MIT SCALE RESEARCH REPORT

The MIT Global Supply Chain and Logistics Excellence (SCALE) Network is an international alliance of leading-edge research and education centers, dedicated to the development and dissemination of global innovation in supply chain and logistics.

The Global SCALE Network allows faculty, researchers, students, and affiliated companies from all six centers around the world to pool their expertise and collaborate on projects that will create supply chain and logistics innovations with global applications.

This reprint is intended to communicate research results of innovative supply chain research completed by faculty, researchers, and students of the Global SCALE Network, thereby contributing to the greater public knowledge about supply chains.

For more information, contact
MIT Global SCALE Network

Postal Address:
Massachusetts Institute of Technology 77
Massachusetts Avenue, Cambridge, MA 02139 (USA)

Location:
Building E40, Room 267
1 Amherst St.

Access:
Telephone: +1 617-253-5320
Fax: +1 617-253-4560

Email: *scale@mit.edu*
Website: *scale.mit.edu*

Research Report: MISI-2013-12
Assessment Model for Outsourced Pick-Up and Delivery Operations
Robin Kumar Thakur

For full thesis version please contact:

Professor Shardul Phadnis
Director of Research
MISI
No. 2A, Persiaran Tebar Layar, Seksyen
U8, Bukit Jelutong, Shah Alam,
40150 Selangor, Malaysia.
Phone: +6 03 7841 4845
Email: sphadnis@misi.edu.my

Assessment Model for Outsourced Pick-Up and Delivery Operations

By Robin Kumar Thakur
Thesis Advisor: Dr. John Park

Summary: ABC EXPRESS is operating its courier service through outsourced Pick-Up and Delivery (PUD) service providers. Due to variability in PUD operations, the challenge is to design a transparent and effective platform for evaluation of PUD service providers. A balanced scorecard model is proposed for comprehensive evaluation of service providers while eliminating the variability present in the system.

Key Insights:

1) **It is recommended to use a limited set of KPIs to better measure and manage the performance.**
2) **It is also recommended that best possible use of the existing system and processes be made to create a performance management system.**
3) **In order to measure the performance across different routes with different customer density, route productivity (speed * stops made per hour), instead of stops made per hour or speed, is an effective and unbiased indicator of the performance.**

Introduction

In order to carry out day to day pick-up and delivery operations, ABC EXPRESS has employed two types of service providers. They are known as Owner Operators Contractors (OCC) and Contractors. Owner operator contractors are the ones who own the vehicle meant for pick-up and delivery and carry out the pick-up and delivery operations as instructed by ABC EXPRESS. On the other hand, contractors are the ones who do not own any vehicles, but carry out pick-up and delivery operations as per the instruction on ABC EXPRESS provided vehicles. Currently there are eight owner operators working only for the ABC EXPRESS Shah Alam facility and nine contractors providing services all over Malaysia. Some deliveries are carried out on priority basis since customer has paid special premium for such shipments. Owner Operators Contractors operate on full routes (i.e., perform a full day's work from morning to evening and a fixed route is assigned to them).

In order to measure the performance of facility, ABC EXPRESS is using a performance matrix based on balanced scorecard. But there is no system present to measure the performance of service providers. At facility level, the matrix has two

broad categories – productivity KPIs and quality of service KPIs.

a) Productivity KPIs: Number of Stops per hour during PUD operations defines the productivity of the facility

b) Quality of service KPIs: Following are a few KPIs which are used in order to measure the quality of service:

1) Delivery by morning
2) Delivery by end of day
3) Miscode shipment
4) Miss pick-up.
5) Delivery exceptions process.
6) Data return timeliness.

ABC Express is facing the problem of understanding the performance of various service providers against the productivity and quality of service. When it comes to comparing two OCCs, it is difficult to compare their performances because route profiles create natural advantage or disadvantage. For example, high customer density on a particular route provides a natural advantage to the OCC operating on that route because it has to travel less per delivery than its counterparts who are working on average customer density routes. The current system cannot draw a fair comparison in presence of such biases. This thesis work has designed a transparent, effective, and efficient performance management system for managing the performance of service providers

Analysis

Correlation is calculated between important parameters and following observations are made:

(a) Speed and stops made per hour: Correlation is -0.43733.

(b) Pick-up error rate and number of stops made per hour: Correlation is -0.36491.

(c) For all the routes, the delivery responsiveness is negatively correlated with the pick-up error rate.

Interpretation of Results

a) The negative correlation between speed and stops made per hour can be defined by the fact of different customer PUD locations of a route on a particular day. If the PUD locations for an OOC are close, despite of the average OOC efficiency, a high number of stops made per hour could be achieved; although the speed would be low since the courier would be busy in PUD activity most of the time. On the other hand, if the customer PUD locations are far from each other, the OOC would not be able to attain decent stops made per hour value; but would have a higher speed value since most of the time OOC would be on ride, provided that the traffic for each routes is the same.

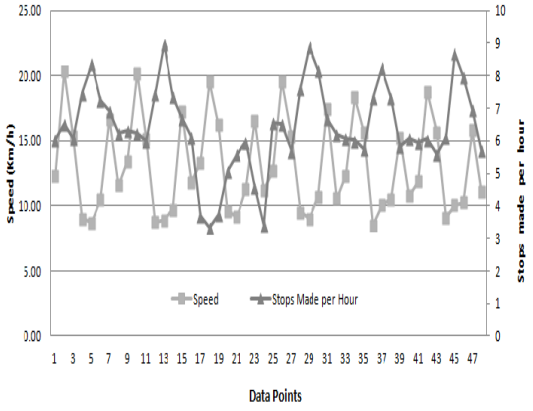

Figure 1 Graph Stops Made per Hour vs Speed

Further an investigation of the graph, Figure 1, between two parameters also establishes the same fact. Whenever the speed of an OOC is low, the stops made per hour is high and vice versa.

b) Correlation between pick-up error rate and stops made per hour is -0.36491. The graphical plot of the parameters is shown in Figure 2 which also

illustrates the negative correlation. This behavior can be explained by the rotation of job done by a PUD driver. In a way, the above mentioned correlation establishes the fact that as speed increases the pick-up error rate will go down. This can be explained as the speed of the vehicle goes up, which means the customer locations are far from one another, hence the PUD driver has sometime in between before making the next pick-up. This rotation of jobs, i.e. pick-up and driving, allows driver to take-up each new pick-up with a fresh state of mind and hence reduces the error rate

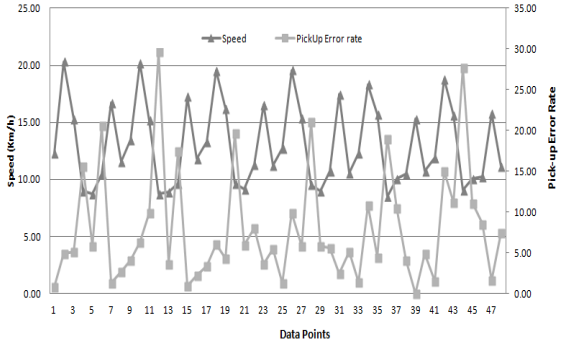

Figure 2 Pick-up Error Rate vs Speed

c) The correlation between pick-up error rate and delivery responsiveness is found consistently negative for all the routes. This correlation is very loosely visible in Figure 3.

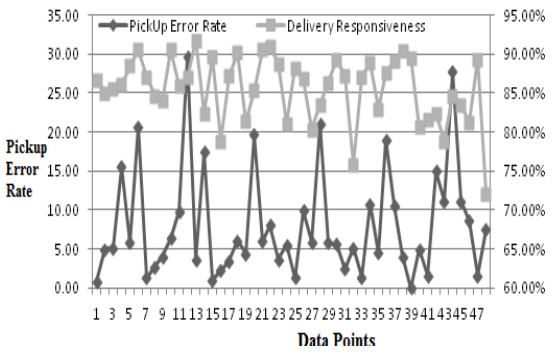

Figure 3 Pick-up Error Rate vs Delivery Responsiveness

But the negative nature of it can be explained by the fact that as the delivery responsiveness increases, which means percentage of deliveries made before noon increases, implies that most of the pick-ups are performed during the afternoon along with a very small percentage of deliveries. Hence higher delivery responsiveness leverages more time per PUD in the afternoon session. So, better delivery responsiveness allows for better pick-up accuracy.

Based on the actual data, derived data and inferences that we have made above, a performance model is proposed in next section.

Proposed Performance Model

According to literature, it is advisable to use the same type of performance model for measuring the facility performance and also the performance of the service providers. This will help align two set of objectives and keep service providers' interest aligned with the objectives of facility. Since facility performance is measured by using a balanced scorecard system, it is the first choice to implement this performance management system for measuring the service provider's performance. Also the balanced scorecard provides comprehensive view of business performance from four perspectives: financial perspective, internal business perspective, customer perspective, and finally innovation and learning perspective. Given the nature of courier industry where customer focus is paramount, process excellence is necessity and the learning ability helps to keep a firm ahead of others, balanced scorecard, which thoroughly focuses on system performance with respect to these parameters, is most suitable choice in current context. In this work, balanced scorecard framework is adopted and defined on three of the four perspectives. The fourth perspective – financial perspective (i.e., impact on ABC Express's

financials due to service provider performance) – is not in the scope of this work. The model focuses on the logistics part of the service. Also as suggested by Neely et al. (1994)[1], it is important to leverage the existing performance management system, which in this case is Balanced Scorecard.

The proposed model is based on the balanced scorecard framework. The weight assignment is as per the importance of various perspectives in courier industry.

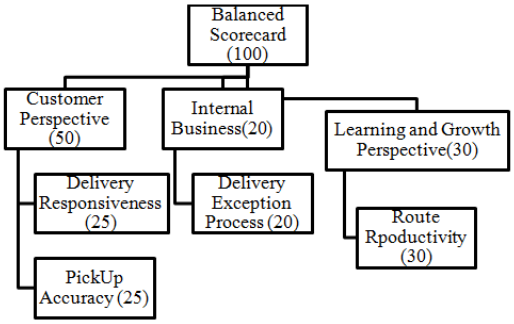

Figure 4 Proposed Performance Model

Working of the Model

Model is a robust and interactive one. It not only considers individual performances for the rating of a service provider but also undertakes its relative performance with other service providers and also with its own past performance. Hence, there are different ways this model can be used:

a) Stand-alone: In this performance index, we calculate the performance of an OCC in a stand-alone environment, without considering its relative standing against other OCCs or comparing this with its past performances. In this type, the performance index is calculated as:

Performance Index$_1$ = W_1 * a_1 + W_2 * (1- a_2) + W_3 * (1- a_3) + W_4 * a_4 / K

Where

a_1 = Delivery responsiveness value for the service provider

a_2 = Pick-Up error Rate per 100 pick-ups

a_3 = Delivery Exception Process Rate (%)

a_4 = Route Productivity

= Speed * Stops made per hour, Or

K, whichever is lower

K = Upper acceptable limit of productivity

W_1 = Weight for Delivery Responsiveness

W_2 = Weight for Pick-up Accuracy

W_3 = Weight for Delivery Exception Process

W_4 = Weight for Route Productivity

b) Relative Performance with respect to other service providers: In this case the relative performance of each service provider is calculated. Following is a formula for performance index calculation of j^{th} OOC.

Performance Index$_2$ = a_j + b_j+ c_j + d_j

Where

(i) a_j = W_a * NormDist (A_j, Mean(A), SD(A),1)

Where A_j = Actual performance of delivery responsiveness of j^{th} OOC; W_a = Weight assigned to parameter; A = {A_1, A_2….A_n} where n = number of OOCs

(ii) bj = W_b–W_b*Normdist (B_j, Mean(B), SD(B),1)

Where B_j = Actual Pick-up error Rate of j^{th} OOC; W_b=Weight Assigned to Pick-up; Accuracy Rate B = {B_1, B_2….B_n) where n = number of OOCs

[1] Neely, A., Mills, J., Platts, K., Gregory, M. and Richards, H. (1994), "Mapping measures and activities: a practical tool for assessing measurement systems", Proceedings of the 1st International Conference of the European Operations Management Association, Manufacturing Engineering Group, University of Cambridge, Cambridge, pp. 313-18.

(iii) $c_j = W_c - W_c$ * NormDist (C_j, Mean(C), SD(C),1)

Where C_j = Actual Delivery Exception Process Rate of j^{th} OOC; W_c = Weight Assigned to parameter for Delivery Exception Process; $C = \{C_1, C_2 \ldots C_n\}$ where n = number of OOCs.

(iv) $d_j = W_d$ * Norm Dist (D_j, Mean(D), SD(D), 1)

Where D_j = Actual Performance on Route Productivity by j^{th} OOC; W_d = Weight Assigned to parameter; $D = \{D_1, D_2 \ldots D_n\}$; n = number of OOCs

c) Relative Performance with respect to past performance: In this case the relative performance of a service provider is calculated with respect to its own history of past three months. Considering more than three months may cause the actual immediate past performance to dilute against longer history and hence will not represent a good reflection of progressive improvement. The calculations will be done exactly the same way as it is done in previous case except the fact that instead of considering other OOC's performance, self performance over past three months would be considered.

Conclusion

This study is instrumental in understanding the PUD operations from a Vendor Management Perspective. In order to yield better results, a performance management system has to be unbiased and competitive in nature. In this case, the proposed system offers an unbiased setup by replacing the stops made per hour KPI with an unbiased KPI known as route productivity (i.e., stops made per hour * speed). The system also ensures the competitive environment by considering relative performance and historic performances for overall assessment. The suggested system is also practical from implementation point of view because it makes use of the existing system to capture data and align itself with the overall performance management system. Moreover, in order to align the interests of the OOCs with ABC EXPRESS, various other decisions related to penalties, incentives, contract extension and termination should also be based on the outcome of proposed PMS.

As a matter of future scope, one can consider to evaluate performance of PUD operators in different traffic profile regions. The idea would be to eliminate the bias created by the traffic profile. Creating a general traffic profile of each route and then using these profiles for evaluation could be one idea but this would not be dealing with the actual traffic conditions of the day. Thus, a more robust idea would be a dynamic one which can understand the traffic conditions on per day basis and hence eliminate the bias (i.e., advantage or disadvantage it has presented to some PUD operators). Other scope of study could be one where one has to build a PMS from scratch (i.e., if there is no PMS existent in the organization and no data is captured for the purpose). In such a situation, which particular PMS may deliver the best results?