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The Analysis and Optimization of Personalized Customization Model of Crowdsourcing Based on GSPN

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Abstract

The development and customization of new products in crowdsourcing is an important crowdsourcing theory application issue. But as a new business model, there are usually low efficiency, poor effect in the process of enterprises, and in practical application and the combination of businesses. This paper proposes the generalized stochastic Petri net (GSPN) theory in the modeling and performance analysis in crowdsourcing business model, and assesses effectively about the overall model's time performance and operation efficiency, which has been verified and optimized by 24% in an example. This paper starts from crowdsourcing contest business model to optimize the process and the frame of crowdsourcing through quantitative analysis results, so as to provide a reference for the decision-making party of the business model.

Keywords: *Crowdsourcing; GSPN; Personalized Customization; Crowdsourcing contest; Time efficiency; Performance Analysis*

1. Introduction

Nowadays, with the development and the knowledge-based economy highly developed, the development and the manufacturing of new products in enterprises, which solely rely on the internal R&D resources innovation or outsourcing to external professional bodies, are increasingly difficult to adapt to and be confronted with the personalized demand that is to be diversified and the fierce market competition.

Under this background, in order to respond to the rapidly changing customers' demands that tend to be more personalized, and to reduce product cycles and to reduce the probability of innovation costs and the failure probability of the products' R&D, it is necessary for enterprises to use the innovation mode to integrate the internal and external resources to improve efficiency, and they can get the resources in need and solutions, so as to enhance the core competitiveness of enterprises. So how to effectively improve the quality of tasks and accelerate the frequency of resources is becoming the urgent topic in the research community.

Using "public participation" as the core concept, the crowdsourcing model can be based on the Internet platform, and can gain the access to a wider range of participants' knowledge, innovative ideas and other kinds of resources, so as to break the specialization and innovation threshold [1]. Finally, the model can provide more suitable solutions about the strategic choices for the enterprises.

The crowdsourcing model transfers from the condition that the producers and their internal resources work as the leading factors, to the direction dominated by consumers, and builds user-centric innovation model. So the enterprises and consumers can be more involved in the requirements analysis of products, the process of R&D, production, innovation and other activities. It also plays the role key to the personalization service [2]. But as a new business model, low efficiency and poor effects usually exist in the enterprises in the process, and in practical application and the combination of businesses.

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This article aims at the main crowdsourcing contest model under the background of the business process of personalized customization services, and uses the generalized stochastic petri network modeling tool and the method based on the timed transitions to do researches. According to the enterprises' process of workflow, material flow in crowdsourcing, we will trigger transitions individually, and inspect into the whole system's efficiency to find out the unreasonable changes to improve. In the meanwhile, we can analyze and optimize the system processes, and provide feasible method and theoretical support to combine and develop the crowdsourcing model and customization services for enterprises [3].

2. Crowdsourcing and Personalized Customization

2.1. The Concept of Crowdsourcing

The crowdsourcing means that a company or organization outsourced the work tasks to non-specific large public networks in the form of free voluntary that were performed by the internal employees.

Different from the outsourcing model that is comprised by the highly specialized company and professional outsourcing enterprises, the crowdsourcing has brought more efficient, strong innovation ability with combining the outsourcees that are of social diversification and differentiation [5]. The outsourcees are often distributed in the various professional fields, and we can conclude some reasonable and low-cost solutions that are various from the specific R&D teams with integrating the cross-intelligence and the innovative resources [6].

According to the different forms of crowdsourcing participating in the business model, the typical model of crowdsourcing can be divided into the value-chain model and the Wiki model [7], Feng-Jianghong, Li-Guoliang and others respectively named as the collaborative crowdsourcing and crowdsourcing contest, and the collaborative crowdsourcing is mainly based on open-sourcing technology, which needs to be completed by the public community and applied the concepts of crowdsourcing to work simply; while crowdsourcing contest is the reconstruction of the original business model according to the concept of crowdsourcing, and it will be picked up by outsourcees independently to complete the business model. In the common process of personalized customization, the crowdsourcing contest model is widely used because of its excellent solution ability.

This paper takes the concrete crowdsourcing contest as the research object, through the analysis of the process of industrial chain in the crowdsourcing model to study the internal mechanism of the model, and improves the efficiency of every link, finally gets the optimization of tasks, so as to maximize the advantages in the competitions. Meanwhile, studying the crowdsourcing model is of practical significance for the enterprises to build the new business model with new concepts.

2.2. Literature and Application Overview

Current research about crowdsourcing can mainly be divided into the following categories: one is focused on researching and improving the concept of crowdsourcing, such as Wei *etc.* (2010) into expounds the differences between crowdsourcing and outsourcing, as well as crowdsourcing business model. Feng *etc.* (2014) discussed crowdsourcing's progress, such as in the field of computer, and summarized the existing technology researches and challenges. However, they didn't discuss or analyze the crowdsourcing about the specific process and concrete optimization.

Second is the analysis and optimization of the crowdsourcing. Pang *etc.* (2015) proposed solutions for the activities of the risk from the aspects of credit evaluation system, rewards and punishment mechanism [8]; Zhang *etc.* (2013) proposes a dynamic quality-control

strategy and quality-evaluation method, which is advantageous for the automatic recognition of the quality of crowdsourcing solutions [9]. But they just focused on the single links to some degree, instead of putting forward the overall and complete solutions. At the same time, crowdsourcing has been fully used in many fields, such as: machine learning and artificial intelligence, information retrieval [10]; amazon uses Mturk platform to undertake and distribute crowdsourcing tasks; Ikea puts the prize-winning works into the customization production market through holding house-design contest [11].

To sum up, the existing researches and applications of crowdsourcing concerns more in the analysis of the theory of crowdsourcing and optimization. While at right now, the crowdsourcing model has been widely applied in personalization service, the combination of the two still has low efficiency, poor flexibility, low input and output ratio *etc.* characteristics. For the reasons that enterprises have the inertia to the existing mode and they are not familiar with the application of the crowdsourcing in the whole process caused the inefficient problem-solving. And existing researches follow the paradigm of performance characteristics [12], lacking market-applicable optimization schemes. Hence we need to do the overall process optimization and quantitative analysis for the crowdsourcing model, to provide a reference for the policy makers.

2.3. The Application of GSPN on Customization

With the abundance of the consumer's personalized demand, more and more markets and brands turn from mass-production into personalized, quantified, creative, while there is no one earlier and more clear than consumers to understand their needs, so personalized customization can combine with the innovative concept that the crowdsourcing regard users as their core together, making the product design dominated by consumers, arising the enthusiasm of the broad masses of customers.

In the customization process, not only will there be good outsourcees to offer clear design; it also needs a big platform with the aid of the brand, supply chain, data platform, intelligent data-analysis standard, and maintenance ability to run continuously, to use data for accurate localization of demand in the production process [13]. Some large enterprises in their early stages of production, will also put the early products and ideas in similar crowdsourcing platform to test, in order to confirm whether is worth investing or absorbing the amendments [14]. However, as a new business model, enterprises usually exist in the process of low efficiency, poor effect in practical application and the combination of business.

This article uses the analysis that can effectively describe the GSPN model of supply chain structure, which can also optimize the efficiency to establish the crowdsourcing model in customization, transforming into equivalent Markov-chain model to analyze the performance of the entire process [15]. Meanwhile, we can calculate the steady-state probability of the supply-chain system through the whole business dynamic characteristics and quantitative analysis of the efficiency of each link in the supply chain. According to the business process of the enterprises and supply chain, we build the GSPN model, optimizing personalization industry chain structure. Through the example, we have speeded up the feedback process, making quality-control stage efficiency optimization to 30% in the entire model, and finally optimized the platform.

3. The Crowdsourcing Modelling

3.1. Constructing the Business Process

Pang *et al.* have adopted the two-stage access mechanism for crowdsourcing. In the first stage, the platform attracts users to register and encourages them to participate in the projects. The second stage, credit form, deposit, declarations and demand document are

provided by both parties. According to the theory, we divide the process into five steps: two-phase of registration and access mechanism, publication of the project by the outsourcer, research and development by the outsourcees, selection and confirmation of the optimal plan, personalized customization. The process of crowdsourcing is shown in Figure 1.

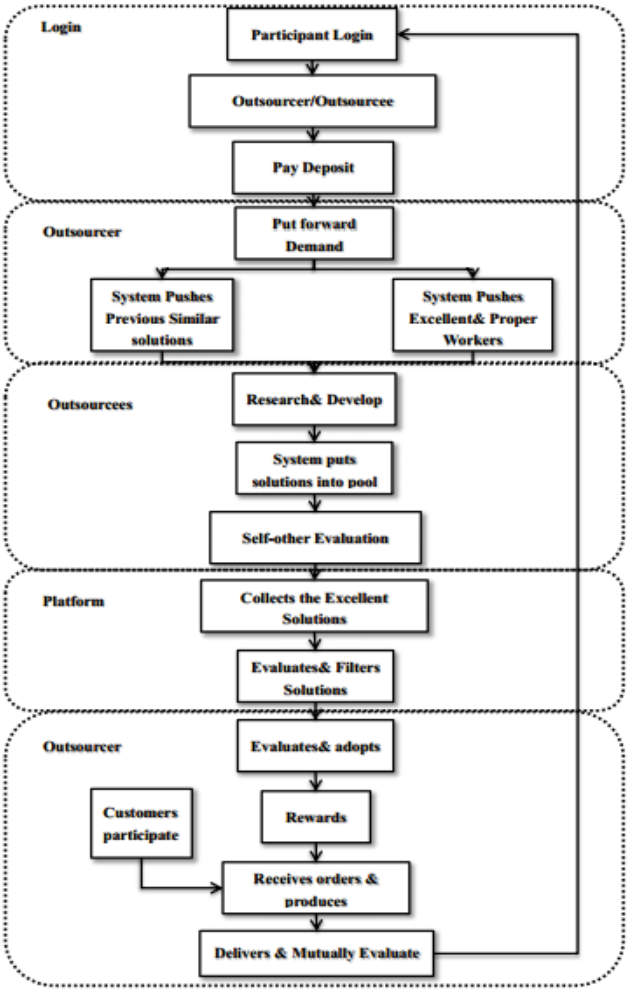

Figure 1. The Business Process Model of Crowdsourcing Contest

Currently, the researches of identifying participants, avoiding risk for both sides, evaluating and filtering the plans can be applied in the workflow. Firstly, participants login the platform, as outsourcers or outsourcees, then pay the deposit, and make intellectual property or contract intention statement, and the system will give credit rating to make sure no low-grade users have taken part in it. This mechanism can effectively reduce the dishonest behaviors or the risk. Then the outsourcer puts forward the customized demand and reward, completes the detail of demand. Later, system will push previous similar solutions to the user based on his or her cookies, tags and demand. Meanwhile, system will push the project to the high-grade, high-credit-rating and active outsourcees based on their tags, reward line, areas. Thirdly, the outsourcees would research and develop. System will put the solutions with the previous solutions into planning pool. We put forward the self-other-evaluation filter method. Later, community will score and rank for plans using machine algorithms, such as inserting golden standard data and EM (expectation maximum) (2013). Step 5, the outsourcer selects the best one. Finally,

customization. The enterprise rewards for excellent plans, and releases final solutions, accepts reservation, produces, to deliver and do the customer-enterprise mutual evaluation.

According to the speed of orders, and after observing and recording the operation in the major site, such as zhubajie.com, Amazon Mturk, we find that in step 1, login and verification take a short time, but in step 2, as outsourcers always revise their demand, it takes long. The push to both parties and the filter and evaluation are based on machine learning, data analysis and algorithm, so it takes short. However, the evaluation and selection of outsourcer spend much longer time because of the involvement of people. As the participants evaluate others' plan, they are familiar with them. No more time are spent on collecting orders. While the time of transferring would be long, according to the conditions of logistics and transportation.

In conclusion, we assume that:

$$\lambda=\{\ 4,3,1,4,3,0.5,2,2,1,4,5,3,1,2\ \} \quad (1)$$

λ is the fire rate of transition. Transitions t1-t14 follows the random exponential distribution. That is the transition rate of states triggered by t can be obtained from reachable state graph. As the random parameter of transition t0~t15 following the exponential distribution.

3.2. Simplification and Calculation

The network structure of crowdsourcing model is simplified to the GSPN model shown in Figure 2.

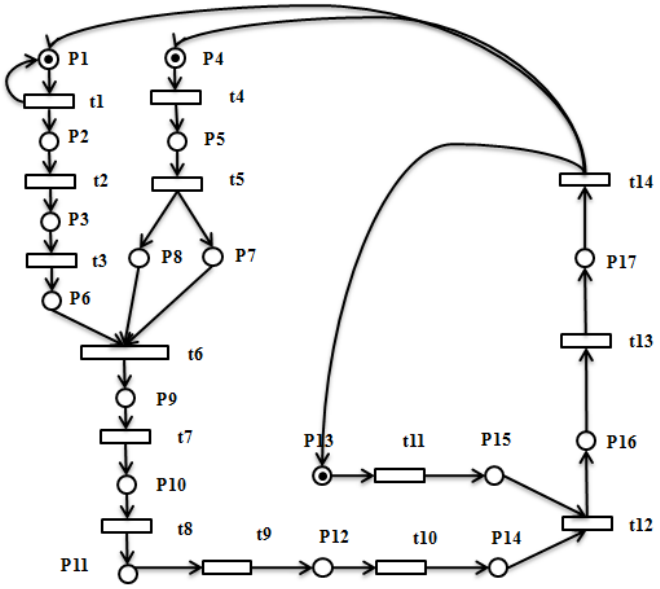

Figure 2.The Corresponding Workflow Model Based on GSPN

Firstly, the crowdsourcers register and login into the platform, trigger t1 and t4 respectively. And the solutions' content and the crowdsourcers with high quality merge into the package pool, through the triggered transition t6. The best schemes are chosen and require enterprises to evaluate and employ them, and then the t9 is to be triggered, and packed into the crowdsourcing platform. The visitors login into the platform and preview product schemes and reserve the orders through the transition t12 triggered, so as to produce the personalized-customization products. The model shown in Figure 2 only

keeps the explicit states, which are comprised by 17 libraries and 14 transitions. The meanings of each library and transition are shown in Table 1 and Table 2:

Table 1. The Meaning of Places

Place	Meaning
P1	Outsourcer has logged in
P2	Outsourcer has prepared the demand
P3	Deposit has been paid
P4	Outsourcees have registed
P5	Outsourcees have logged in
P6	Demand has been completed
P7	High-grade outsourcees
P8	Previous similar solutions
P9	Solution pool has been generated
P10	Good solutions has been collected
P11	Excellent solutions has been collected
P12	The optimal solution has been elected
P13	Customers are ready
P14	The solution has been activated
P15	Customers view the plan
P16	Products have been made
P17	Feedback has been given

Table 2.The Meaning of Transitions

Transition	Meaning
t1	Wetsite verifies
t2	Pay deposit
t3	Outsourcer puts forward the demand
t4	Website verifies
t5	Platform pushes based on demand, credit rate, tag, etc
t6	Outsourcees research and develop
t7	Oursourcee self-other evaluate for the solutions in the pool
t8	Platform evaluate and filter solutions by algorithm
t9	Outsourcer evaluates and adopts
t10	Outsourcer rewards
t11	Customers log in
t12	Book and produce
t13	Deliver and mutual evaluate
t14	Analyze the fulture bisiness

Therefore, it can be concluded that the total running time of the whole system:

$$T = {}^{1}/_{\lambda_1} + {}^{1}/_{\lambda_2} + {}^{1}/_{\lambda_3} \ldots\ldots {}^{1}/_{;} \quad (2)$$

Meanwhile, we need to do the system optimization for the GSPN model, and calculate the efficiency after the reduction and the simplification. It is shown in Table 3 about the

reduction rates of each part of systems before and after. We can see obviously that the same process has shortened the more time. It is shown in Figure 3. After the reduction process of GSPN model. According to the simplified model, we can obtain after the accessible state diagram, as is shown in Figure 4.

Table 3. Changes Before and After the Simplification

Original Parameter	Original λ	Simpified Parameter	Simplified λ'
λ1	4	λ1	0.63
λ2	3		
λ13	1		
λ4	4	λ2	4
λ5	3	λ3	3
λ6	0.5	λ4	0.5
λ7	2	λ5	0.44
λ8	2		
λ9	1		
λ10	4		
λ11	5	λ6	5
λ12	3	λ7	3
λ13	1	λ8	1
λ14	2	λ9	2

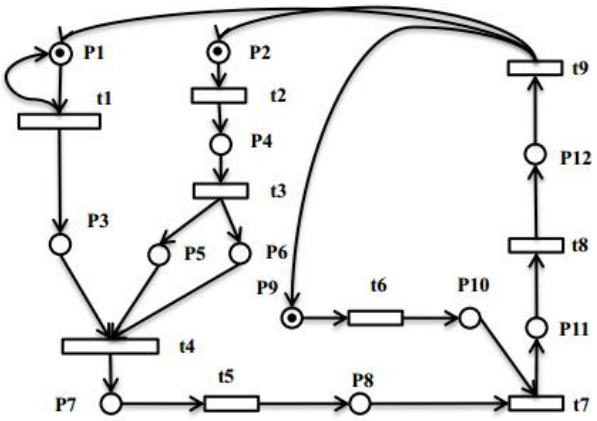

Figure 3. Simplified GSPN Model

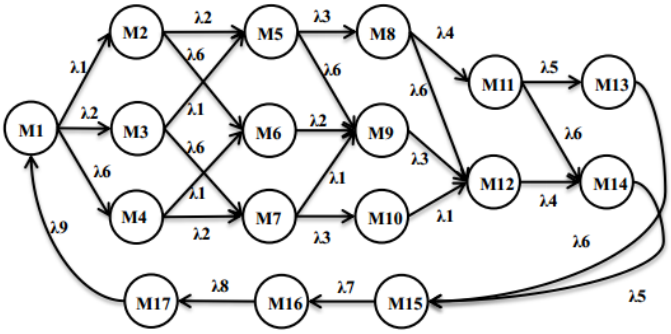

Figure 4. Reachable State Graph

We can solve the reachable sets of GSPN to construct the corresponding Markov chain. When the constructed Markov chain is in stationary distribution, then the steady-state probability of systems can be calculated. First the steady-state can be drawn up according to Figure 4, then we will mark every logo of steady-state probability by row vector: structure matrix vector P = { P(M1), P(M2), P(M3), ….P(M17)}, and we can draw the formula according to the related theorem of Markov stationary distribution :

$$\begin{cases} P * Q = 0 \\ \sum_{i=1}^{k} P(M_i) = \end{cases} \quad (3)$$

The matrix Q is the transition probability matrix of markov process, and the diagonal elements of matrix Q need to satisfy the formula as follows:

$$q_{ii} = -\sum_{i \neq j} q_{ij} \quad (4)$$

According to the formula (3), (4), Q transition probability matrix is constructed as shown in Figure 5. At the same time, according to the reachable state graph and the library's changes we get reachable identifier table of the GSPN model.

Q=

$$\begin{pmatrix}
-9.6 & 0.6 & 4 & 5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & -9 & 0 & 0 & 4 & 5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & -5.6 & 0 & 0.6 & 0 & 5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & -4.6 & 0 & 0.6 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & -8 & 0 & 0 & 3 & 5 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & -4 & 0 & 0 & 4 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & -3.6 & 0 & 0.6 & 3 & 0 & 0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & -5.5 & 0 & 0 & 0.5 & 5 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -3 & 0 & 0 & 3 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.6 & 0 & 0.6 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -5.4 & 0 & 0.4 & 5 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.5 & 0 & 0.5 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -5 & 0 & 5 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -0.4 & 0.4 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -3 & 3 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -1 & 1 \\
2 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & 0 & -2
\end{pmatrix}$$

Figure 5. The Transition Probability Matrix

According to the formula (3), we conclude the calculation of the matrix with Matlab that: P(M1)=0.01330 ,P(M2)=0.00093 ,P(M3)=0.00944 ,P(M4)=0.01435, P(M5)=0.00121, P(M6)=0.00343, P(M7)=0.02881, P(M8)=0.00066, P(M9)=0.01266, P(M10)=0.13685, P(M11)=0.00006, P(M12)=0.25545, P(M13)=0.00001, P(M14)=0.28806, P(M15)=0.04268, P(M16)=0.12805, P(M17)=0.06403。

The transition probability matrix is shown in Figure 5.According to the transitions and the reachable state graph, we can get the Reachable identifier table in Table 4.

Table 4. Reachable Identifier Table After

	P1	P2	P3	P4	P5	P6	P7	P8	P9	P10	P11	P12
M1	1	1	0	0	0	0	0	0	1	0	0	0
M2	1	1	1	0	0	0	0	0	1	0	0	0
M3	1	0	0	1	0	0	0	0	1	0	0	0
M4	1	1	0	0	0	0	0	0	0	1	0	0
M5	1	0	1	1	0	0	0	0	1	0	0	0
M6	1	1	1	0	0	0	0	0	0	1	0	0
M7	1	0	0	1	0	0	0	0	0	1	0	0
M8	1	0	1	0	1	1	0	0	1	0	0	0
M9	1	0	1	1	0	0	0	0	0	1	0	0
M10	1	0	0	0	1	1	0	0	0	1	0	0
M11	1	0	0	0	0	0	1	0	1	0	0	0
M12	1	0	1	0	1	1	0	0	0	1	0	0
M13	1	0	0	0	0	0	0	1	1	0	0	0
M14	1	0	0	0	0	0	1	0	0	1	0	0
M15	1	0	0	0	0	0	0	1	0	1	0	0
M16	1	0	0	0	0	0	0	0	0	0	1	0
M17	1	0	0	0	0	0	0	0	0	0	0	1

4. The Performance Analysis Based on Crowdsourcing Model

4.1. Time Efficiency Analysis

The whole system's speed is one of the important performance of the model, and the time performance refers to the time that when system is in steady-state, the time cost of production, according to the requirements of the users or the cost of the process running, and we can use the average time to measure.

According to the formula of Little: $N = \lambda T$, and N is the tokens' number of the whole system that is in a steady state. T is the average execution time of the subsystem, and λ is the tag number of going into a subsystem in units of time. Since it is in the steady state, and subsystem contains all transitions. So we can conclude the subsystem's average execution time, and that is the average execution time of the whole system.

Further, by computing the probability of different P libraries if they are at busy or idle time, we can analyze and optimize the system's performance.

We analyzed the process of Figure 3, and we defined the subsystem as P' = {P, T, F, 'M', λ'}, including P2 = P - {P1, P2, P9}, and T ' to λ' is the same as T to λ. F is the collection of sides after the F removed the links to P1, P2, P9. While the subsystem is still in a steady state, and the number of the tokens outputted from the system equals the number inputting the system, which equals the degree of the original system. So we can use the subsystem's average execution time to estimate the average execution time of a workflow in the whole system.

The subsystem contains P3, P4, P5, P6 and P7, P8, P10, P11, P12, whose probability that these libraries contain at least one token is that:

P(M(P3=1))=P(M2)+ P(M5)+ P(M6)+ P(M8)+ P(M9)+ P(M12)= 0.27434

P(M(P4=1))= P(M3)+ P(M5)+ P(M7)+ P(M9)= 0.05301

P(M(P5=1))= P(M8)+ P(M10)+ P(M12)=0.39296

P(M(P6=1))= P(M8)+ P(M10)+ P(M12)=0.39296

P(M(P7=1))= P(M11)+ P(M14)=0.28812

P(M(P8=1))= P(M13)+ P(M15)=0.04269

P(M(P10=1))= P(M4)+ P(M6)+ P(M7)+ P(M9)+ P(M10)+ P(M14)+ P(M15)=0.52684
P(M(P11=1))= P(M16)=0.12805
P(M(P12=1))= P(M17)=0.06403
The token averages of the N tokens in the subsystem:
N = P(M(P3=1))+ P(M(P4=1))+ P(M(P5=1))+ P(M(P6=1))+ P(M(P7=1))+ P(M(P8=1))+ P(M(P10=1))+ P(M(P11=1))+ P(M(P12=1))= 2.163

As for the subsystem, the number of tokens going into the subsystem equals the number of the tokens through t1, t2, t6 inputting and outputting the subsystem in the unit time, which equals the weighted value for speed multiplied by the probability of the weighted value.

λ= P(M(P1=1))×0.63 + P(M(P2=1))×4 + P(M(P9=1))×2 =0.091099
The average execution time of process is T = N/λ.
T=2.163 / 0.091099 = 23.74 h

4.2. Operational Performance Analysis

Operational efficiency of the process can well reflect the coordination efficiency in crowdsourcing model, such as the resources, manpower and mutual tightness. While the efficiency analysis is the core of the whole process of crowdsourcing, and it is one of the important indicators to measure the performance, which can optimize supply chain process of redundant time to provide specific measures with strong directivity.

As is shown in Figure 3, the crowdsourcing GSPN model needs to determine the busy state probabilities for each specific link, which means to check if the probabilities of libraries are equal to 1.

A1 represents the efficiency of the outsourcers' contracting the customization, and A2 represents the efficiency of the site's auditing about the outsourcees and their credits; A3 represents the efficiency of the platform's pushing solutions and good outsourcees; A4 represents the efficiency of the R&D's part; A5 represents the efficiency of the process of screening solutions and eventually adopting them; A6 represents the efficiency of the users' login into website platform; A7 represents the efficiency of scheduled orders' completion; A8 represents the efficiency of the products transportation, ending the mutual judgment.

We can conclude:
A1= { M1,M2,……,M17 },
A2= { M1,M2,M4,M6 },
A3= { M2,M5,M6 ,M8,M9,M12},
A4= { M8,M12 },
A5= { M11, M13,M14,M15 },
A6= { M1,M2,M3,M5,M8,M11,M13},
A7= { M15,M16 },
A8= {M16, M17},
Operational efficiency for each part is:
P(A1) = 1,
P(A2) = 0.0319,
P(A3) = 0.2734,
P(A4) = 0.2552,
P(A5) = 0.3326,
P(A6) = 0.0255,
P(A7)= 0.1702,
P(A8)= 0.1914.

We can get the rate that the crowdsourcing model's execution time occupies in the entire process's execution time. Meanwhile, we can further calculate of the efficiency of the core processes in the interior:

P(R&D) = (P(A4)) / (P(A1) + P(A2) + P(A3) + P(A4) + P(A5)) = 0.2552 / 1.8931 = 13.48%

P(order) = (P(A7)) / (P(A7) + P(A8)) = 0.1702 / 0.3616 = 47.06%

We can conclude that R&D link's efficiency is 0.2743 in the crowdsourcing's core process. Also, the order link's efficiency is 0.6667 within the crowdsourcing's core process. We can see that there are plenty of spare-time of the link in process by the calculation, low operation efficiency, and the resources' allocations is unreasonable. And we can take relevant measures to improve; the internal efficiency of the order process is suitable, we can see better allocation of resources.

The efficiency of customization is appropriate, and the R&D's efficiency is low, so we need measures to improve its process, in order to accelerate all the processes. So in addition to the R&D, each firing rate plus 1, as is shown in Table 4.

Therefore we can conclude that new P (M1)- P (M17) value, and P(R&D)' = (P (A4))/(P (A1) + P (A2) + P (A3) + P (A4) + P (A5)) = 0.5172, you can see, compared with the previous efficiency of P(R&D) that is 0.2743, has increased 0.2429 in total. So we suggest that we can optimize the crowdsourcing process, such as the efficiency of the outsourcing, the site auditing speed, and the use of evaluation algorithm with efficient quality to do high-speed solutions screening and so on.

As we can see the comparison above, we succeeded in accelerating the non-significant links in the whole process to raise the core R&D's efficiency and occupies to a considerable degree.

Comparing with the different λ, it can be concluded that the occupies of the core processes are increasing effectively with the λ's gradual growth. So we can make it optimized by the direct measures that applied to the unimportant links to improve the efficiency of the cores, as we haven't change the final procedures we package together as is shown in Table 5.

Table 5. Changes Shortening the Feedback Process

	λ+0	**λ+1**	**λ+2**	**λ+3**
λ1	0.63	1.05	1.43	1.79
λ2	4.00	5.00	6.00	7.00
λ3	3.00	4.00	5.00	6.00
λ4	0.50	0.50	0.50	0.50
λ5	0.44	0.73	1.00	1.26
λ6	5.00	5.00	5.00	5.00
λ7	3.00	3.00	3.00	3.00
λ8	1.00	1.00	1.00	1.00
λ9	2.00	2.00	2.00	2.00
%R&D	11.19%	13.02%	13.97%	14.57%
%Order	7.46%	8.68%	9.31%	9.72%

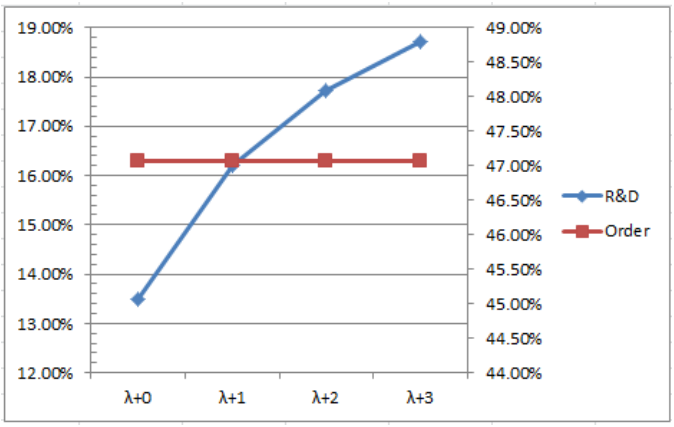

Figure 6. The Changes Tendency of the Core Parts

5. Conclusion and Future Direction

As the above results, we can see that the complete operation of crowdsourcing process and each link of the business rely on the A1-A8, the implementation of the main functional processes. First of all, it can be seen that there is a low efficiency in demand releasing, and one important reason is that the demands of the enterprise are not clear; additionally, network platform is slower when being audited, and the feedback and the confirmation are not rapid enough of paying the deposit of users.

The efficiency of the site's reviewing the quality and credit of the outsourcees is higher, and the site will usually classify outsourcees' credit rating to a digital hierarchy, and we can analyze the data through the algorithm or machine learning to recommend the data in the high digital hierarchy. Or we can automatically ignore the requests to access the system of the outsourcees with bad poor credit records.

The efficiency of pushing the good solutions and outsourcees is in general performance, which results from that the platform needs to have a two-way matching about the keywords and the content to the proper solutions and the outsourcers, and ti needs to recommend appropriate outsourcees to carry out the services according to the credit rating, and it also needs to recommend qualified solutions according to the similar problems, such as the Mturk platform. There are some problems existing in the pushing algorithm such as the low efficiency and poor compatibility, resulting in that the two sides still need to confirm the match reciprocally after the push.

R&D's efficiency is high, accounted over 50% time ratio of core processes, namely the ratio of the time's utilization is larger, and the allocation of resources is reasonable. The processes of crowdsourcing model have the advantage that R&D processes the self-organization and the relatively disordered states, which makes the knowledge resources to fully mix, increase degree of sharing technology and ideas, therefore, when there are enough outsourcees in the community, and the outsourcers put forward the demand plans with limited timing, high amount of rewards the crowdsourcing community often can respond quickly to give suitable solutions.

Filtering and adopting spend much time, as there are four steps: self-other evaluation among outsourcees, filtering and assessment based on algorithm by platform, outsourcing evaluation and adopting. The vote by outsourcees takes short and spends little, and eliminates invalid and malicious packages effectively. The assessment done by platform bases on complex algorithm, and takes a bit long.

In conclusion, the efficiency isn't as good as possible, which depends on outsourcers, outsourcees, platform and customers. Therefore optimization can be operated in each part, such as the presentation on platform, algorithm of evaluation, push service based big data and the publication of demand.

Thus we have put forward to some specific measures with strong directivity to further optimize the whole chain process of redundant time:

1. Concretely, we limit the frequency that the enterprises modify their demands so as to increase the efficiency and push the enterprises treat their demands carefully, and limit the time of the platform's auditing.
2. Second, we analyze the data through the EM algorithm, inserting the golden standard data or machine learning to recommend the outsourcees and outsourcers in the high digital hierarchy. And we automatically ignore the requests to access the system of the outsourcees with bad poor credit records to save time.
3. Use the muti-phase quality control algorithm to improve the rate of recognition of acceptable solutions, so as to increase the R&D's occupies.
4. We suggest the outsourcers to set the areas and space in the platforms to communicate the thoughts and knowledge. Meanwhile, they also need to raise the bonus and contract the deadline, or they can set the mechanism that the time of deadline would be negotiated between the two parties, and adopt the solutions by time to motivate the outsurcees to accelerate the steps of work.
5. At last, the enterprises would fully communicate with the manufacture business, or book them in advance to some degree by advance payment, which can be paid by the consumers online voluntarily.

6. Summary

Based on the above analysis, we found the GSPN model for studying the optimization problem in crowdsourcing model is very effective. We found the process still has a lot of links that can be targeted to optimize in order to improve the core process— R&D and customization's ratio. We suggest that the outsourcers standardize the requirements, give a detailed demand question, and reduce probability of reworking. At the same time, adjusting the margin to an appropriate level, can not only increase the malicious cost of both sides, and can also maximize to attract the outsourcees. In addition, the optimization method of personalized recommendation, can deliver each other more accurately reciprocally, such as taking the method of Ambati to utilize users' browse records, to construct preference model to recommend their interested task. Appropriate and accurate push will make the outsourcees more satisfied, so as to achieve incentive of attracting outsourcees with high quality back, to improve quality of crowdsourcing platform.

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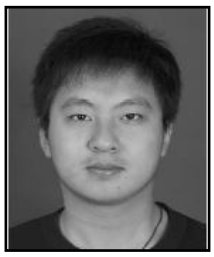

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