CSCanada
Management Science and Engineering
Vol. 10, No. 4, 2016, pp. 1-7
DOI:10.3968/9019

ISSN 1913-0341 [Print]
ISSN 1913-035X [Online]
www.cscanada.net
www.cscanada.org

Profit Allocation of E-Commerce Logistics Enterprise Alliance Based on Revised Shapely: Under the Circumstance of Warehouse Overload

ZENG Mingang[a],*; LIN Han[a]

[a]School of Management Administration, South China University of Technology, Guangzhou, China.
*Corresponding author.

Supported by Guangdong Software Science Foundation (2015A070704010, 2016A070705021); Fundamental Research Funds for the Central Universities (2015XZD19).

Received 2 October 2016; accepted 4 December 2016
Published online 26 December 2016

Abstract

This paper introduces the impact factor set, which includes input cost value, risk share coefficient, leadership in industry, market influence and the desire of participation, to revise the classic Shapley value, and use the revised Shapely value to research the profit allocation problem of an E-commerce logistics enterprise alliance under the circumstance of warehouse overload. A numerical example is presented to demonstrate the feasibility of the revised Shapely value. The result indicates that the revised Shapely value can objectively reflect the regulating effect of impact factors, show the differences between the core enterprise and general enterprises in an alliance, and promote the rationality and equity of alliance profit allocation.

Key words: E-commerce logistics enterprise alliance; Profit allocation; Shapely

Zeng, M. G., & Lin, H. (2016). Profit Allocation of E-Commerce Logistics Enterprise Alliance Based on Revised Shapely: Under the Circumstance of Warehouse Overload. *Management Science and Engineering*, *10*(4), 1-7. Available from: URL: http://www.cscanada.net/index.php/mse/article/view/9019
DOI: http://dx.doi.org/10.3968/9019

INTRODUCTION

With the rapid growth of cross-border E-commerce, the global online retail market is booming, which drives the expansion of the scale of E-commerce express delivery. In this case, warehouse overload has become a typical problem for many E-commerce logistics enterprises, especially in developing countries whose logistics infrastructure is still low-level. In order to face increasing competitive pressure, as well as environmental uncertainty, E-commerce logistics enterprises need to invest massively in technology, management, human resources and fixed assets. However, the ability of any single enterprise is always limited. The successful case of Fedex Trade Networks Services has demonstrated that, cooperation can effectively reduce corporate operation cost, improve the efficiency of resource allocation, and realize sustainable development. Thus, cooperation alliance becomes a necessary means to maintain competitive advantage and to deal with market risk for enterprises. In order to ensure the establishment and stabilization of the alliance, a reasonable profit allocation mechanism is key. However, there is little research regarding how to distribute profit in the E-commerce logistics enterprise alliance, especially under the circumstance of warehouse overload.

1. LITERATURE REVIEW

1.1 Profit Allocation of Logistics Alliance

Few scholars conduct research on the profit allocation of logistics enterprise alliance. For example, He and Guo (2005) applied the sealed-bid auction model to profit allocation problem of vertical logistics alliances. Wang and Feng (2008) considered the different statuses of members in a virtual logistics alliance and established the profit allocation mechanism based on Nash model. Wu (2009) set up a two-stage process model for the profit allocation of dynamic logistics alliances. Yan et al. (2010) presented a cooperation game model for the profit allocation problem of small and medium size logistics enterprise alliances, and took the influence of leading enterprise into account.

1.2 Classic Shapely Value

As a classic method to allocate alliance profit, scholars have done a lot of applied research on Shapely value. Krajewska and Kopfer (2008) discussed the profit allocation mechanism of horizontal cooperation among freight carriers and verified the feasibility of Shapely value. Liu et al. (2010) formulated the less-than-truckload collaboration game and allocated carrier-alliance profit using Proportional Allocation, Shapely value and Nucleolus respectively. Xue et al. (2014) applied the Shapely method to solve the game of air pollution control among Beijing, Tianjin and Hebei provinces in China. Wang et al. (2015) proposed a Shapely value model based on cooperative game theory to obtain the optimal profit allocation strategy among distribution centers.

1.3 Revised Shapely Value

Classic Shapely value distributes profit only based on participants' marginal contribution to the alliance respectively, which overlooks other impact factors' influences on the alliance profit allocation. In this case, scholars have tried a lot of methods to modify it. Medda (2007) considered that risk coefficient was a key factor which affected the alliance profit allocation. Shen et al. (2003) and Long et al. (2009) both considered the impact of discount factor. Hu et al. (2011) proposed a model which included investment ratio, risk share coefficient and the degree of contract completion to allocate profit between private and public sections in PPP projects. Xie and Dou (2012) introduced the desire of participants to improve the traditional Shapely value method and applied it to the low-carbon economy game. Liu and Wang (2013) analyzed the profit allocation in Technology Innovation Alliance game model of industrial chain and considered the technology innovation level as an impact factor.

Based on the aforementioned discussion, first, there is no discussion about how to use the Shapely method to solve the profit allocation problem of E-commerce logistics alliances, especially under the circumstance of warehouse overload. Second, former studies only consider the regulating effect of single impact factor, but neglect the synthetic effect of multi-factor. Third, some discussed impact factors should be subdivided and analyzed more carefully. Therefore, we propose an impact factor set to revise the classic Shapely value, and subsequently apply it to the profit allocation problem of an E-commerce logistics enterprise alliance under the circumstance of warehouse overload.

The remainder of the paper is organized as follows. In Section 2, we analyze impact factors which will influence the profit allocation of E-commerce logistics enterprise alliances, and then introduce how to measure these factors. In Section 3, we introduce the classic Shapely value first, and then establish the revised impact factor set to improve it. In Section 4, we establish a model of warehouse overload and a numerical example is presented to demonstrate the feasibility of the revised Shapely value.

2. IMPACT FACTORS OF PROFIT ALLOCATION IN E-COMMERCE LOGISTICS ENTERPRISE ALLIANCE

2.1 Impact Factors Analysis

2.1.1 Input Cost Value

To establish an alliance, E-commerce logistics enterprises need to invest in logistics infrastructure (e.g. warehouse facilities, transportation vehicles, intelligent terminals), information system (e.g. RFID, ERP, ITS), human resources (e.g. postmen, technicians, administrators) and so on. In accordance with Resource-Based View (RBV), heterogeneity of organizational resources results in the differentiation of competitive advantages directly (Zeng, Lü, & Wu, 2014). Likewise, the value of corporate input cost is closely related to the uniqueness and scarcity of its resources. Therefore, the profitability of different investments varies a lot accordingly. Ordinary and useless input cannot be the reason for receiving high expected profit. However, many former studies only consider the investment amount, but neglect the value (or quality) of it. In view of this, we consider the Input Cost Value as an impact factor that influences the alliance profit allocation greatly.

2.1.2 Risk Share Coefficient

No matter to cooperate with others or not, E-commerce logistics enterprises always face risks from external environments and themselves, such as freight security, service quality, capital turnover, change of policies and so on. On one hand, based on Utility Theory, an enterprise who takes more risks should get a vantage position in profit allocation accordingly. On the other hand, whether or not a member enterprise can prevent and handle risks effectively is significant to the stabilization and sustainability of the alliance. In view of this, we consider the risk share coefficient as a key factor that affects the final profit allocation.

2.1.3 Leadership in Industry

Former studies usually regarded the enterprise status as an integral factor when they revised the classic Shapely value (Wang & Feng, 2008; Yan, Zhao, & Luo, 2010) which is too macroscopic to measure. In view of this, based on the different objects of corporate influence, we subdivide the enterprise status into 2 facets, leadership in industry and market influence.

Leadership in industry shows the enterprise impact on other companies. In the E-commerce logistics industry, some enterprises may possess great leadership due to their corporate scale, distinctive resources, core competitiveness, and so forth. An enterprise with great leadership can take advantage of its own peculiarities to attract or persuade other common enterprises to follow its behavior, and push forward the alliance establishment. We deem that this particular ability of leading enterprises is mainly embodied in the decision-making authority during the negotiation of building an alliance. The greater leadership an enterprise possesses in the industry, the more contributions it makes to the establishment of the alliance. Considering this, the specific contributions of leading enterprises should also be reflected in the final profit allocation.

2.1.4 Market Influence

Market influence shows the enterprise impact on consumers. E-commerce logistics enterprises can get massive user data and feedback from express delivery, which is the only stage that has immediate contact with end consumers in the O2O chain. By integrating the obtained information effectively, the logistics alliance is able to understand the market trends, improve the service quality, and then further enlarge its market share. In view of this, user information actually becomes an invisible investment, which will be largely converted into a resource for the whole alliance during the collaboration. Based on the Attraction Model of Market Share (Bell, Keeney, & Little, 1975), enterprises with greater market influence can gain more user information and customer resources, as well as more power to promote the market share and profitability of the alliance. Therefore, we consider the corporate market influence as an invisible contribution to the alliance, which indeed affects the profit allocation.

2.1.5 The Desire of Participation

In order to meet different demands of delivery speed, freight security and other personalized requirements, each E-commerce logistics enterprise has a specific market positioning. Accordingly, for each enterprise, the desire of joining an alliance varies based on the corporate strategy. If joining the alliance brings great benefits to the enterprise, its desire of participation will advance in proportion. However, the bargaining power of an enterprise weakens along with the advance in the desire of participation (Long, Peng, & Iwamura, 2009). The reason is that, in order to build the alliance, enterprises with higher desire of participation have to transfer part of its allocated profits to other potential members whose desire is lower than the average level. Therefore, the desire of participation is inversely proportional to the profit allocated.

2.2 Impact Factor Measurement

2.2.1 Input Cost Value

In accordance with Resource-Based View (RBV), the value of different input cost varies a lot. Therefore, let n be the number of enterprises, $i \in [1, n]$. m_{input} denotes the number of different input costs. α_t denotes the value coefficient of input cost t, where. denotes the amount of input cost t that enterprise i invests. cv_i denotes the total input cost value of enterprise i. Thus,

$$cv_i = \sum_{t=1}^{m_{\text{input}}} \alpha_t c_{i,t} \quad (i = 1,2, \ldots, n) \ .$$

2.2.2 Risk Share Coefficient

Due to the different probabilities and consequences of risks, let m_{risk} be the number of different risks. r_k denotes the probability of risk k. w_k denotes the weight coefficient of risk k. $\beta_{i,k}$ denotes the share of enterprise i for risk k, where $\sum_{i=1}^{n} \beta_{i,k} = 1, (k = 1,2, \ldots, m_{\text{risk}})$. cr_i denotes the total risk share of enterprise i. Thus,

$$cr_i = \sum_{k=1}^{m_{\text{risk}}} \beta_{i,k} r_k w_k \,, (i = 1,2, \ldots, \mathrm{n}) \,.$$

Considering that risks are always uncertain and hard to quantify, it is suggested to use AHP-fuzzy comprehensive evaluation method to measure the parameters above (He, Wu, & Jiang, 2014).

2.2.3 Leadership in Industry

An enterprise's leadership in the industry is mainly embodied in the decision-making authority during the negotiation regarding building an alliance. In fact, potential members usually decide whether to build the alliance or not by voting. If the aggregate votes exceed a specific threshold value (e.g. 50%), the alliance is built. The greater leadership an enterprise possesses in the industry, the greater decision-making authority it commands.

Let D_i (i=1, 2…, n) denotes the decision-making authority for enterprise i, $\sum_{i=1}^{n} D_i = 1, 0 < D_i < 1$. where T denotes the decision point. When, $\sum_{i=1}^{n} D_i > T$ the alliance is built. Enterprise j (j=1, 2…, n) is the key enterprise if and only if, $\sum_{i=1}^{j-1} D_i \leq \mathrm{T}, \sum_{i=1}^{j-1} D_i + D_j > T$ q_i denotes the number of times that enterprise i becomes the key enterprise, where $\sum_{i=1}^{n} q_i = \mathrm{n}!$. Θ_i denotes the frequency that enterprise i becomes the key enterprise, thus $\Theta_i = \dfrac{q_i}{n!}$. The higher Θ_i indicates that enterprise i has greater decision-making authority in industry and makes more contributions to the establishment of alliance. Therefore, we use Θ_i to represent the leadership in industry.

2.2.4 Market Influence

From the view of marketing, market influence, which affects the trust and buying-behavior of consumers, is composed of corporate brand and reputation. According to the empirical study of Fombrum and Van Riel (2004), good brand image and reputation have significant impact on the corporate market share. Thus, we use the market share of an enterprise to measure its market influence. Let (i=1,2…,n) be the market share of enterprise i, where $0 \leq S_i \leq 1$.

2.2.5 The Desire of Participation

For an enterprise, its decision on whether joining an alliance or not is always driven by profit. Thus, we use the change rate of expected profit before and after the establishment of alliance to measure an enterprise's desire of participation.

Let E_i and E_i' denote the expected profit of enterprise i before and after the establishment of alliance respectively. $\frac{E_i' - E_i}{E_i}$ denotes the change rate. h_i denotes the desire of participation for enterprise i. Suppose that if joining the alliance has few or negative impact on expected profit, the enterprise has no desire to participate, thus $h_i = \max\left(\frac{E_i' - E_i}{E_i}, 0\right)$.

3. THE PROFIT ALLOCATION MODEL BASED ON REVISED SHAPELY VALUE

3.1 Classic Shapely Value

Shapely Method is a classic approach to solve the profit (or cost) allocation problem of n-person collaborative game. Let n denote the number of players. $N=\{1,2,\dots,n\}$ N denotes the set of all the players . A coalition is any subset $S \subset N$. The characteristic function $V(S)$ is the largest guaranteed payoff to the coalition S, where $V(\emptyset) = 0$ and $V(N) \geq \sum_{i=1}^{n} V(i)$.

Let x_i be a real number for each $i \in N$, which represents the share of the value of $V(N)$ received by player i. Then an allocation $X=(x_1,x_2,\dots,x_n)$ is called the Shapely value if

$$x_i = \sum_{\{s\in\Pi^i\}} [V(S) - V(S-i)] \frac{(|S|-1)!\,(|N|-|S|)!}{|N|!} \qquad (1)$$

where Π_i is the set of all coalitions $S \subset N$ containing i as a member. |S| and |N| denote the number of members in S and N respectively. Notice that Shapely value satisfies the individual rationality ($x_i \geq V(i)$), as well as group rationality ($\sum_{i=1}^{n} x_i = V(N)$)..

The classic Shapely method distributes profit based on the marginal contribution of alliance members respectively, which avoids equal distribution. However, this method supposes that each alliance member has the same impact level to the profit allocation, which can be expressed in probability $\frac{1}{n}$. In practice, corporate internal peculiarities and external market circumstances both have obvious influences to the profit allocation of alliances. Therefore, we need to revise the classic Shapely method to improve its rationality and equity.

3.2 The Revised Impact Factor Set

According to the analysis in chapter 2, we build the revised impact factor set as shown in Table 1, where denotes the value of impact factor j for enterprise i (i=1,2,…,n; j=1,2,..,5).

Table 1
The Revised Impact Factor Set of Profit Allocation

Impact Factor	Input cost value (cv_i)	Risk share coefficient(cr_i)	Leadership in industry (θ_i)	Market influence(s_i)	Desire of participation(h_i)
Enterprise 1	a_{11}	a_{12}	a_{13}	a_{14}	a_{15}
Enterprise 2	a_{21}	a_{22}	a_{23}	a_{24}	a_{25}
⋮	⋮	⋮	⋮	⋮	⋮
Enterprise n	a_{n1}	a_{n2}	a_{n3}	a_{n4}	a_{n5}

Then normalize the impact factor set. Let $b_{ij} = \frac{a_{ij}}{\sum_i^n a_{ij}}$ where. $\sum_i^n b_{ij} = 1$ denotes the revised impact factor matrix after normalization. Therefore,

$$B = \left(b_{ij}\right)_{n\times 5} = \begin{Bmatrix} b_{11} & b_{12} & b_{13} & b_{14} & b_{15} \\ b_{21} & b_{22} & b_{23} & b_{24} & b_{25} \\ \vdots & \vdots & \vdots & \vdots & \vdots \\ b_{n1} & b_{n2} & b_{n3} & b_{n4} & b_{n5} \end{Bmatrix}. \qquad (2)$$

3.3 Revised Shapely Value

Since the importance of different impact factors varies a lot, it is suggested to consult experts about the weight coefficient of them. Let φ_j denote the weight coefficient of impact factor j, where $0 \leq \varphi_j \leq 1$. Thus the weight vector . $\varphi = (\varphi_1, \varphi_2, \varphi_3, \varphi_4, -\varphi_5)^T$. Because the factor 5, desire of participation, has negative impact on the profit allocation, so the coefficient of φ_5 is minus. Let I denote the comprehensive impact coefficient vector:

$$I = (I_1, I_2, \cdots, I_n)^T = B \times \varphi\ . \qquad (3)$$

Therefore the revised Shapely value of enterprise i is

$$x_i'(V) = x_i(V) + \left(I_i - \frac{1}{n}\right) \times V(n), i \in [1, n]\,. \qquad (4)$$

The revised Shapely value considers the synthetic effect of different impact factors, and improves the equity, rationality and objectivity of profit allocation.

4. AN EXAMPLE OF PROFIT ALLOCATION UNDER THE CIRCUMSTANCE OF WAREHOUSE OVERLOAD

4.1 Model of Warehouse Overload

Let n be the number of E-commerce logistics enterprises who handle the warehouse overload problem together, and set N={1,2,⋯,n}. Q_i denotes the number of express parcels that enterprise i delivers. Q_i' denotes the maximum processing ability of enterprise $i, i \in N$. It is obvious that $Q_i > Q_i'$ when warehouse is overloaded. C_i denotes the unit express delivery cost of enterprise i. R_i denotes the unit express delivery risk of enterprise i. C_{Ri} denotes the unit express delivery failure cost of enterprise i. TC_i denotes the total cost of enterprise i.

Suppose that when $Q_i \leq Q_i'$, enterprise can insure the security and timeliness of express delivery, then R_i=0. Inversely, when $Q_i > Q_i'$, the number of express parcels exceeds the enterprise's maximum processing ability, where risks emerge and R_i>0. Therefore,

$$TC_i = c_i \cdot Q_i + (Q_i - Q_i') \cdot R_i \cdot C_{Ri} \,. \tag{5}$$

Similarly, let set $S \subseteq N$ and $S \neq \emptyset$. Then $Q_s = \sum_{i \in S} Q_i$ denotes the number of express parcels that alliance S delivers. $Q_s' = \sum_{i \in S} Q_i'$ denotes the maximum processing ability of alliance S. C_i denotes the unit express delivery cost of alliance S. R_S denotes the unit express delivery risk of alliance S. C_{RS} denotes the unit express delivery failure cost of alliance S. TC_S denotes the total cost of alliance S.

After the establishment of alliance, member enterprises can reduce logistics cost and avoid delivery risk by sharing customer information, scheduling logistics infrastructure as a whole, and optimizing distribution routes (Ergun, Kuyzu, & Savelsbergh, 2007). Therefore, $C_S \leq C_i, R_S \leq R_i, C_{RS} \leq C_{Ri}$, and

$$\begin{aligned} TC_S &= c_s \cdot Q_s + (Q_s - Q_s') \cdot R_S \cdot C_{RS} \\ &= C_S \cdot \sum_{i \in S} Q_i + \left(\sum_{i \in S} Q_i - \sum_{i \in S} Q_i' \right) \cdot R_S \cdot C_{RS} \,. \end{aligned} \tag{6}$$

4.2 Parameters Settings

Suppose that there are 3 E-commerce logistics enterprises which are the detailed settings of model parameters is shown in Table 2.

Table 2
Parameters Settings

Content	Parameter value	Unit
Unit express delivery cost	C^A=C_B=C_C=10,C_{AB}=C_{AC}=C_{BC}=8,C_{ABC}=6	RMB/unit
Amount of express parcels	Q_A=50000, Q_B=30000, Q_C=20000	Unit
Maximum processing ability	Q_A'=40000,Q_B'=20000 , Q_C'=10000	Unit
Unit express delivery risk	R_A=R_B=R_C=10%,R_{AB}=R_{AC}=R_{BC}=8%, R_{ABC}=5%	/
Unit express delivery failure cost	C_{Ra}=C_{Rb}=C_{Rc}=20,C_{RAB}=C_{RAC}=R_{RBC}=15,C_{RABC}=10	RMB/unit

By Formulas (5), (6), the computation results are shown in Table 3.

Table 3
Computation Results

Total cost/RMB	Overall cost of system/RMB
TC_A=520000, TC_B=320000, TC_C=220000	TC_A+TC_B+TC_C=1060000
TC_{AB}=664000	TC_{AB}+TC_C=884000
TC_{AC}=584000	TC_{AC}+TC_B=904000
TC_{BC}=424000	TC_{BC}+TC_A=944000
TC_{ABC}=615000	TC_{ABC}=615000

TC_{ABC}=615000 has the minimum overall cost of system, which equally means that enterprise A, B and C can get maximum extra profit by collaborating. Therefore, we use Shapely method to allocate the profit, in other words, the saved cost.

4.3 Profit Allocation Based on Classic Shapely Value

Let characteristic function V be the saved cost of alliance, then

$$V(\emptyset) = 0; V(A) = V(\mathrm{B}) = V(C) = 0$$
$$V(A \cup B) = TC_A + TC_B - TC_{AB} = 176000$$
$$V(A \cup C) = TC_A + TC_B - TC_{AC} = 156000$$
$$V(B \cup C) = TC_B + TC_C - TC_{BC} = 116000$$
$$V(A \cup B \cup C) = TC_A + TC_B + TC_C - TC_{ABC} = 445000$$

By Formula (1) we obtain: $x_A(V) = \frac{1}{3} \times 0 + \frac{1}{6} \times 176000 + \frac{1}{6} \times 156000 + \frac{1}{3} \times 329000 = 165000$. Similarly, x_B

(V)=145000, x_C (V)=135000. If we transform the Shapely values into the total cost respectively, we obtain:

Enterprise: TC_A-x_A (V)=520000-165000=355000
Enterprise: TC_B-x_B (V)=320000-145000=175000
Enterprise: TC_C-x_C (V)=220000-135000=85000

4.4 Profit Allocation Based on Revised Shapely Value

According to the expertise and enterprise investigation, the revised impact factor set B after normalization is shown in Table 4.

Table 4
Parameters Settings of Impact Factor Set

Impact factor	Input cost value (ce_i)	Risk share coefficient (cr_i)	Leadership in industry (θ_i)	Market influence (s_i)	Desire of participation (h_i)
Enterprise	39.1%	33.3%	66.6%	50.0%	20.0%
Enterprise	34.8%	33.3%	16.7%	30.0%	30.0%
Enterprise	26.1%	33.3%	16.7%	20.0%	50.0%

Similarly, the weight vector φ is:

$$\varphi=(0.50, 0.15, 0.15, 0.15, 0.05)^T.$$

By Formula (3), we obtain:

$$I = (I_A, I_B, I_C)^T = \begin{Bmatrix} 39.1\% & 33.3\% & 66.6\%50.0\% & 20.0\% \\ 34.8\% & 33.3\% & 16.7\%30.0\% & 30.0\% \\ 26.1\% & 33.3\% & 16.7\%20.0\% & 50.0\% \end{Bmatrix} \times \begin{pmatrix} 0.50 \\ 0.15 \\ 0.15 \\ 0.15 \\ 0.05 \end{pmatrix}$$

$$= (0.43, 0.31, 0.26)^T.$$

By Formula (4), we obtain:

$$x'_A(V) = x_A(V) + \left(I_A - \frac{1}{3}\right) \times V(n) = 165000 + \left(0.43 - \frac{1}{3}\right) \times 445000 = 208016.7.$$

Similarly x'_B (V)=134616.7, x'_C (V)=102366.6. If we transform the revised Shapely values into the total cost respectively, we obtain:

Enterprise :TC_A-x'_A (V)=520000-208016.7=311983.3
Enterprise :TC_B-x'_B (V)=320000-134616.7=185383.3
Enterprise :TC_C-x'_C (V)=220000-102366.6=117633.4

The contrast before and after the revision can be seen in Table 5. Enterprise has higher values in impact factors like input cost value, leadership in industry and market influence, which means it owns great discourse power and makes more contributions to the alliance. Therefore enterprise gains higher profit (saved cost) accordingly. Inversely, enterprise B and C, with lower negotiation ability, are on common status in the alliance, thus their revised Shapely values are lower than classic ones. In general, the revised Shapely value truly reflects the predominant and pivotal effect of core enterprises during the operation of alliance, and improves the equity and rationality of traditional profit allocation.

Table 5
Contrast Before and After the Revision

Enterprise	Classic shapely value	Revised shapely value	Total cost before revise	Total cost after revise
A	165000.0	208016.7	355000.0	311983.3
B	145000.0	134616.7	175000.0	185383.3
C	135000.0	102366.6	85000.0	117633.4

CONCLUSION

Even though many E-commerce logistics enterprises have made great progress, the present logistics infrastructure and information level cannot fully adapt to the fast development of E-commerce. Therefore, win-win collaboration becomes an important approach for E-commerce logistics enterprises to face short-term challenges and achieve long-term development. However, whether it can realize effective collaboration or not depends on a reasonable and equitable profit allocation. This paper revises the classic Shapely value from aspects of input cost value, risk share coefficient, leadership in the industry, market influence and the desire of participation, and demonstrates the feasibility of revised Shapely value through a numerical example of warehouse overload. The result indicates that the revised Shapely value can reflect the regulating effect of different impact factors, show the difference between the core enterprise and other common members in the alliance, and improve the equity and rationality of profit allocation.

REFERENCES

Bell, D. E., Keeney, R. L., & Little, J. D. C. (1975). A market share theorem. *Journal of Marketing Research, 12*(2), 136-141.

Ergun, Ö., Kuyzu, G., & Savelsbergh, M. (2007). Shipper collaboration. *Computers & Operations Research, 34*(6), 1551-1560.

Fombrun, C. J., & Van Riel, C. B. M. (2004). *Fame and fortune: How successful companies build winning reputations*. New Jersey: Prentice Hall.

He, S. Y., & Guo, X. L. (2005). The benefits allocation of logistics alliance under the coalition of multi-provider. *China Business and Market*, (5), 12-14.

He, X. J., Wu, Y. Y., & Jiang, G. R. (2014). Profit allocation model of supply network based on revised Shapely. *Soft Science, 28*(2), 70-73.

Hu, L., Zhang, W. G., & Ye, X. S. (2011). Profit allocation of PPP model based on the revised shapely. *Journal of Industrial Engineering and Engineering Management*, (2), 149-153.

Krajewska, M., & Kopfer, H. (2008). Horizontal cooperation among freight carriers: Request allocation and profit sharing. *Journal of the Operational Research Society*, (59), 1483-1491.

Liu, P., Wu, Y. H., & Xu, N. (2010). Allocating collaborative profit in less-than-truckload carrier alliance. *Journal of Service Science and Management, 3*(1), 143-149.

Liu, Z. Y., & Wang, D. D. (2013). Analysis of profit allocation in technology innovation alliance game model of industrial chain. *Canadian Social Science, 9*(2), 62-67.

Long, W., Peng, J., & Iwamura, K. (2009). Uncertain equilibrium analysis on profits distribution between partner firms in competitive strategic alliances. *Soft Computing, 13,* 203-208.

Medda, F. (2007). A game theory approach for the allocation of risk in transport public private partnerships. *International Journal of Project Management, 25*(3), 213-218.

Shen, Y. Z., & Wang, H. L. (2003). Interest allocation model of unequal alliance under uncertain environment. *China Soft Science*, (1), 135-137.

Wang, R. G., & Feng, Y. J. (2008). Research on profit distribution of virtual alliance. *Control and Decision, 23*(10), 1087-1091.

Wang, Y., Ma, X. L., Xu, M. Z., Wang, L. K., Wang, Y. J., & Liu, Y. (2015). Methodology to exploit profit allocation in logistics joint distribution network optimization. *Mathematical Problems in Engineering*, 1-15.

Wu, L. (2009). The method of prodit alloction of dynamic logistics alliance under the mode of product share contract. *System Engineering, 27*(5), 25-29.

Xie, J. J., & Dou, X. S. (2012). The income distribution problems in the low-carbon economy game: An application of Shapely value method. *Soft Science, 26*(12), 69-73.

Xue, J., Xie, W. L., & Li, C. M. (2014). Inter-provincial cooperative game model of Beijing, Tianjin and Hebei province air pollution control. *Systems Engineering-Theory & Practice, 34*(3), 810-816.

Yan, L., Zhao, Y. P., & Luo, J. Q. (2010). Cooperation game method for profit distribution in small-and-medium-size logistics enterprise alliance. *Industry Engineering Journal, 13*(5), 45-47.

Zeng, M. G., Lü, S. B., & Wu, Q. Q. (2014). Research on the relationship of government support, trust and supply chain integration. *Chinese Journal of Management Science, 22*(12), 48-55.

