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# Optimization Model of Manufacturing Process-oriented Cost Real-time Control Based on Petri Net

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**Abstract:** Using hybrid petri net (First Order Hybrid Petri Net) to analyze and solve the cost control problems of process manufacturers and carried out model optimization, the key parameters of the model get a detailed description and definitions and gives the corresponding linear regression method for solving the problem. Finally, the application of a pharmaceutical factory hard capsules process as example, the real-time control of the cost breakdown into the energy costs and the cost of materials, modeling and optimized.

**Key words:** Cost real-time control, dynamic optimization, Hybrid petri net, capsules process

## INTRODUCTION

The cost index is an important part of KPI (Key Performance Indicators) system for factory, also is a comprehensive reflection of the management level of factory and concrete manifestation, is one of the key competitive elements. Always cost management and control is the core content and the eternal theme of factory.

As early as in 1885, the U.S. Ordnance officer Henry Metcelelf (1885) wrote the book "The Cost of Manufacture". In the book, he had a thorough discussion of the issue of cost accounting, first proposed cost management system. "Control", that is, through the measurement of personal or organizational unit performance, compare actual with planned target and identify differences, to identify the causes of the difference and based on the feedback information to eliminate confounding factors to ensure that objectives or plans to achieve the management process. Cost control real-time, a certain sense, is to improve the cost information feedback frequency, reduce blindness and improve the possibility of the cost of the project to achieve the objective. Hybrid Petri Nets optimization method is Fabio Balduzzi *et al.* (2000) proposed a new research method. The method has been proposed to obtain a wide range of applications, such as Chen and Cheng, 2000 proposed a detailed definition of Petri net workflow and apply it to the modeling and simulation of the workflow. Pan and Jiang (2000) to select the Petri nets workflow modeling and applied to the work management system. Jiang *et al.* (2004) Petri nets used for testing and validation of the model. Dong and Luo (2001) Petri net model of cigarette production volume access package workshop AGVS for analysis. Giua *et al.* (2001) applied to the inventory management system parameter optimization; Wang and Zhang (2012) for energy-saving objective function to calculate the optimal production scheduling policy. Jing *et al* (2003) Petri nets and probability information combined for power system fault detection. Cost of Petri nets, the following scholars made ??a significant contribution: Kiritsis *et al.* (1999) use Petri nets to estimate the manufacturing cost of the technology and use it to identify viable process to produce the overall cost of the program. El-Fakih *et al.* (2006) used the extended P9etri net direct message exchange protocol for distributed application, in order to reduce communication costs. Tsai Kuo (2013) used Petri net analysis of waste removal and recycling of electrical and electronic equipment, in order to achieve a win-win economic costs and environmental benefits. Lee (1994) Beta-distributed Stochastic Petri Nets (BSPN) the time and cost of software project management and the BSPN model is strong enough to cope with the uncertainty of large-scale software project management and concurrency issues. the cost of real-time control hybrid Petri nets to study not only the management, fine, fine craftsmanship, fine and the lowest cost but also helps to analyze the improvement, conducive to the cost of real-time control.

This article focuses on hybrid Petri net model through in the silk process of cigarette production cost real-time control and information feedback process, to

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achieve the reduction of production costs and the rationalization of control. The innovation of this paper is to: Main logistics of the production process, cost control with an intensification of production and low power balanced production, the method of combining the hybrid petri nets used in the process of cost control and information, the realization of the cost of real-time and dynamic cost control.

## PROCESS-ORIENTED HYBRID PETRI NETS OPTIMIZATION MODEL

### Formal definition of the model

**Definition 1:** Real-time control and process-oriented cost optimization model of the hybrid Petri nets is a six-tuple, that Ep = {P, E, Aft, G, M}.

Among working equipment location set $P = P_C \cup P_d$, $P_D$ is a discrete set of locations, the control information representative of the production process which means that with a single circle; $P_C$ is a continuous set of locations, $Pc = P_c^n \cup, P_c^m$, $P_c^n$ is the continuous set of locations for the energy color, on behalf of the energy consumed in the production process equipment, n is the number of types of equipment energy consumption, expressed as a dotted line double circle; $P_c^m$ is a material continuous set of locations which means that the non-energy materials in the production process, raw materials, auxiliary materials, intermediate products, final products, expressed as a double circle with a solid line.

Let the set of transitions $E = E_C \cup E_d$, $E_d$ is transition set for the discrete exponential distribution, on behalf of the unreliable response time in the production process, with the black box, the average excitation time is $1/\lambda_i$, $\lambda_i$ is the distribution parameters for the corresponding index. $\forall t_i \in E_d$, $E_c$ is a continuous set of transitions which means that the energy-using equipment in the production process, expressed in both boxes, the total number of energy consumption type is n, the total number of devices is:

$$FR:\begin{cases} P_d \times E_d \to N \\ P_c \times E_c \to R_o^+ \end{cases}$$

Pre-set to the correlation function is $\forall E \in E_C$. $Fr:P^n_c$, on behalf of the products on the Bill of Materials (BOM) as an ordinary arc set, expressed as a solid line with arrows; $Fr:P^n_c \times E_C$ on behalf of the energy consumed measurement data in the production process, It is the arc set of color digital m, expressed in dotted lines with arrows; $\forall t_i \in E_c$, $F_r$: $P^m_d \times E_d$, is means that information into the previous set of directed arcs, for the ordinary arc set, expressed as a solid line with arrows.

Let subsequent correlation function is:

$$Aft:\begin{cases} P_d \times E_d \to N \\ P_c \times E_c \to R_o^+ \end{cases}$$

$\forall E \in E_c$, $Aft:P^n_c \times E_c$, on behalf of outputs the list of semi-finished products which means that ordinary arc set, expressed as a solid lines with arrows; $Aft:P^n_c \times E_c$ on behalf of the recycled energy measurement data in the production process, It is color digital m's arc set, expressed in dotted lines with arrows; $\forall E \in$, Aft: $P^m_c \times E_d$ indicates information into the backward arc set, for the ordinary arc set, expressed as a solid line with arrows.

## OPTIMIZATION PROCESS

### Objective function

**Definition 2:** process-oriented real-time control cost Hybrid Petri Nets optimization model, the instant activation rate is $V_i$ for any production equipment $t_i \in E_c$, material consumption rate and output rate of processing equipment are $F_r(P^m_c, t_i)\cdot V_t$, $Aft(P^m_c, t_i)\cdot V_i$ collectively referred to as the logistics rate, denoted by $V^m_i$.

**Definition 3:** In general, proportional to the number of energy consumption and production, so the device requires 1 ton of product quantities required for the calculation of loss, a single batch of energy consumption (or material consumption) in the preparation of the plan should list the various types of the unit of material consumption and energy consumption per unit, got $V^n_{ij}\cdot t = a_{ij}\cdot V^m_i\cdot t \Rightarrow a_{ij}\cdot V^m_i$, $a_{ij}$, is No. j loss costs of the No. i device, defined $V^n_{ij}$ as the cost flow rate.

Real-time costs incurred in the production process are many, including the cost of material and energy consumption and other aspects of their respective units of measurement are also different, Unified Computing, Hybrid Petri network optimization model of process-oriented real-time control cost unified translation cost per ton (including energy consumption of various energy is converted into steam which is a measure of the total energy equivalent to the energy indicators, the unit consumption (t) then multiplied by the price of the steam will been energy consumption per unit cost). Using cost measurement matrix to record the cost of the production process, $C(P^n_c, t_c) = [a_{ij}]_{m\times n}$, m is the number of the kinds of the production process cost, n is the number of devices running costs incurred in the production process. $C(P^n_c, t_c) = [a_{ij}]_{m\times n}$, is abbreviated as $C^n$. Its value is not the production process measurement matrix but the cost per ton of production process measurement of the coefficient matrix.

**Definition 4:** In the Hybrid Petri network optimization model of process-oriented real-time control cost, the total real-time cost of N0. I machine is:

$$C_{fj} = \sum_{j=1}^{m} a_{ij} \cdot V_i$$

In a macro cycle, the total real-time control cost of the production process is:

$$C = \sum_{i=1}^{n} C_{fj} = \sum_{f=1}^{n} \sum_{j=1}^{n} a_{ij} \cdot V_i$$

The objective function of real-time control cost of the production process is:

$$C_f \to \min C_f = \min \sum_{i=1}^{n} C_{fj} = \min \sum_{i=1}^{n} \sum_{j=1}^{m} a_{ij} \cdot V_i \quad (1)$$

Equipment capacity constraints:

**Definition 5:** There are continuous changes of n machines in the Hybrid Petri network optimization model of process-oriented real-time control cost, Its associated matrix is W, suppose $E_c(m) \subset E_c$ which means that the subset of continuous changes of m enable machine equipment. $E_N(m) \subset E_c$ which means that the subset of continuous changes of m does not enable machine equipment. $P_c = \{p = P_c | m_p = 0\}$ represents the empty subset of material continuous position, at any instant activation vector $V = [V_1, V_2, ..., V_n]$, is in the m state, having the following linear set of feasible solutions:

$$V_j^{max} - V_j \geq 0, \forall t_j \in E_c(m) \quad (2)$$

$$V_j - V_j^{min} \geq 0, \forall t_j \in E_c(m) \quad (3)$$

$$V_j = 0, \forall t_j \in E_N(m) \quad (4)$$

$$\sum_{t_j \in T_\varepsilon} W(p, t_j) \cdot v_j \geq 0, \forall p \in p_\varepsilon(m) \quad (5)$$

**Production scheduling constraints of logistics rate:** Production scheduling section through the storage of semi-finished products in the production process, the conflicting goals of each device decoupling, when the product oversupply, scheduling policy, reduce product yield; to take scheduling policy, increase the amount of product when the product is in short supply. Two storage capacity but also by the enterprise warehouse storage capacity constraints.

Process-oriented cost optimization model of the real-time control Hybrid Petri Nets scheduling strategy into production scheduling logistics rate inequality constraints, the inventory capacity constraints into production status change conditions in the macro cycle.

**Definition 6:** For the position of any material $p \in P^m_c$, Production scheduling strategy is to increase the production of the material storage warehouse at a rate of not less than $v_x$, so:

$$\sum_{t_i \in T_\varepsilon} W(p, t_i) \cdot V_i \geq V_x$$

In the case of discrete change is not excited, the length of the k-th macro cycle is $\Delta\tau = \tau_k - \tau_{k-1}$, constantly increasing amount of material storage warehouse $m_p(\tau)$, at time $\tau_k$, when the state of the technological changes to meet the critical state:

$$\sum_{t_i \in T_\varepsilon} W(p, t_i) \cdot V_i \cdot \Delta\tau = m_p^{max} \quad (6)$$

Similarly, for the position of any material $P \in P^m_c$, Production scheduling strategy is to decrease the production of the material storage warehouse at a rate of not less than $v_x$, so:

$$\sum_{t_i \in T_\varepsilon} W(p, t_i) \cdot V_i \leq V_x$$

In the case of discrete change is not excited, the length of the k-th macro cycle is $\Delta\tau = \tau_k - \tau_{k-1}$, constantly decreasing amount of material storage warehouse $m_p(\tau)$, at time $\tau_k$, when the state of the technological changes to meet the critical state:

$$\sum_{t_i \in T_\varepsilon} W(p, t_i) \cdot \Delta\tau = m_p^{min} \quad (7)$$

## MODEL OPTIMIZATION

**Model of linear optimization:** as described above, the control cost objective function of the production process is:

$$C_f \rightarrow \min C_f = \min \sum_{i=1}^{n} C_{fj}$$
$$= \min \sum_{i=1}^{n}\sum_{j=1}^{m} a_{ij} \bullet V_i \quad (8)$$
$$= \min \left( \sum_{j=1}^{m} a_{ij} \bullet \sum_{i=1}^{n} V_i \right)$$

and:

$$C_i = \sum_{j=1}^{m} a_{ij}, V_i = \sum_{i=1}^{n} V_i$$

The objective function can be transformed into the standard form of a linear programming:

$$C_j = c \cdot v \quad (9)$$

Wherein, v is the n-dimensional column vectors. According to the analysis of the production constraints shows that, there are feasible region meet:

$$D = \{ v \in R^n \mid a \bullet v \le b, aeg \bullet V = beg, V \ge 0 \} \quad (10)$$

In this study, the simplex method for solving the optimal value of the objective function of real-time cost control of the production process, the optimization goal in all basic feasible solution, the basic idea is that starting from an initial basic feasible solution to look for another basic feasible solution that has a greater decline in value of objective function, the number of basic feasible solution is limited, after a finite number of iterations, will certainly be able to find the optimal solution. Solving steps are as follows:

**Step 1:** Find an initial basic feasible solution; Re-arranged A column vectors into a = (B, N), B is linearly independent vectors; corresponding $V = (V_E, V_N)$, $C = (C_E, C_N)$, corresponding variable $V_B$ is a base variable, $V_N$ is no basic variable. Therefore, there:

$$C_f = C_E \bullet V_B + C_N \bullet C_N \quad (11)$$

$$aV = BV_B + NV_N = b \quad (12)$$

So, has:

$$\frac{V_B(b - NV_N)}{B} \quad (13)$$

Deduce that:

$$C_f = C_B(b - NV_N)/B + C_N \bullet V_N = C_B b/B + (C_N - C_B N/B)V_N \quad (14)$$

Let $V_N = 0$, the result is:

$$V_E = \frac{b}{B} \quad (15)$$

**Step 2:** Check whether the current basic feasible solution is optimal, if the best, have found the optimal solution, stop iteration; Otherwise, go to step 3

If basic feasible solution to further meet the $C_N$-$C_B N/B \ge 0$, that is $C_N \ge C_B N/B$, to all feasible solutions v, there must be $C_f(V) \ge C_B b/B$, In this case, the basic feasible solution $V_N = (bB^{-1}, 0)^r$ is the optimal solution.

**Step 3:** Go to another basic feasible solution, where the objective function value gets the improvement, return to step 2

**Optimization of the production process real-cost:** The solving of process-oriented hybrid petri net optimization model of cost of real-time control is based on the industry standard process for solving cost-based, real-time control of the a variety of energy consumption, all kinds of raw materials consumption, auxiliary materials consumption, to achieve of production process real-time cost minimized in every macro-running cycle.

Assuming the processes cost of industry standard is $\overline{c_{si}}$, the real-time cost of the production process is $\overline{c_{ft}}$, the objective function of the optimal control is:

$$\Delta C_f = \left| \overline{C_{si}} - \overline{C_{ft}} \right| \longrightarrow 0 \quad (16)$$

Real-time cost of production line in the period is:

$$C_f = \sum_{i=1}^{n} C_{fi} \bullet \Delta\tau \quad (17)$$

## OPTIMIZATION EXAMPLE

**Description of the problem:** This study takes the manufacturing process of solid preparation of traditional Chinese medicine(Hard capsules)as example, involved in the supply of raw materials, mixing, capsule filling, capsule cleaning, inspection capsules, capsule conveying, plastic packaging, packaging, transport kit, finished packing, product storage and other processes.

- **Fill material is prepared:** For a variety of materials involved a total of five kinds of Chinese medicine ingredients, namely the A component, B component, C component, D component, E component (lubricant) energy consumption of electricity and gas

- **Mix:** Mixing the various components involved, consumption of electricity
- **Preparation of filling materials:** The kind of energy consump-tion is electricity
- **Capsule filling:** The kind of energy consumption are electric- ity and stream
- **Capsule cleaning:** Involves cleaning and polishing, the kind of energy consumption are electricity and stream
- **Capsule inspection:** Eligible capsules directly go into the fini- shed capsules transportation, substandard capsules are removed into waste containers, send the finished capsules into packaging processes, the kind of energy consumption is electricity
- **Capsule delivery:** Online delivery and storage, the kind of en- ergy consumption is electricity
- **Inner packing:** Plastic tissues are involved as materials, the kind of energy consumption are electricity and stream
- **Outer packing:** Brochures and kits are involved as materials, the kind of energy consumption is electricity
- **Delivery kit:** The kind of energy consumption is electricity
- **Finished packing:** Kits are involved as materials, the kind of energy consumption are electricity and stream
- **Product storage:** The kind of energy consumption is electricity

In the calculation process, per ton subassembly as the optimization of the unit, 8 h shift as the macro running cycle; the supply status of Pharmaceutical excipients in per subassem-bly is not the same, medicine, lubricants and energy supplies are adequate in the optimized design and production process; consumed of the electrical, Traditional Chinese Medicine (TCM), the supply of various excipients in the production process are shown in Figure 4. Supplying necessary Chinese herbal medi- cinal ingredients of each batch drug in accordance with material requirements list (BOM); In order to optimize the feasibility, raw materials (TCM) and the energy consumption in the produ-ction process are converted into a unified currency and uses the cost of per ton raw material for the accounting unit.In calcula-tions, labor costs, as well as the clean water and other costs, without taking into consideration in the optimization model.

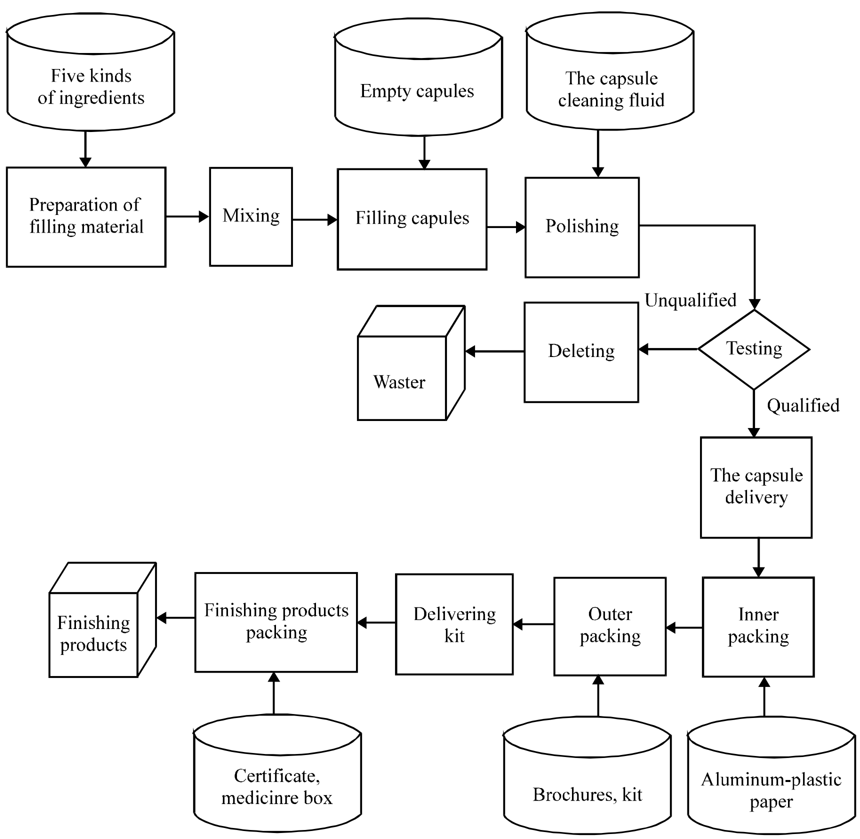


Fig. 1: Hard capsule production process flow diagram

Energy data as follows:

1 KW·h = 0.1228 kgce; 1t3.5 Mpa steam = 125.714 kgce

Electric power consumption:

Electricity 0.6 yuan/KW;
equivalent to steam 8.589 yuan/ton

**Ingredients:** Water 2 yuan/ton (including water treatment costs): Equivalent to steam 2 yuan/ton.

System in accordance with the 90% output 328 days per year, steam 129.6 t/day, 42508.8 t/year.

**Lighting:** 508505.6 K W·h/year.

**Equipment maintenance:** 30,000 yuan/year; equivalent to steam 0.706 yuan/ton.

**Other unforeseen expenses:** 1.2 million/year; equivalent to steam 0.283 yuan/ton

**Basic fixed consumption costs:** Equivalentsteam14.627 yuan/ton

**Standard coal equivalent:** 5000 (kcal $kg^{-1}$) by 580 yuan/ton.

$$W^M = \begin{array}{c|ccccccccccc} & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c & E_1^c \\ P_1^n & 52.33 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_2^n & 0 & 49.73 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_3^n & 0 & 0 & 48.01 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_4^n & 0 & 0 & 0 & 47.23 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_5^n & 0 & 0 & 0 & 0 & 44.37 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_6^n & 0 & 0 & 0 & 0 & 0 & 41.43 & 0 & 0 & 0 & 0 & 0 \\ P_7^n & 0 & 0 & 0 & 0 & 0 & 0 & 39.77 & 0 & 0 & 0 & 0 \\ P_8^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 39.69 & 0 & 0 & 0 \\ P_9^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 35.27 & 0 & 0 \\ P_{10}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 31.19 \\ P_{d1}^n & 5.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d2}^n & 4.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d3}^n & 6.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d4}^n & 40.0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d5}^n & 1.4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d6}^n & 0 & 0 & 1.5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d7}^n & 0 & 0 & 0 & 3.4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\ P_{d8}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0.2 & 0 & 0 & 0 & 0 \\ P_{d9}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 3.75 & 0 & 0 & 0 \\ P_{d10}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.375 & 0 & 0 & 0 \\ P_{d11}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.06 \\ P_{d12}^n & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0.37 \end{array}$$

**Floating markets coal consumption costs:** Equivalent to steam 134.855 yuan/ton.

## MODELING AND SOLVING

A pharmaceutical production aspect of energy and material consumption as shown in Fig. 2.

In a macro running cycle, for example, described in detail the process of drug production cost savings by controlling the optimal excitation rate of equipment during the material consumption and energy consumption process, that is the optimal operating equipment productivity.

First, clear 10 key process as excitation rate of production interval of equipment $V_i(V_s, V_d)$, the amount of finished goods warehouse is defaulted cache five days of the normal workload of factory, the amount of intermediate cache facilities at the rated capacity of the cache.

All equipment is running, so the above description, we can create the following two linear equations.

Matrix of energy consumption coefficient is $W^M$ (units converted into ten thousand yuan/ton).

Matrix of material components consumption is $W^N$ (units converted into ten thousand yuan/ton):

$$W^N = \begin{bmatrix} 0.320508 & 0.249284 & 0.0845292 & 0.422646 & 0.007047 & 0.12412 & 0.2320 & 0.08874 & 0.13075 & 0.239 \\ 4.6400 & 0 & 6.9600 & 9.8600 & 0 & 0 & 1.1600 & 0 & 0 & 1.0440 \end{bmatrix}$$

The linear equation of production equipment:

$$C_{f1} = \sum_{j=1}^{2} \sum_{i=1}^{10} a_{ij}^e \cdot \tau \cdot V_i^e$$

$$\begin{aligned} C_{f1} = {} & (0.320508 + 4.64) \times 5 \times v_1 + (0.249284 + 0) \times 4 \times v_2 \\ & + (0.0845292 + 9.69) \times 6.5 \times v_3 + (0.422646 + 9.86) \times 40 \times v_4 \\ & + (0.007047) \times 1.4 \times v_5 + (0.12412) \times 1.5 \times v_6 \\ & + (0.2320 + 1.1600) \times 3.4 \times v_7 + (0.08874) \times 0.2 \times v_8 \\ & + (0.13705) \times 0.375 \times v_9 + (0.2390 + 1.0440) \times 0.37 \times v_{10} \end{aligned}$$

So has:

$$C = [24.8025, 0.997, 45.786, 411.305, 0.00986, 0.186, 4.73, 0.177, 0.051, 0.4747]$$

Then the feasible region of device excitation rate is:

$$2 \le v_0 \le 20, 1 \le v_1, v_2, v_3, v_4 \le 10, 2 \le v_5 \le 1000, 2 \le v_6, v_{13} \le 10, 5 \le v_7, v_{14} \le 10, 1 \le v_8 \le 20, 2 \le v_9 \le 10, 1 \le v_{10}, v_{11}, v_{12} \le 20$$

So have:

vlb = [2, 1, 1, 1, 1, 2, 2, 5, 1, 2, 1, 1, 1, 2, 5], vub = [20, 10, 10, 10, 10, 1000, 10, 10, 20, 10, 20, 20, 20, 10, 10]

By definition 5, in the current production scheduling strategy to meet the $5v_1+4v_1+6.5 v_1+40v_1+ 1.4v_1 = 49.78v_2$ which can be obtained b = [20, 30].

By definition 6, the above production constraints into linear optimization MATLAB command:

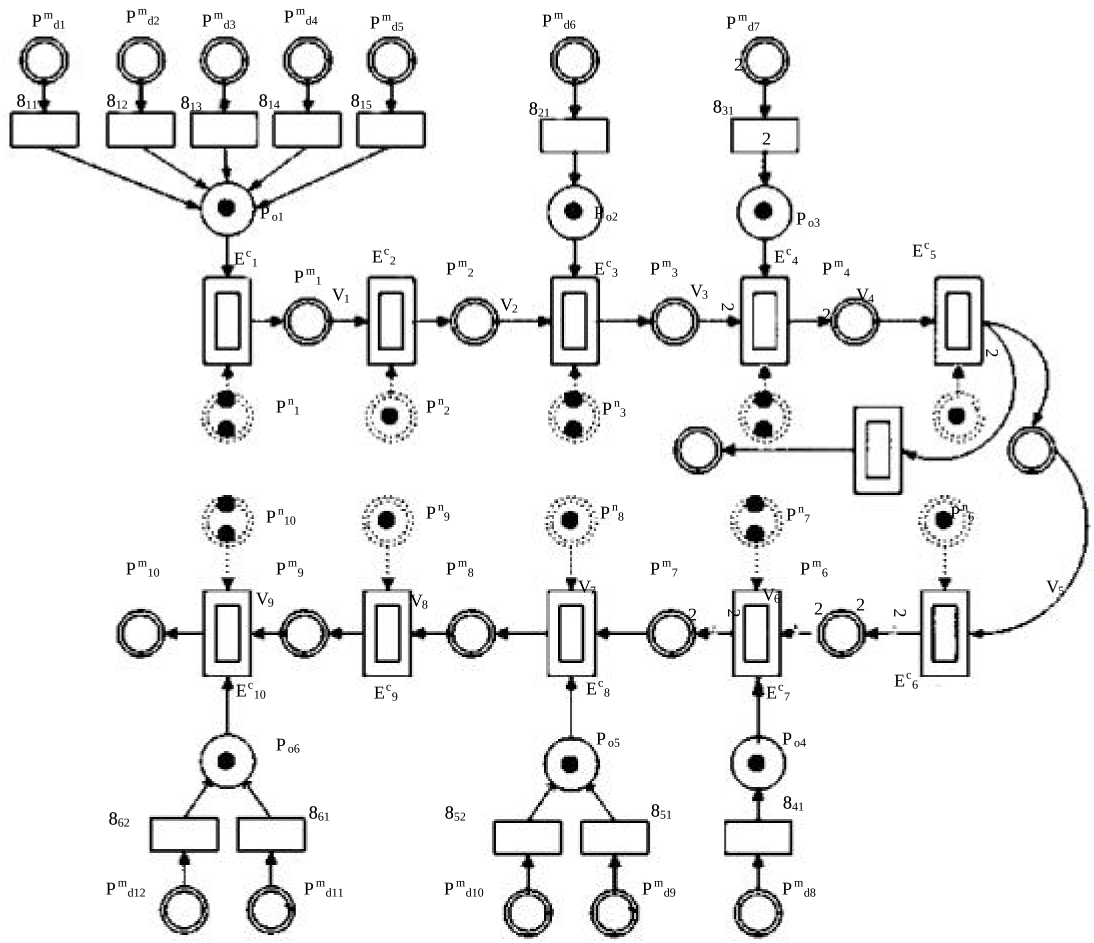


Fig. 2: Petri net model diagram

$$[V, C_{f1} = \text{linprog (c, a, b, aeq, beq, vlb, vub)}]$$

to get the optimal solution:

$$V = [12,\ 15,\ 15,\ 15,\ 2, 5, 5, 411, 2, 5],$$
$$C_{f1} = 0.7595 \text{ (ten thousand ton}^{-1}\text{)}$$

Similarly, the cost of material consumption can be got based on linear equation:

$$C_{f2} = \sum_{j=1}^{15}\sum_{i=1}^{14} a_{ij}^{m} \bullet \tau \bullet V_i^m$$

so, $C_{f2}$ = 6.89028 (ten thousand yuan/ton).

Thus, the total cost of the capsules production process is $C_f = C_{f1}+C_{f2} = 7.64978$ (10,000 yuan ton$^{-1}$).

## CONCLUSION

This study provides a theoretical basis for Implement information systems development and integration when enterprise information system uses hybrid petri network optimization model, finally examples optimization are given according to the previously discussed out of model, the realization of the dynamic reflection of real-time cost. Enterprise information technology has been widely used in domestic and foreign research and practice, the use of information technology and hybrid Petri net model for the dynamic feedback of control costs which favors enterprises to achieve the intensification of production and cost rationalization.

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