

# The Formation of the Quick Response Capability Assessment Index System of Logistics Companies

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**Abstract.** To assess logistics quick response capability in a right way is basically helpful to bring competitive edges for a logistics company. After reliability analysis, factor analysis, and validity analysis conducted on the collected questionnaires, this paper formed a logistics quick response capability assessment index system, a 2-level hierarchy structure, composed of 7 secondary indexes and 41 tertiary indexes. The assessment system can be applied to evaluate quick response capability of logistics companies.

**Keywords:** logistics company; quick response; assessment

## 1. Introduction

Time-based competition requires companies to adapt to its environment effectively and efficiently. Quick Response (QR), a strategy proposed by Kurt Salmon Associates in USA to strengthen the competitive advantages of the American Apparel Manufacturers Association in the 20<sup>th</sup> century, has been applied widely in the manufacturing industry over the past two decades. QR can be an effective approach for the creation of more lean and efficient supply chains. QR has been unanimously applied in the domain of logistics, and successful logistics companies like FedEx, UPS and DHL take quick response as an effective strategy to improve relative competitive advantages.

It is helpful to assess quick response capability, improve logistics service, and increase competitive edges for a logistics company by forming a quick response capability assessment index system. A number of authors[3][4][5][6] has done some researches on this, but has not concluded an integrated and normalized assessment index system. Junbo Li[7][8], Gao Yang and David Ambaye[7] studied the first layer assessment indexes to evaluate logistics quick response capability, which has been testified to be reliable and reasonable. Based on this, this paper presumes a hierarchy assessment system of 7 secondary indexes  $C_i$  and 62 tertiary indexes  $C_{ij}$  as summarized in table 1. The 7 secondary indexes are  $C_1$  = customer service,  $C_2$  = time management,  $C_3$ =logistics cost,  $C_4$ = information system,  $C_5$ = logistics hardware,  $C_6$  = coordination control,  $C_7$  = staff quality, and the content of each individual  $C_{ij}$  is not described at this moment.  $C_1$  has 13 tertiary indexes labeled as  $C_{11}$ ,  $C_{12}$ ,  $C_{13}$ ,  $C_{14}$ ,  $C_{15}$ ,  $C_{16}$ ,  $C_{17}$ ,  $C_{18}$ ,  $C_{19}$ ,  $C_{110}$ ,  $C_{111}$ ,  $C_{112}$ ,  $C_{113}$ ;  $C_2$  has 8 tertiary indexes labeled as  $C_{21}$ ,  $C_{22}$ ,  $C_{23}$ ,  $C_{24}$ ,  $C_{25}$ ,  $C_{26}$ ,  $C_{27}$ ,  $C_{28}$ ;  $C_3$  has 11 tertiary indexes labeled as  $C_{31}$ ,  $C_{32}$ ,  $C_{33}$ ,  $C_{34}$ ,  $C_{35}$ ,  $C_{36}$ ,  $C_{37}$ ,  $C_{38}$ ,  $C_{39}$ ,  $C_{310}$ ,  $C_{311}$ ;  $C_4$  has 10 tertiary indexes labeled as  $C_{41}$ ,  $C_{42}$ ,  $C_{43}$ ,  $C_{44}$ ,  $C_{45}$ ,  $C_{46}$ ,  $C_{47}$ ,  $C_{48}$ ,  $C_{49}$ ,  $C_{410}$ ;  $C_5$  has 6 tertiary indexes labeled as  $C_{51}$ ,  $C_{52}$ ,  $C_{53}$ ,  $C_{54}$ ,  $C_{55}$ ,  $C_{56}$ ;  $C_6$  has 7 tertiary indexes labeled as  $C_{61}$ ,  $C_{62}$ ,  $C_{63}$ ,  $C_{64}$ ,  $C_{65}$ ,  $C_{66}$ ,  $C_{67}$ ;  $C_7$  has 7 tertiary indexes labeled as  $C_{71}$ ,  $C_{72}$ ,  $C_{73}$ ,  $C_{74}$ ,  $C_{75}$ ,  $C_{76}$ ,  $C_{77}$ .

TABLE I. THE HIERARCHY ASSESSMENT INDEX SYSTEM

$C_i$	No.	$C_{ij}$	$C_i$	No.	$C_{ij}$	$C_i$	No.	$C_{ij}$
$C_1$	1	$C_{11}$	$C_3$	22	$C_{31}$	$C_5$	43	$C_{52}$
	2	$C_{12}$		23	$C_{32}$		44	$C_{52}$

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	3	C <sub>13</sub>		24	C <sub>33</sub>		45	C <sub>53</sub>
	4	C <sub>14</sub>		25	C <sub>34</sub>		46	C <sub>54</sub>
	5	C <sub>15</sub>		26	C <sub>35</sub>		47	C <sub>55</sub>
	6	C <sub>16</sub>		27	C <sub>36</sub>		48	C <sub>56</sub>
	7	C <sub>17</sub>		28	C <sub>37</sub>	C <sub>6</sub>	49	C <sub>61</sub>
	8	C <sub>18</sub>		29	C <sub>38</sub>		50	C <sub>62</sub>
	9	C <sub>19</sub>		30	C <sub>39</sub>		51	C <sub>63</sub>
	10	C <sub>110</sub>		31	C <sub>310</sub>		52	C <sub>64</sub>
	11	C <sub>111</sub>		32	C <sub>311</sub>		53	C <sub>65</sub>
	12	C <sub>112</sub>		33	C <sub>41</sub>		54	C <sub>66</sub>
	13	C <sub>113</sub>		34	C <sub>42</sub>		55	C <sub>67</sub>
C <sub>2</sub>	14	C <sub>21</sub>	C <sub>1</sub>	35	C <sub>43</sub>	C <sub>7</sub>	56	C <sub>71</sub>
	15	C <sub>22</sub>		36	C <sub>44</sub>		57	C <sub>72</sub>
	16	C <sub>23</sub>		37	C <sub>45</sub>		58	C <sub>73</sub>
	17	C <sub>24</sub>		38	C <sub>46</sub>		59	C <sub>74</sub>
	18	C <sub>25</sub>		39	C <sub>47</sub>		60	C <sub>75</sub>
	19	C <sub>26</sub>		40	C <sub>48</sub>		61	C <sub>76</sub>
	20	C <sub>27</sub>		41	C <sub>49</sub>		62	C <sub>77</sub>
	21	C <sub>28</sub>		42	C <sub>410</sub>		62 Tertiary indexes	

## 2. Quick Response Capability Assessment Index System Formation

### 2.1 The questionnaires

As it's not easy to get quantitative data, questionnaires are designed to collect from participants qualitative data regarding the "importance" of each individual tertiary index to logistics quick response capability. The "importance" of a tertiary index in the designed questionnaire is categorized into 9 grades from "critically important" to "critically unimportant". 152 Questionnaires were mailed to those who are doing management or technical work and have been working in logistics field for more than 2 years. 137 qualified answered questionnaires were collected, and can be used for SPSS analysis.

Most of the respondents are male, aging between 31 and 50, and have good understanding of logistics management and logistics quick response significance. Most of those who filled the questionnaires generally have undergraduate degrees, with 30% of whom graduated with master degrees.

### 2.2 The Analysis to the Assessment Index System

#### 1) The Reliability Analysis

We use Cronbach's alpha to measure the internal consistency of the assessment index system, that is to see, how closely related the set of items are as a group. A "high" value of alpha is often used as evidence that the items measure an underlying construct, which is the assessment index system. However, a high alpha does not imply that the measure is unidimensional. In addition to measuring internal consistency, we wish to provide evidence that the scale in question is unidimensional, additional factor (index) and validity analyses are to be performed. The reliability analysis of the questionnaire is summarized in table II.

TABLE II. THE VARIABLES RELIABILITY ANALYSIS

Variable	No. of Items	$\alpha$
C <sub>1</sub> : Customer Service	13	0.719
C <sub>2</sub> : Time Management	8	0.839
C <sub>3</sub> : Logistics Cost	11	0.713
C <sub>4</sub> : Information System	10	0.767
C <sub>5</sub> : Logistics Hardware	6	0.726
C <sub>6</sub> : Coordination Control	7	0.814
C <sub>7</sub> : Staff quality	7	0.907

All  $\alpha$  values in table II are bigger than 0.7, which certifies the internal consistency of the questionnaire, hence, the proposed assessment index system has good reliability.

#### 2) The Factor Analysis

Factor analysis is a statistical method used to describe variability among observed variables in terms of a potentially lower number of unobserved variables called factors. Factor analysis searches for such joint variations in response to unobserved latent variables. The observed variables are modeled as linear

combinations of the potential factors, plus "error" terms. The information gained about the interdependencies between observed variables can be used later to reduce the set of variables in a dataset.

TABLE III. THE QUESTIONNAIRE FACTOR ANALYSIS TEST

Variable	KMO	Bartlett	Correlation
C <sub>1</sub> : Customer Service	0.714	226.795	0.000
C <sub>2</sub> : Time Management	0.703	690.063	0.000
C <sub>3</sub> : Logistics Cost	0.701	707.698	0.000
C <sub>4</sub> : Information System	0.708	223.464	0.000
C <sub>5</sub> : Logistics Hardware	0.697	43.275	0.000
C <sub>6</sub> : Coordination Control	0.701	27.075	0.000
C <sub>7</sub> : Staff quality	0.726	33.075	0.000

a) *The Bartlett's Test:* The calculated KMO(Kaiser-Meyer-Olkin Measure of Sampling Adequacy) helps with the Barlett's test. KMO value varies between 0 and 1, and needs to be above 0.7 to allow further factor analysis. Table III summarized the KMO values of the Barlett's test to the variables, and certifies that they are good for factor analysis.

b) *principal component analysis:* In principal components analysis (PCA) and factor analysis (FA) we wish to extract from a set of  $p$  (*herein*  $p=62$ ) variables a reduced set of  $m$  components or factors that accounts for most of the variance in the  $p$  variables. In other words, we wish to reduce a set of  $p$  variables to a set of  $m$  underlying superordinate dimensions. The SPSS PCA analysis helps to identify a total of 41 tertiary indexes to determine logistics quick response capability assessment index system , which is shown in table IV.

TABLE IV. THE CONSTRUCTED QUICK RESPONSE CAPABILITY ASSESSMENT INDEX SYSTEM OF LOGISTICS COMPANIES

C <sub>1</sub>	C <sub>11</sub>	C <sub>2</sub>	C <sub>21</sub>	C <sub>3</sub>	C <sub>31</sub>
	C <sub>12</sub>		C <sub>22</sub>		C <sub>32</sub>
	C <sub>13</sub>		C <sub>23</sub>		C <sub>33</sub>
	C <sub>14</sub>		C <sub>24</sub>		C <sub>34</sub>
	C <sub>15</sub>		C <sub>25</sub>		C <sub>35</sub>
	C <sub>16</sub>		C <sub>26</sub>		C <sub>36</sub>
	C <sub>17</sub>				C <sub>37</sub>
	C <sub>18</sub>				
C <sub>6</sub>	C <sub>61</sub>	C <sub>4</sub>	C <sub>41</sub>	C <sub>5</sub>	C <sub>51</sub>
	C <sub>62</sub>		C <sub>42</sub>		C <sub>52</sub>
	C <sub>63</sub>		C <sub>43</sub>		C <sub>53</sub>
	C <sub>64</sub>		C <sub>44</sub>		C <sub>54</sub>
	C <sub>65</sub>		C <sub>45</sub>	C <sub>7</sub>	C <sub>71</sub>
		C <sub>46</sub>	C <sub>72</sub>		
		C <sub>47</sub>	C <sub>73</sub>		
				C <sub>74</sub>	

C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub>, C<sub>6</sub>, C<sub>7</sub> in table IV have unanimous meanings in this paper as in other tables, while C<sub>ij</sub> in table IV is not the same as they are in table I . The C<sub>ij</sub> in table IV are re-labeled as from C<sub>11</sub> to C<sub>74</sub> just for the convenience to construct the quick response capability assessment index system of logistics companies. The assessment system has 7 secondary index labeled as C<sub>1</sub>, C<sub>2</sub>, C<sub>3</sub>, C<sub>4</sub>, C<sub>5</sub>, C<sub>6</sub>, C<sub>7</sub>. Customer Service C<sub>1</sub> has 8 tertiary indexes: C<sub>11</sub>=Document Accuracy, C<sub>12</sub> = Customer Complaint Rate, C<sub>13</sub> =Occasional Logistics Service Capability, C<sub>14</sub>=Customized Logistics Service Types, C<sub>15</sub>=Order Fulfillment Rate, C<sub>16</sub>=Customer Conservation Rate, C<sub>17</sub>=Goods Lost/Brokerage Rate, C<sub>18</sub>=JIT Delivery Rate; Time Management C<sub>2</sub> has 6 tertiary indexes: C<sub>21</sub>=Transportation Time, C<sub>22</sub>=Distribution Time, C<sub>23</sub>=Order Processing Time, C<sub>24</sub>=Sitework Deliverytime, C<sub>25</sub>=Customer Demands Response Time, C<sub>26</sub>=Planning Time; Logistics Cost C<sub>3</sub> has 7 tertiary indexes: C<sub>31</sub>=Logistics Management Cost, C<sub>32</sub>=Information Processing Cost, C<sub>33</sub>=Inventory Management Cost, C<sub>34</sub>=Distribution Cost, C<sub>35</sub>=Transportation Cost, C<sub>36</sub>=Distribution Processing Cost, C<sub>37</sub>=Warehousing Cost; Information System C<sub>4</sub> has 7 tertiary indexes: C<sub>41</sub>=Expansibility, C<sub>42</sub>=Openness, C<sub>43</sub>=Reliability, C<sub>44</sub>=Cooperativity, C<sub>45</sub>=Maintainability, C<sub>46</sub>=Networking, C<sub>47</sub>=Applicability; Logistics Hardware C<sub>5</sub> has 4 tertiary indexes: C<sub>51</sub>=Logistics Infrastructure, C<sub>52</sub>=Transportation Infrastructure, C<sub>53</sub>=Networking Communication Facilities, C<sub>54</sub>=Modern Logistics Facilities; Coordination Control C<sub>6</sub> has 5 tertiary indexes: C<sub>61</sub>=External Coordination, C<sub>62</sub>=Internal Coordination, C<sub>63</sub>=Information Visibility, C<sub>64</sub>=Coordination Management, C<sub>65</sub>=JIT Information Delivery; Staff Quality C<sub>7</sub> has 4 tertiary indexes: C<sub>71</sub>=Operation Normative, C<sub>72</sub>=Knowledge Capability, C<sub>73</sub>=Organizational Culture, C<sub>74</sub>=Responsibility.

c) *Validity Analysis*: Content Validity is based on the extent to which a measurement reflects the specific intended domain of content. It's sometimes called logical or rational validity, and is the estimate of how much a measure represents every single element of a construct.

TABLE V. THE INDEX COORELATION COEFFICIENTOF THE ASSESSMENT SYSTEM

$C_i$	$C_{ij}$	No.	r(Pearson)	r(Spearman)
$C_1$	$C_{11}$	1	0.504	0.507
	$C_{12}$	2	0.550	0.539
	$C_{13}$	3	0.525	0.512
	$C_{14}$	4	0.510	0.507
	$C_{15}$	5	0.574	0.536
	$C_{16}$	6	0.534	0.522
	$C_{17}$	7	0.585	0.593
	$C_{18}$	8	0.507	0.507
$C_2$	$C_{21}$	9	0.523	0.501
	$C_{22}$	10	0.561	0.589
	$C_{23}$	11	0.507	0.512
	$C_{24}$	12	0.556	0.546
	$C_{25}$	13	0.540	0.500
	$C_{26}$	14	0.552	0.537
	$C_{31}$	15	0.502	0.725
$C_3$	$C_{32}$	16	0.636	0.628
	$C_{33}$	17	0.756	0.689
	$C_{34}$	18	0.703	0.692
	$C_{35}$	19	0.519	0.747
	$C_{36}$	20	0.864	0.813
	$C_{37}$	21	0.856	0.825
	$C_{41}$	22	0.728	0.698
$C_4$	$C_{42}$	23	0.790	0.790
	$C_{43}$	24	0.763	0.737
	$C_{44}$	25	0.521	0.517
	$C_{45}$	26	0.700	0.647
	$C_{46}$	27	0.662	0.586
	$C_{47}$	28	0.812	0.836
	$C_{51}$	29	0.653	0.635
$C_5$	$C_{52}$	30	0.584	0.559
	$C_{53}$	31	0.504	0.491
	$C_{54}$	32	0.552	0.507
	$C_{61}$	33	0.503	0.513
$C_6$	$C_{62}$	34	0.504	0.509
	$C_{63}$	35	0.587	0.556
	$C_{64}$	36	0.527	0.526
	$C_{65}$	37	0.544	0.536
	$C_{71}$	38	0.544	0.553
$C_7$	$C_{72}$	39	0.529	0.546
	$C_{73}$	40	0.612	0.563
	$C_{74}$	41	0.626	0.626

In order to provide information on the content validity, Pearson correlations coefficient and Spearman correlations coefficient were calculated by SPSS, which are summarized in table V. Each of the coefficients is bigger than 0.5, demonstrating that the constructed logistics quick response capability assessment index system is valid.

### 3. Conclusions

Logistics quick response has been widely applied in logistics field. To correctly construct a logistics quick response capability assessment index system is helpful to improve logistics service, and increase competitive edges for a logistics company. Based on the statistical study on the proposed assessment index system, we constructed a reliable and valid logistics quick response capability assessment index system, which is composed of 7 secondary indexes and 41 tertiary indexes.

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study needs to be done to construct a mathematical model on this assessment index system to calculate logistics quick response capability for any specific logistics company to provide information for performance improvements.

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