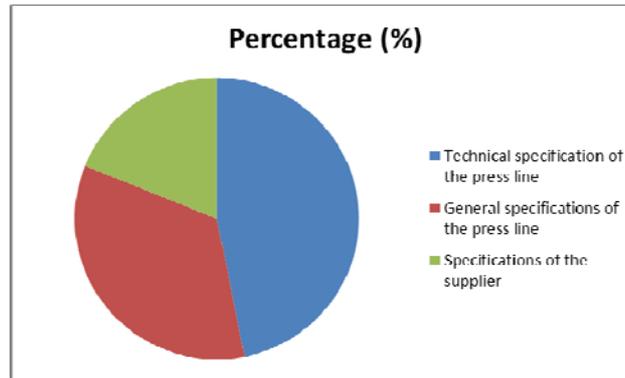


Figure 2. Importance values of the selection criteria

According to Table 1, the importance of technical specifications of the press line is approximately the half of all criteria. Also, the importance of general specifications of the press line has similar value even it is the second one (only 12% lower). Lastly, the least important (specifications of the supplier) criterion has less than 20 %. Figure 2 shows all criteria's importance values in a pie chart.

Conclusions

The major aim of this study is to create a model for the selection of the production line. This study is done to evaluate press-lines' performance and to find the most appropriate one between some press-line brands. The performance criteria for evaluating press-line brands in the portfolio were obtained through the field study and the most appropriate products for the portfolio were determined with respect to these performance criteria.

With the help of literature review, an expert survey is prepared with in-depth interview with the suppliers. This expert survey has three main criteria to reach the study's goal: the first main criterion is "general specifications of the press lines", the second main criterion is "technical specification of the press lines" and the third main criterion is "specification of the supplier". Based on this study, technical specifications of the press lines is more important than the other ones. The most important criterion is found as technical specification of the press lines while the least one is specification of the supplier.

As further studies, new criterion for the press-line selection for the automotive industry may be investigated with their subcriteria. Also, the relationship between suppliers' opinions and current brands' situations may be investigated.

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