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Cost Control with Modeling in Motor Housing Process

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Abstract: With regards to the assembly line of cost control of Dechang company, the motor housing's cost control of process will be necessarily appreciated. Though the supply quantity is large in a machine and the price of motor housing is cheaper, the cost control of automatic production line is significant in this respection. It is found that insufficiency power is main cause for production line failure. The cost control of equipment includes to structure wheel, conveyor and motor for benefit which also needs to be controlled in detail. Only in this way can we fundamentally resolve the main problem of high cost process. When the capital price L increases, A_{V_C} also increases too with nonlinear meantime, and T_C & V_C increase in proportion to K. Among them, the T_C increases the highest and then V_C increases lightly. Generally when labour quantity L and capital quantity K increase cost increases in proportion.

Keywords: automatic production line; flywheel; conveyor precision; motor; motor housing; molds; process of cost control; modeling control

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1 Introduction

Motor housing can be used to flow production line. But now cost and modeling management can not keep up with housing volume, there is no proper supervision in almost work time and even less personnel quantities in management, let the machine work continuously. Motor housing processing in workshop has a large number of machines with continuous work in production line. It connects coil steel plate into punch machine for three or four working procedure to complete motor housing with continuous processing in a short time[1-7]. They rapidly produce a lot of products in a certain time, the line is the automatic punch processing which is more difficult in the cost control. So we should also follow this issue, struggle for the scientific management, digital and AI (Artificial intelligence) management.

Toyota motor company in Japan is very strict in assembly line cost control. The company engineer adopts their scientific modelling results and compares with before and after the control is done in lines, so the low-deviated high accuracy can be known by sale engineer. Then they can ensure machine lifespan, not only excessive wearied, but also so fast that we do not make machine equipment breakdown for maintenance timely.

On the other hand, they have to spend a lot of money and apply the original factory personnel for coming and fixing. This is because that the load and frequency of the machine are too over, and do not reach the designated engineering demand on raw material. In this way they will produce a lot of waste materials and over used machines. The mould economic efficiency is important factor in automatic industry so that we discuss this factor for the benefit of module. Papers majoring in management at some famous universities in Japan as shown in Figure 1 are studying the cost control of production lines about Toyota motor company. The highest inventory turn and lowest defect are detained at Toyota company in 1990 meantime the productivity maintained higher value when they are compared with other countries. The Japan follows the Toyota, which says the environmental support has been detained in Japan too. Then America and Europe takes the third and fourth position respectively. It also says that Japanese industry occupied No. 1 leading edge clearly. Among them, Toyota takes the first efficient and profit company in Japan.

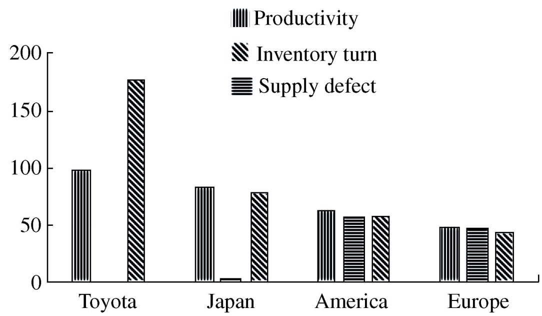


Figure 1　The average compare of index between Toyota & company in other regions in 1990

From Figure 2, the spending increases from 2002 to 2005 in respects of ISV (Independent software vendors) PLM (Prodcuction lifecycle management) and its relative use of hardware expense.

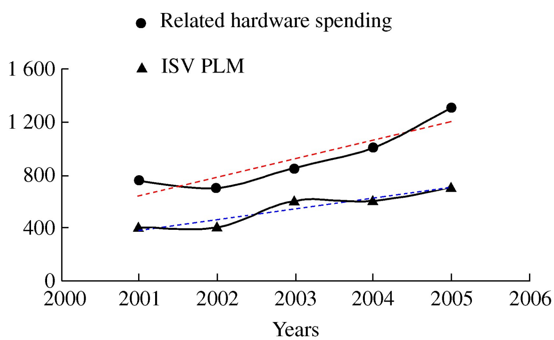


Figure 2　Trends of related hardware spending and ISV PLM

It explains recently that the increasing amount and expense has been spent at factories largely. PLM is going to grasp the world digital R & D (research and development), manufacture and maintenance & dealing field dependent on their strong computing and drawing application function to realize the flow chart for us to make a unified strategic decision. PLM has excellent distribution of resource initiated or responded for the best innovation such as complex production in every stage of production lifecycle. In hospital the digital management is good example for us to be convenient because we do not need to carry any graphs all the time in treatment. The doctor only sees digital graph in his computer to diagnose our disease simply and quickly. In factory we are needed no more to draw with pensils on the picture. We use CAD (Computer aided design), CAM (Computer aided manufacturing), CAE (Computer aided engineering) & CASE (Computer aided software engineering).

2 Calculation courses

2.1 Punching motor housing power

There are three punching motor housing powers of process as shown in Figure 3.

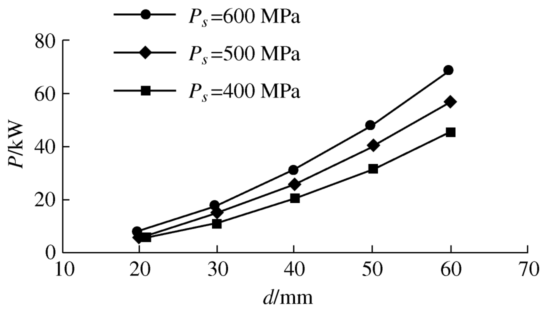
Because of $P = F_1 l_1 / t$ (1)

Here, $F_1 = \pi P d_1^2 / 4$ (2)

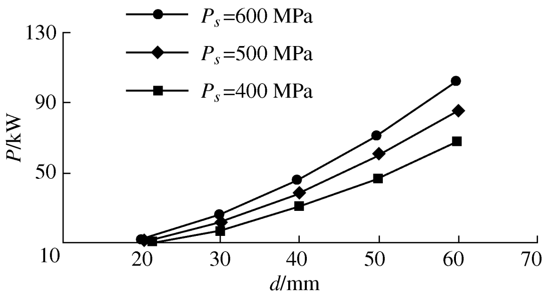
Has $v = \dfrac{\pi d n}{60 \times 1\,000}$ (3)

and $T = 9.55 \times 10^5 P / n$ (4)

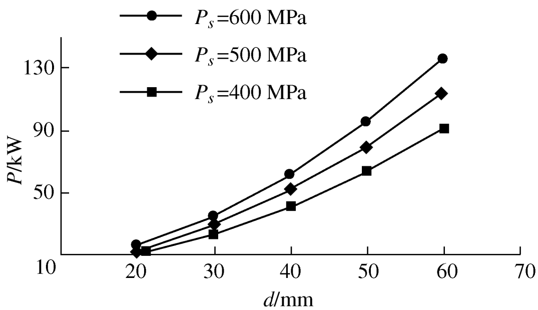
Where: v is velocity of rotation in wheel, mm/s; n is rotation, r/min; P is power, kW; T is torque, N · m; F_1 is the force by punch in the first punching; t is the punch time in the first punching, s.



a) l_1=20 mm



b) l_1=30 mm



c) l_1=40 mm

Figure 3 The relation sof strokes power with 400 - 600 MPa forces and l_1 is 20 - 40 mm in housing punches

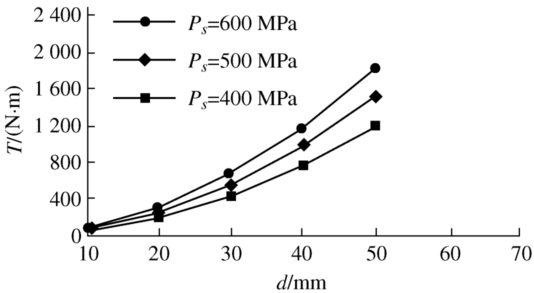
The parameters of motor housing processes is listed in Table 1.

Table 1 The parameters of the first motor housing process

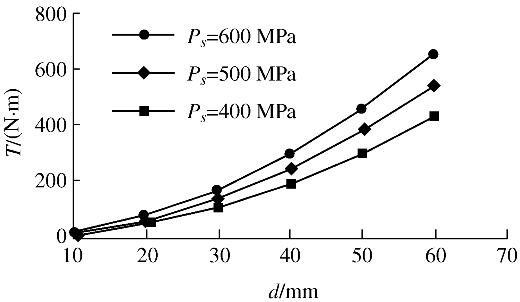
d_1/mm	l_1/mm	t_1/mm	t/s	P_s/MPa	remarks
50	30	0.6	0.5	400 - 600	Low C steel

In Table 1: d_1 is the punching diameter which is the same as the first motor housing diameter, mm; l_1 is punching length which is the same as the first motor housing length, mm; t_1 is thickness, mm.

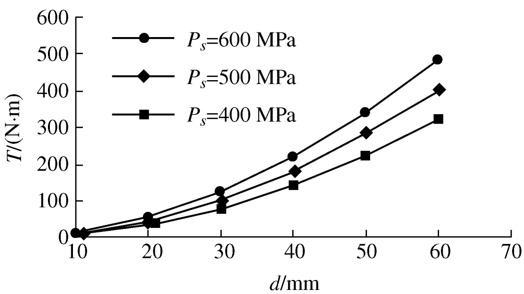
In Figure 4 the increasing function between power P and housing diameter d is observed. Meanwhile with increasing l_1 and punch press are P_s(400 - 600 MPa), the power P is increasing too. The maximum force is about 1 700 t and the minimum is 30 t under the condition of 60 mm(600 MPa) & 10 mm(400 MPa), respectively.



a) n=500 r/m



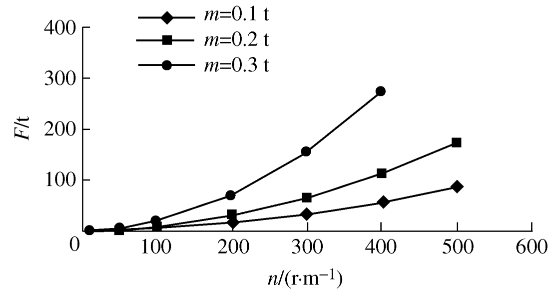
b) n=1 000 r/m



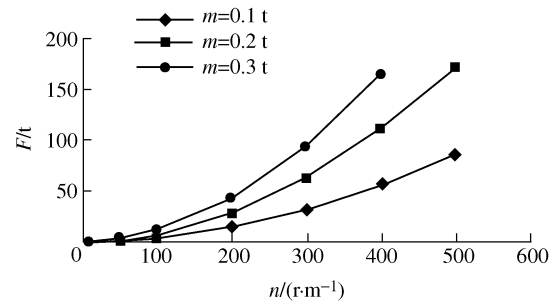
c) n=1 500 r/m

Figure 4 When the shaft n is 1 000 - 1 500 r/m the relation between torque and diameters with 400 - 600 MPa forces in housing punches

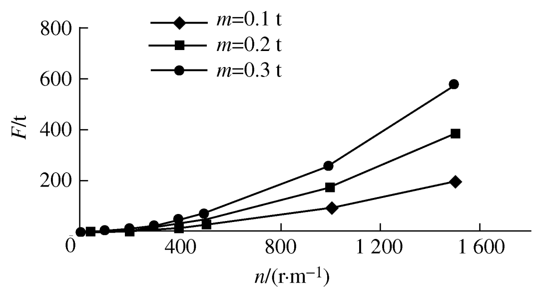
In Figure 5 with the rotary speed increasing, the force decreases too meantime, with the diameter increasing to 60 mm, the force increases to 600 N · m under the rotary of 1 000 r/m. In Figure 5 the flywheel force decreased with the n increases. Meantime with the flywheel diameter decreases to 0. 5 m, the force will increase to 1 000 t under the rotary n of 1 500 r/m.



a) d=1.5 m



b) d=1 m



c) d=0.5 m

Figure 5 When the flywheel diameter d is 1.5 m , 1 m and 0.5 m, the relation between torque and rotary speed n in housing punches.

3 The cost control of modeling on flow line

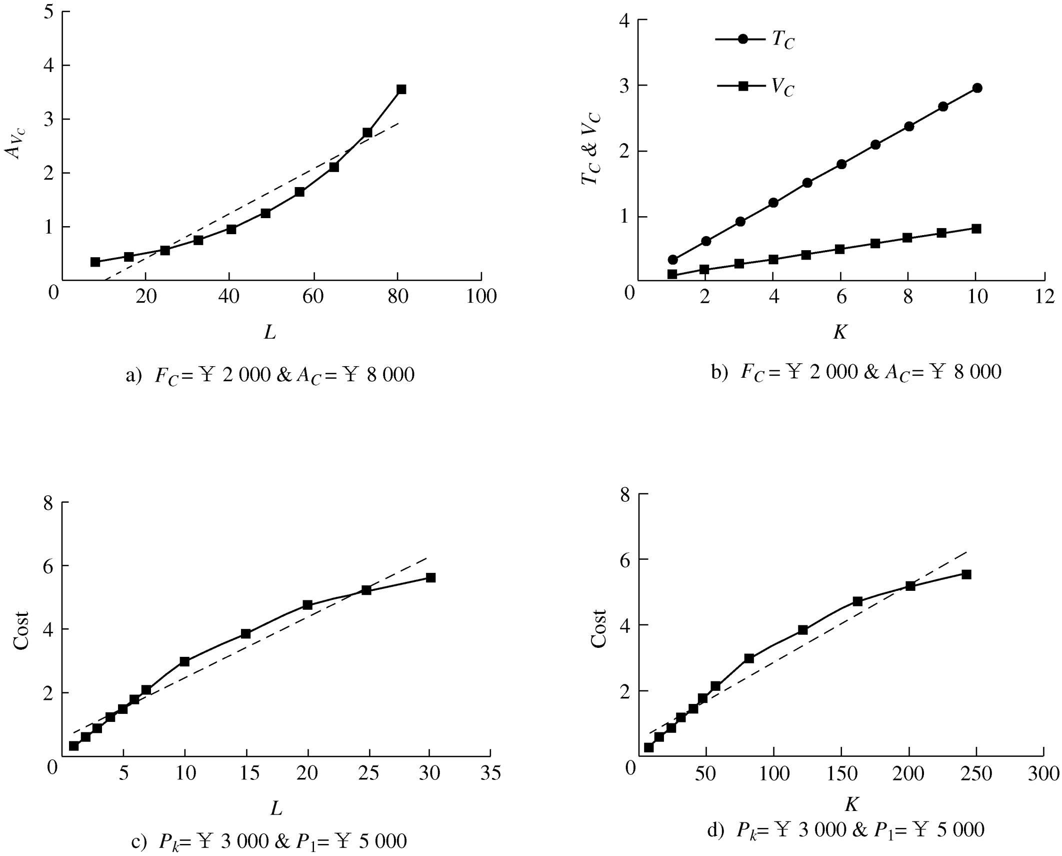


Figure 6 Relations between T_C, V_C & A_{V_C} and cost in housing punches of cost control

Here, T_C is total cost, F_C is fixed cost, V_C is variable cost. A_C is average cost, M_C is marginal cost, A_{V_C} is average variable cost, A_{F_C} is average fixed cost. It is thought that F_C is ¥30 000 and A_C is ¥8 000). It is supposed that P_k is ¥3 000 and P_1 is ¥5 000. Here P_k is capital price and P_1 is labour price.

When the capital price L increases, A_{V_C} increases too with nonlinear, meantime T_C & V_C increase in proportion to K from Figure 4a) – Figure 4b). From Figure 5b) among them the T_C increases highest and then V_C increases lightly. Generally the figure reflects the three parameters. When labour quantity L and capital quantity K increase cost increases in proportion (dot line is trend) from Figure 4c).

The formulas for cost control are listed as below

$$A_C = T_C' \tag{1}$$

$$A_{F_C} = F_C' = 0 \tag{2}$$

$$A_{V_C} = V_C' = 100Q \tag{3}$$

$$A_C(Q) = A_{F_C} + A_{V_C}(Q) = A_{V_C}(Q) \tag{4}$$

$$M_C = T_C' = 100Q \tag{5}$$

Production quantity Q is defined as below

$$Q = f(L, K) = \gamma L^{\alpha} K^{\beta} \tag{6}$$

Where: γ is technique coefficient; α is producing labour; β is capital elasticity. Here, $\alpha>0$ and $\beta<1$, solet $\alpha=0.62$, $\beta=0.37$ and $\gamma=8$. It has

$$C = P_l L + P_k K \tag{7}$$

$$M_P = \frac{\mathrm{d}T_p}{\mathrm{d}L} \tag{8}$$

$$\frac{M_{Pk}}{P_k} = \frac{M_{Pl}}{P_l} \tag{9}$$

4 Analysis and discussion

The quantity will be increased if the investment of risk money is increased for the profit increasing. We know the cost of machine will be decreased while we increase the investment of machine quantity.

For the sake of working precision and stability there is a huge wheel set in above and behind the machine. If there is precise kind of deviation we should think about the balance huge wheel. In a company, when the punch machine took place error, the manufacture technique should seperated machine and exposed the above huge balance wheel, and found out the error, then offer a solution.

It is known that this machine was in full day of 24 h working. It had two or three workers to be operated with hands picking down the product all the 24 h time.

Firstly the over time causes the bearing wore out to happen this imprecise problem. Secondly the over load also causes this. The high punch power stimuluses continuously the bearing of wheel and at last it has lost efficacy. So products are not continuously produced. Only if they are taken on the plan schedule which is incontinuous so that incontinuous work time is as seperation a certain as possible, this kind of failure will be eliminated throughly. Many fee to repare and travel can be saved meanwhile the spare time is used too. The manual operation process to make criterion can save money. To upgrade device in order to ensure machine capacity is necessary. Periodic check to maintain device state is a measure and as to some components they are bought in advance to take place of them at emergent time. Mainly it was the most benefit machine to form a transforming voltage penal which price was not high per product but the whole price is very high in a day.

Another problem is conveyor precision. Only if this is precise the punching moulds will fit to punch the formed figure to play continuous flow line work. The distance in whole length is key so that we let workers to regulate this length is a measure. We do not wait to the problem taking place to regulate it. The distance moved a little is okay but moving more than several centimeters will damage the conveyor precision. So it was prohibited from big load and continuous one & defective design which is main causes to big distance. To educate the worker to fit to correct operation is key and take the endurance education.

In the management of machines and tooling equipment we shall make it to improve efficiency in order to avoid over work too longly. It is used for 8 h to work and rest for 10 min at least to make sure the machine lifespan and decrease failure rate and not blindly increase product which is difficult to ensure the quality of machines and tools. The over working shall be enough to guarantee the lifespan of motor not being too heavey.

It is so as to decrease its heat & short-circuit breaking and motor is the core of machinery and equipment. Maintaining qualification motor is the most important. We know that the motor under rated power is at work of certain load of current in a certain load. If punch mold deformation will make impact pressure to strike, the influence of motor overloads increases wreckage chances under a increased pressure affecting the service lifespan of mould.

The cost control refers to the mold, motor and transportation devices. Such as strict operational management and a corresponding system of standardization and constantly update toward zero defective product to motor. The maintenance and standardization is the key to ensure product engineering quality and continuous quantities. To develop and update the rules is the main task.

The current training essential subjec traine operator's service quality and level. University professors or lecturers need to make theory guiding. They act as a expert in the professional proposal in theory and practice as we need improve quality, fast producing product and fast transport in these two aspects. The customer needs time to prepare for PLM (Product lifecycle management) software which can also be managed to motor out daily product quantity. The scientific forecast can be completed under just-in-time constitution for the customer with the fast product time and low cost.

Even flowing line halt occurs because of excessive force and causes the tool to be broken etc. We will be responsible for it. The mould status need be checked often. If the tool is found to be dull it is replaced immediately to avoid accident. The continuous production line has certain influence on the use of machines and life. Motor continuous work will affect the service life of motor and mould which becomes short and shortcoming. Greater than the rated power in a state of continuous run for 8 h has been harmful to motor use. After use of the motor from several months to years, the rotational speed is slow or even halt phenomenon occur. If the motor is too small, its driving effect is poor. If the motor is too large it can make the structure to be too large. So we need know about the motor of the indexes. Do not use the motor after a period of time because we know it is a little joke that we may not take substitution on it on the market, affect the normal work.

5 Conclusions

The increasing function between power P and housing diameter d is observed. Meanwhile with increasing l_1 and punch pressure P_s(400 - 600 MPa) the power P is increasing too. Detail data about force is shown in Figure, the maximum force is about 1 700 t and the minimum is 30 t under the condition of 60mm(600 MPa) & 10 mm(400 MPa) respectively. With the rotary speed increasing the force decreases too. Meantime with the diameter increasing to 60 mm the force increases to 600 N · m under the rotary speed of 1 000 r/m. The flywheel force decreases with the increasing n. Meantime with the flywheel diameter decreases to 0. 5 m the force will increase to 1 000 t under the rotary n of 1 500 r/m. When the capital price L increases A_{V_C} increases too with nonlinear meantime T_C & V_C increase in proportion to K. Among them the T_C increases highest and then V_C increases lightly. Generally when labour quantity L and capital quantity K increase, the cost increases in proportion.

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Brief Biographies

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