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Study on the Delivery Area Optimization and Management

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Abstract: This study aims to introduce a method for better configuration of delivery area so as to increase the delivery efficiency at lower cost. Key delivery performance indicators are introduced. Objectives and expected outputs of Delivery Area Optimization and Management (DAOM) are analysed. Then the paper goes in detail to the four main steps of DAOM. Successful implementation of this process and usage of effective tools for ongoing management would bring benefits to corporate with respect to service quality and competitiveness.

Key words: Delivery, delivery area, optimization, efficiency, design

INTRODUCTION

Customer satisfaction is primary for all corporate. To achieve that, corporate must make all efforts to improve their service quality and efficiency. In all aspects of customer service, on-time delivery is very critical (Rutner *et al*., 2003). Good delivery performance means on-time delivery at the lowest possible cost. The major contributor to good delivery performance is the predetermined delivery area design.

There are many drawbacks in delivery area designing and managing at present (Qing *et al*., 2004):

- Inadequate monitoring of delivery activities
- No defined productivity targets at delivery area level
- Poorly specified delivery area design techniques
- Inflexible delivery area structures, unable to efficiently cope with large variations of volumes
- No effective tools available to manage delivery area performance
- No capacity calculations or staffing requirement models
- Significant inconsistencies in the planning, content and implementation of "check-rides" program

From the above analysis, we could come to the conclusion that lack of effective tools or guidelines make it difficult for supervisors to design and manage their delivery areas (Taniguchi and Thompson, 2002). They are forced to rely on their knowledge of the area, intuition and courier feedback. Increasing volumes and competitor pressure are calling for a better method for the delivery area management.

Delivery Area Optimization and Management (DAOM) is the process to ensure well-proportioned delivery areas are established and managed on a continuous basis. DAOM aims to increase delivery area productivity, i.e. to maximize the number of delivery points for a given level of resources. The approach to achieve this goal is by optimizing the number of delivery areas required to reach a predefined service goal.

SOME DEFINITIONS AND PRODUCTIVITY INDICATORS

Definitions:

- **Point:** A Point is defined as "an individual visit to a customer" (Fisher, 2002). A courier's capacity is defined by the number of points a courier is required to perform rather than the total number of shipments, total pieces or shipments per point
- **Cycle:** A Cycle is defined as each period away from the Service Center. This is to simplify data collection and minimize the complexity of delivery area construction

Figure 1 provides a simple illustration of one cycle.

- **Time:** The Outside Time contains the total time required to complete a cycle

The Delivery Time is the effective productive time period in which the courier is able to deliver shipments.

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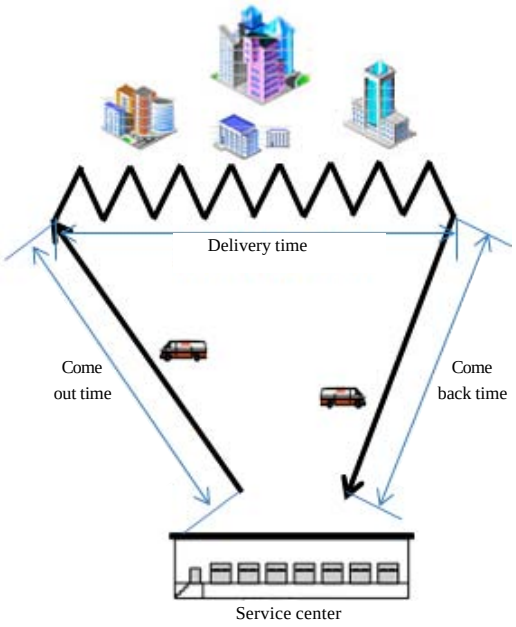

Fig. 1: A simple cycle

Come Out Time and Come Back Time directly impact the Delivery Time and hence on productivity. The key lies in the selection of the most optimized way to the first customer and from the last customer. Besides, the Service Center's location and traffic patterns also have impact on them.

Other Activities Time is the time taken for other activities (such as: refueling, traffic jam, brakes).

The basic calculations are expressed as Eq. 1-4.

$$\text{Come out time} = \text{first point time-depart from Service Center time} \quad (1)$$

$$\text{Come back time} = \text{arrive at Service Center time-ast point time} \quad (2)$$

$$\text{Delivery Time} = \text{last point time-first point time} \quad (3)$$

$$\text{Outside time} = \text{Come out time+delivery time+come back time} = \text{total cycle time} \quad (4)$$

Productivity indicators:

- **Points per outside hour (PPOH):** One important productivity indicator is PPOH which reflects rate of work over complete cycle. PPOH is a very powerful productivity indicator as it includes all the delivery area's characteristics (Son and Kim, 2001): Come Out Time, Come Back Time, the delivery area density, the time lost between customers (traffic, parking, etc.), the time spent at each customer and number of customers, the customers profile (business, private), the volume profile (flyers, parcels, etc.), lunch breaks (on delivery area), meeting times with sweepers and other activities

PPOH may be expressed as Eq. 5:

$$\text{PPOH} = \frac{\text{Total points}}{\text{Outside hour}} = \frac{\text{Total points}}{\text{Arrival time-departure time}} \quad (5)$$

- **Points per delivery hour (PPDH):** The PPDH indicates the actual rate of work during deliveries. PPDH is widely used in the construction phase of delivery area for estimating how many points could be achieved for a given productive time (Delivery Time). It differs for each delivery area and cycle for it considers several aspects in each area such as traffic, point density, parking, volume, etc.

One important thing is to screen out Other Activities during the Delivery Time wherever possible to get the true rate of work and remove inefficiencies from the new delivery area configuration.

PPDH may be expressed as Eq. 6:

$$\text{PPDH} = \frac{\text{Total points}}{\text{Delivery hour-Other activities hour}} \quad (6)$$

KEY OBJECTIVES AND OUTPUTS OF DAOM

Key objectives of DAOM:

- Make a balance between improving service levels and containing costs
- Optimize delivery area boundaries based on current courier activities
- Review organization configuration
- Set productivity targets
- Optimize allocation of employees and subcontractors to use

Key outputs of DAOM:

- Well- proportioned delivery area
- Productivity targets per delivery area
- Optimized mix of different courier type utilization
- Time reduction
- Action lists to reduce efforts on non-value added activities
- Streamlined organization configuration

FOUR MAIN STEPS

DAOM contains four main steps as follows:

Project scoping and data collection:

- **Scoping:** The first phase of DAOM is scoping. When a DAOM project is kicked off, it is crucial to prepare, plan and validate the project. Various local factors, the preliminary findings and the forecast cost of the project compared to the returns should be analyzed. At the end of scoping phase, decision will be made whether to initiate, to wait for a more appropriate time or to cancel the project

In this phase, project objective and scope should be defined. Team requirements (logistics, people, data) should be confirmed. Service Center specifics that may require additional investigation should be worked out and team members' responsibilities should be defined.

- D**ata collection:** The objective is to collect the data required for the dotting and delivery area design phases. Minimum of 4 weeks data is required which contains:
- Addresses of all points
- First/last point times
- Come out time, come back time
- Delivery volumes

The accuracy of the collected data must be ensured; otherwise, it will have serious negative effect on DAOM results and may lead to a suboptimal output for Service Center.

To guarantee data accuracy, on-going quality checks should be performed:

- Cooperate couriers to monitor performance
- Ensure proper scanner using during collection period
- Review data generated from DAOM reports

Courier daily sheet as illustrated in Table 1 needs to be filled in by each courier at the end of each cycle during the data collection period.

Summary sheet (Table 2) summarizes the information collected in the courier daily sheets and calculates the additional data required for the delivery area construction phase.

As long as the times of departure, first point, last point and arrival are recorded, then come out, delivery, come back and outside times can be calculated using Eq. 1-4.

Table 1: Courier daily sheet

	Date		Mon	Tues
A cycle	Depart from service center time			
	First Point time			
	Last point time			
	Arrive at service center time			
	Delivery	Points		
		Shipments		
		Pieces		

Table 2: Summary sheet

	Date		Mon 22/7/2013	Tues 23/7/2013
A cycle	Depart from service center time		8:10	8:07
	First Point time		8:48	8:50
	Last point time		12:20	12:35
	Arrive at service center time		13:04	13:22
	Delivery	Points	24	28
		Shipments	33	38
		Pieces	51	57
	Total points		24	28
	Come out time (hr:min)		0:38	0:43
	Come back time (hr:min)		0:44	0:47
	Delivery time (decimal)		3.53	3.75
	PPDH		6.8	7.5

Delivery area construction: Here lists the basic delivery area construction principles (Taniguchi *et al*., 1999):

- Identify locations of each point and high density clusters
- Allocate points to delivery areas starting from furthest delivery area
- Avoid delivery areas that cross over natural or man-made obstacles (rivers, mountains, roads, rail lines, etc.)
- Try to allocate a high density area to one delivery area
- Minimize dead travel time for delivery areas that have high come out time and come back time
- Minimize lost travel time
- Pass excess points from outer delivery area to inner delivery area, ending up with "Baseline" delivery area (special delivery area close to the station, use for special needs, e.g. heavier than normal volume). This is called "Flexing"

- **Dotting:** The first phase in the establishment of a new delivery area structure is dotting. In this phase, a standard procedure is set to dot points in a representative day for each delivery area cycle (Han, 2006)

The first thing is to select a representative day for each delivery area cycle. This is to ensure the newly-established delivery area be correctly dimensioned in the next phase. If a light day is dotted, it will result in a delivery area structure that will be overloaded soon.

Otherwise, a heavy day will lead to a less-effective delivery area structure as it will include excessive buffer capacity.

Therefore, the proper way to select the dotted day should amongst days with total volume (in points) slightly above the average for all cycles. It is permissible to select different days for different cycles. Through this way, the delivery area construction will be less complicated and less susceptible to error.

There should be normal service conditions for the selected day, that is: normal weather, no abnormal traffic conditions, no shuttles and flights delay.

Dotting technique generally includes:

- Plot all points in the selected day manually on large wall maps
- Distinguish dots for each delivery area by different colors
- Plot each cycle on separate maps
- Highlight exceptions and key accounts, such as time committed points or heavy AM shippers;
- Write down the number of shipments and pieces on each dot. Indentify the number of points, shipments and pieces on the dot if more than one point are located in the same building
- Affix the appropriated colored dot to each delivery sheet after it is plotted

Figure 2 shows one example of dotting.

- D**elivery area design:** Based on the preparation work from the previous phase, a new delivery area structure can be established which has the optimized number of delivery areas and achieves a predefined service level (Hwang, 2002)

Seven main steps will be followed in delivery area structure design:

Step 1: Preliminary questions. This step is to identify the key driver of the current performance level

Step 2: Delivery time calculation

Step 3: PPDH goal setting. This indicator should be defined on the delivery area basis, not the courier. The productivity targets must be set at a reasonable level. A less challenging target is easy to achieve and courier would have less motivation to increase the productivity continuously. While a too high target is too difficult to reach and will reduce the courier's confidence. The target setting should be clearly claimed to the courier

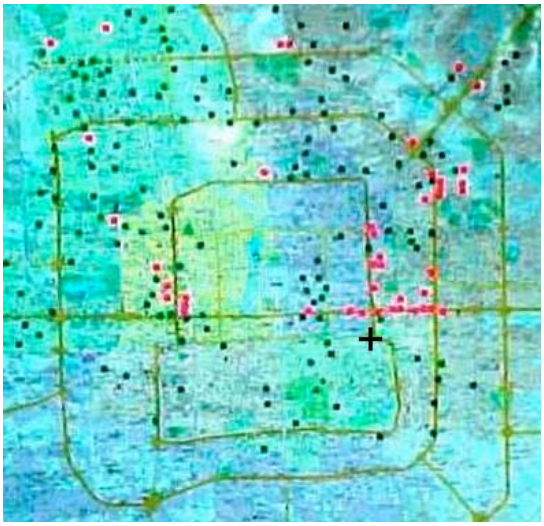

Fig. 2: Example of dotting

Step 4: Determination of ideal number of points. Ideal number of points is defined as the number of points the courier can achieve by working at the agreed rate over the agreed time window. From this definition, it is easy to get the ideal number of points by multiplying the agreed rate of work (PPDH) by the ideal working window time (Delivery Hour)

Step 5: Adjusting points. In this phase, the plotted number of points is compared with the ideal number of points to decide whether to add or to remove points from the delivery area. If ideal<plotted-1, remove points; If ideal = plotted+/-1, leave as it is; If ideal>plotted+1, add points. This calculation is performed to ensure the real capacity of the delivery area is taken into account. Adding or removing points should follow basic principles as (Ackermann and Muller, 2007): create homogenous clusters of points leading to a more efficient delivery area structure. Adding points starts from points further away from the Service Center. Similarly, removing points begins at points closer to the Service Center. In case a point cluster contains excessive points but is located further away from the station, it is recommended to add it to the delivery area, although this means to remove points from the other side of the delivery area. Through these ways, more homogenous clusters will be created and the possibilities of two couriers visiting the same area will be greatly reduced. When constructing new delivery areas,

always start from delivery area furthest from the Service Center and work around the station boundary perimeter, gradually working towards the station. This helps to ensure no stand-alone points and that all the left over points (incomplete delivery areas) can be combined into a delivery area close to the Service Center. Figure 3 is the example of adding points

Step 6: Adjusting PPDH. PPDH goal should be adjusted after adding or removing points to an existing delivery area. The updated PPDH target should be uploaded to the new delivery area data during delivery area construction. The degree of change depends on the difference between the PPDH for both delivery areas and number of points changed

Step 7: Mapping minimum/maximum points. Mapping the following information onto the delivery area configuration: The delivery area number, the delivery area boundaries, the points/shipments/pieces target, the PPDH and PPOH target, the overall paths, the maximum/minimum number of points. In principle, the delivery area should be configured to the ideal number of points. The maximum and minimum points are just used for reference to assess the impact of number of points above or below ideal. The maximum Delivery Time is the ideal time window with no allowance for other activities in delivery area. This figure is just for reference to decide the maximum number of points that could be achieved. Obviously, it is not appropriate to configure the delivery area to the maximum in case the courier is being allocated a legitimate break while in delivery area. The minimum Delivery Time is derived from: the ideal time window minus other activities time minus 30 minutes. This figure is used to assess the minimum points achievable if the courier is delayed for up to 1/2 hour by late shuttles, traffic jams, etc.

The flexing area should be designed and highlighted on the map when all the delivery areas of one cycle are designed. The following elements must be considered when designing the flexing areas: Flexing should always move points in the direction of the Service Center; flexing should not deeply modify the delivery area density; the flexing area must be big enough to contain a sufficient number of points in both delivery areas; flexing should not impact time committed points (Chopra, 2003).

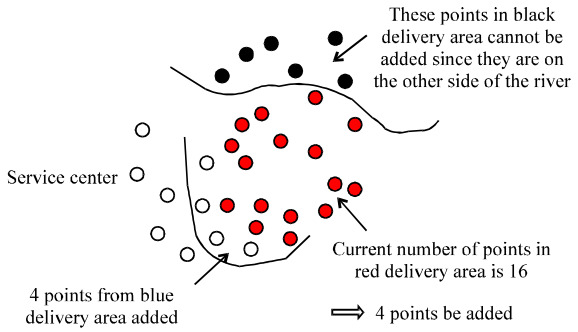

Fig. 3: Example of adding points

The baseline is the area surrounded by all the circles. It contains all the left-over from the delivery area design.

- **Summary report:** The delivery area design phase will be ended up with a summary report which should contain:

- Summarize the optimized configuration result
- Assess the potential savings (cost reduction, cost avoidance, etc.)
- Keep record of the service improvement
- Document any potential issues and follow up with an action plan

Implementation: To validate the new delivery area design, test it and make modifications if needed before widely implementation (Antun *et al*., 1998). Generally, it is recommended to follow below steps in implementation phase:

- **Communication:** Communicate with the couriers about the new delivery area configuration and the new goals. Collect feedback from them and summarize
- **Testing:** Test a limited number of delivery areas to validate some assumptions. Check Come Out Time, Come Back Time, departure time, transit time, PPDH, volumes, etc.
- **Modification:** Make necessary modifications to the delivery area configuration based on feedbacks and testing results. Normally this would include: Review of the building process of the delivery area, identification of the wrong assumptions, re-calculation of the overall delivery area PPDH, analysis on the impact on the ideal number of points, flexing of the points, mapping of the delivery area

This is the most critical phase of the project. If this phase is not well prepared, there is a risk that motivation and local ownership generated during the previous phases will disappear if the station encounters any problem.

- **Implementation:** Put the agreed delivery area configuration into implementation. Till now, all the previous work is turned into the actual improvement of productivity and service quality

There are three keys to a successful implementation:

- Daily follow-up of performance
- Motivation, enthusiasm, confidence, planning
- Check rides

- **Evaluation:** The implementation results should be reviewed and documented at the end of this phase. Also, the actual savings will be calculated and the overall station goals will be reviewed

Ongoing management: Implementation is not the final stage of DAOM. Keep close eyes on the new delivery area configuration and ensure it runs at high efficiency all the time. Thus, there should be effective tools for supervisors to manage their delivery areas.

- D**aily and weekly reports:** The daily report provides an overview of the previous day's performance (delivery performance). Supervisor will judge if any immediate actions are required

The Weekly Report provides an overview of the couriers' performance over the past week. This allows for trends to be assessed and for overall courier management.

- **Check rides:** The check ride is a supervisory tool which is intended for the edification of each courier about proper delivery methods. It is a close loop to get critical feedbacks from the couriers. It also provides a proper way for supervisors to observe each courier's delivery performance.

Check ride aims to ensure that all couriers perform in an organized, safe and efficient manner. Any areas requiring improvement are identified and relevant coaching or training is performed. The ultimate goal is to ensure PPOH targets can be meet and continuously improved.

CONCLUSION

DAOM concept is put forward in this paper for more efficient delivery performance and better customer service quality. Key delivery performance indicators are listed. The objective of DAOM and desired outputs are analyzed. Then four main steps of DAOM are discussed in detail including: project scoping and data collection, delivery area construction, implementation and ongoing management. Effective tools for continuously monitoring and improving productivity are also provided.

Properly usage of DAOM will result in better-proportioned delivery area construction, thus higher productivity and lower cost.

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