

The Measurement and Management of Unused Capacity in a Time Driven Activity Based Costing System

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Abstract:

Companies rendering continuous 24 hours a day service may encounter difficulties in determining their unused capacity. In addressing this issue, managers can consider using a Time Driven Activity Based Costing (TDABC) System. In the measurement of unused capacity, managers should consider two new concepts, real and compulsory unused capacities. The aim of this paper is, to enhance the efficiency of the TDABC System by clarifying and explaining the real and compulsory unused capacities per shift.

The principal result of the study is that the number of employees to be dismissed or directed to other productive areas should be determined on the basis of each shift, rather than considering the total amount of unused capacity in a day/month for the whole of the company. Finally, the study concludes that the management of unused capacity will only be effective when the real and compulsory unused capacities per shift are considered.

Keywords:

**Time Driven Activity Based Costing
Activity Based Costing System
Unused Capacity
Real Unused Capacity
Compulsory Unused Capacity**

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Introduction

In the current global environment, businesses are exposed to rapidly increasing competition and are forced to enhance their competitive advantage in order to survive. As such, businesses must apply an effective cost management system. There is much evidence that the Traditional Cost System (TCS) can be considered a major obstacle to gaining a competitive advantage; due to the fact that this system produces inaccurate information about the costs of goods and services. This lead to the introduction of Activity Based Costing (ABC) and a simplified version of it called Time Driven Activity Based Costing (TDABC) (see Ratnatunga and Waldmann, 2010, and the literature quoted therein)

TDABC was developed due to implementation difficulties encountered in ABC. Kaplan and Anderson (2007a) in proposing TDABC ensured an efficient cost system for businesses that was also easy to implement (Pernot, et al., 2007). Kaplan and Anderson (2007a) also claimed that this new cost system provides a significant competitive advantage to many companies. However, TDABC has some significant shortcomings. The measurement of time is still problematic. This is because, when direct observation is not possible, it uses the time estimations stated by operatives (Gervais et al., 2010). Another significant shortcoming, discussed in this paper, is that the TDABC has a significant issue regarding its interpretation of unused capacity, due to the uncertainty surrounding this capacity. Unused capacity is clearly a complicated concept; however, the uncertainty of unused capacity originates from the organisations' operations. Some types of organisation such as service organisations giving a 24-hour, 365-day service, are more problematic than others. This paper will focus on the uncertainty of the unused capacity itself rather than focusing on the types of organisation or organisations' operations.

Eliminating a business's unused capacity is, in general, the best way for a manager to increase its efficiency. However, unused capacity can never be fully eliminated due to its special characteristics. This situation is most clearly seen in service companies rather than manufacturing ones. Unlike most manufacturing companies, service companies,

such as hospitals, hotels, and certain restaurants, may render a 24 hours a day 7 days a week service. In view of the fact that services in such industries are produced and consumed simultaneously, the capacity utilisation of service companies directly depends on the demand of their customers. In addition, since demands cannot be inventoried (Balanchandran et al., 2007), eliminating the uncertainty of unused capacity becomes difficult for these types of companies.

Therefore, the ultimate purpose of this paper is not only to minimise the uncertainty of unused capacity but also to enhance the efficiency of the TDABC system by clarifying and explaining the real and compulsory unused capacities per shift. For this purpose, a case study was conducted in a hospital located in the southern part of Turkey. Not only does this case study contribute to our understanding of TDABC, but it also creates an effective example through which to formulate effective decisions about the employment of the work force in the service sector.

The remainder of this paper is organised as follows: Information about unused capacity is presented and then numerical examples are given to express the uncertainty of unused capacity. In an attempt to mitigate this uncertainty, a theoretical framework is created; and this framework will be tested through a case study of a business in the service sector.

Predecessors of TDABC

In the current advanced business environment, labour-intensive production has been replaced by capital-intensive production. As a result, the role of direct labour in manufacturing has also reduced. As a result, applying TCS, which uses direct labour hour as an allocation base, has been shown to produce distorted cost data (Gunasekaran and Sarhadi, 1998; Ratnatunga and Waldmann, 2010).

It is evident that companies that use distorted cost data have little opportunity to compete with their rivals. This has generated a need for a new cost system to protect and maintain a competitive advantage. In addition, the new systems can assist and encourage innovations to be realised in the organisations (Ostergren and Stensaker, 2011). This resulted in Activity

Based Costing (ABC). The ABC system provides more reliable and useful results than the TCS. This is because the ABC system uses cost drivers to assign the cost of activities to products and services. Consequently, it recognises the relationship between cost drivers and activities and this relationship helps managers analyse the causes of costs much more easily. Moreover, it provides better information about the costs of activities, products and services, which helps to improve the effectiveness of decision-making (Ellis-Newman and Robinson, 1998; Yennie, 1999). Companies such as Chrysler and Safety-Kleen have used ABC and improved the accuracy of their cost measurements (Beheshti, 2004).

Despite its attractiveness, the ABC system encounters some significant problems. Measurements and operational complexities may result in problems for ABC implementers, as the ABC system requires estimations of the costs of activity pools as well as cost drivers. These estimations of the nature of resource usage can cause measurement errors, which lead to less accurate cost information (Bruggeman et al., 2005). Two other problems are the high costs of conducting interviews, and the subjectivity of data used (particularly for time allocations) (Lambino, 2007). In addition, the updating process of the system is problematic. Finally, this system becomes theoretically inadequate when it does not take the possibility of unused capacity into account. Consequently, Kaplan and Anderson, (2007a) proposed TDABC as a revised model of the ABC system; in order to create a more easily implementable and more effective and reliable cost allocation system.

TDABC is a simple, yet effective way to approach business processes as it enables one to produce comprehensive information about the costs of products and services (Kaplan and Anderson, 2007b). It also provides businesses with an elegant, well-designed and practical option for identifying the capacity utilisation of their processes; not to mention its aid in determining the cost and profitability of their products and services. Moreover, the TDABC enables organisations to enhance their cost management systems by gathering reliable and adequate cost data (Kaplan and Anderson, 2007a; Pernot et al., 2007). Unit costs of supplying resources and the time needed to perform an activity by the resource group are the only two factors used by the TDABC

system. It is recommended that managers should also combine standard costing to implement the TDABC allocation system successfully (Ratnatunga and Waldmann, 2010). TDABC provides easy updating of the cost system, even in fast changing environments (Everaert and Bruggeman, 2007; Kaplan and Anderson, 2007a). It also enhances the applicability of cost management systems by recognising the unused capacity incurred by a company (Tse and Gong, 2009). However, the uncertainty of unused capacity is still problematic in TDABC. Thus, the structure of unused capacity should be considered to understand and minimise its uncertainty.

Unused Capacity

Companies often minimise their limitations in an effort to increase efficiency. It is important to note that recognising limitations may become very difficult for managers since it requires a comprehensive investigation of all aspects, sections and processes of the company.

One of the major limitations of companies is unused capacity, which can be defined as the difference between available resources and consumed resources (Tse and Gong, 2009). In other words, unused capacity is the amount of capacity that is not employed in the primary activity of the business (White, 2009). It is also important to note that unused capacity could be found, as stated by Cooper and Kaplan (1992), by subtracting the 'activity usage' from the 'activity availability'.

Therefore, it provides the relationship between the costs of resources used and the costs of resources supplied. The researchers will also emphasise that practical capacity is more appropriate than theoretical capacity; therefore, practical capacity should be used in the calculations of unused capacity.

Nevertheless, the practical capacity concept is not comprehensive enough to be used alone to minimise or eliminate the complexity of unused capacity. This is because it does not indicate how many employees should be dismissed or directed to other productive areas.

As well as disclosing other efficiency and effectiveness limitations, cost systems can be used to expose a company's unused capacity.

This is because cost systems enable managers to recognise their existing situation as they provide comprehensive information about the company. In this regard, a truly resource based system helps companies to shape their strategies (Barsky and Marchant, 2000).

Unlike TDABC, the TCS is unable to identify the unused capacity, because the predetermined overhead rates used in this system are calculated by dividing estimated or budgeted overhead costs by the estimated total cost driver capacity such as direct labour hours. This practice results in inefficient outcomes since the cost of unused capacity is assigned to products or services. Similarly, the ABC system does not reveal the unused capacity since it assumes that employees and other resources all work at full capacity (Kaplan and Anderson, 2007a).

An accurate system could be used to show capacity utilisation, which provides the basis for the planning and control activities (Bamford and Chatziaslan, 2009). Unlike TCS and ABC, the TDABC system provides valuable information by disclosing the unused capacity. However, all data gained through the TDABC system must be analysed in a more detailed way as certain company policies, such as total daily service duration, may go unnoticed by the implementers of the TDABC system. This is because the unused capacity is not separated into subdivisions by this system. As a result, it becomes difficult for managers to thoroughly analyse unused capacity in the interpretation process.

A detailed examination of the unused capacity provides clarity as to whether the workforce should be reduced or directed to other areas. Examples, which demonstrate the complexity of unused capacity, will be presented in this section, and a case study will be discussed in a subsequent section.

Before giving examples, it is also important to emphasise that formulations given in the paper are created to eliminate complexity and to simplify the determination of unused capacity. These formulations will also be used in the case study to display the suggested solutions to the complexity of unused capacity.

Example 1: This example is given to illustrate the uncertainty of unused capacity:

Assuming that three or four receptionists are working in a hotel between 24.00-08.00 hours, unused capacity may occur because of the arrival of a small number of customers during that shift. On the other hand, when a group of people arrives at the hotel at the same time, the number of employees, including receptionists and bellhops, may be too few to sustain an adequate level of service.

It can be said that the uncertainty of unused capacity in the example above results from the uncertainty of demand. Uncertainty is the state of having limited knowledge about a specific topic, condition, or event; in other words, uncertainty is a situation arising when a manager or employee cannot precisely determine or predict a specific event. As noted earlier, the unused capacity can be considered to be the 'uncertain' element. The uncertainty of unused capacity may result due to various reasons; of which four are listed here. Firstly, when events in a company are not expected, unused capacity may occur. Secondly, the possibility of the occurrence of extraordinary situations may result in the uncertainty of unused capacity. Thirdly, when employee' behaviour does not match expectations, it will be difficult for them to perform effectively. This can also result in the occurrence of unused capacity. The final but most importantly, uncertainty of demand may result in the uncertainty of unused capacity. This is because when a customer needs a product or service, he or she could request it at any moment during a shift. Thus, there should be a minimum of one employee available during the shift. In this respect, a lack of customers will cause unused capacity to occur. The uncertainty of unused capacity affects both service and manufacturing industries, and it may lead to inadequate pricing policies, which may be one of the main causes of customer dissatisfaction.

In order to maintain the balance between input and output flows, the service duration capacity should be larger than the expected demand in service companies. Meanwhile, because of the uncertainty of production time, a similar strategy may need to be implemented by manufacturing companies (Balanchandran et al., 2007). For these types of situation, one way that managers can make an efficient decision is to consider the unused capacity. This is because emphasising the unused capacity costs may lead to a reduction of

unused capacity resources (Buchheit, 2003). In general, there are three major decisions that must be made. The first is to increase organisational outputs or to reduce quantities of committed resources; i.e. organisations can improve their operational efficiency by increasing the demand of customers or decreasing the quantities of committed resources (Buchheit, 2003; Tse and Gong, 2009). The second is to reduce the number of employees, although managers should always employ at least one employee for each shift. It is also important to emphasise that dismissal of employees is not desirable. Thus, if it is possible (if other departments need to recruit new staff and if employees to be dismissed have the necessary qualifications that meet the requirements of these departments), these employees can be employed in other departments of the company. The other initiative is for managers to allow employees to direct their own unused capacities towards other productive jobs. By doing this, when the demand of customers cannot be increased, the negative effect of the unused capacity to be incurred is minimised. As a result, it can be said that the examination of unused capacity per shift must be done accurately and effectively in order to make the right decisions.

Example 2: This example is given to emphasise that a separate analysis of unused capacity should be done for each shift.

Company X operates two shifts per day and the unused capacities in the first and second shifts are 10,000 minutes and 12,000 minutes, respectively. If the practical capacity of an employee is equal to 11,000 minutes, a manager who makes a general analysis can say that the total amount of unused capacity is equal to the practical capacities of two employees (10,000 min + 12,000 min = 2*11,000 min) so two employees can be dismissed. However, when the analysis of unused capacity is made on the basis of each shift, it can be said that only one employee should be dismissed. Furthermore, the employee working in the first shift should be directed to perform other more productive tasks. One employee could be dismissed from the second shift (since the unused capacity is higher than the practical capacity of one employee) but an employee is needed for the first shift (11,000 min – 10,000 min) requiring a total of 1,000 minutes.

When the example is analysed, it appears that a separate analysis of unused capacity should be conducted for each shift. This is due to the fact that, in some circumstances, the unused capacity of a single shift may become less than the practical capacity of an employee.

However, if the total amount of unused capacity for all shifts is considered, then that amount may easily become higher than the practical capacity of the employee. This may lead to inappropriate decisions, as it appears that the number of employees to be dismissed/redeployed to other area is more than it should be.

Example 3: This example illustrates that an analysis of unused capacity should be made by considering the service durations of businesses:

Hotel BCD has ten receptionists. They work 2,240 hours per month (10 receptionists*8 hours per day*28 days per month). If the receptionists spend 15% of their time on breaks and training, the total practical capacity of them becomes 114,240 minutes per month (The total practical capacity for each receptionist is 11,424 minutes). They need only 33,600 minutes for customers; therefore, the unused capacity is equal to 80,640 minutes (114,240 min – 33,600 min). It seems that three receptionists would suffice for this hotel since the practical capacity of three receptionists (34,272 min) is higher than the minutes required by the task (33,600 min). If seven receptionists are dismissed (10 receptionists - 3 receptionists, or 80,640 min/11,424 min), inefficiency problems will occur since this number not only includes the employees who should be dismissed from the hotel, but also the employees who should be retained and directed to other areas in the hotel. Indeed, Hotel BCD provides a 24-hour service, so it needs a minimum of 43,200 minutes (30 days per month*24 hours per day*60 minutes per hour) per month. Thus, a minimum of four receptionists (43,200 min/11,424 min = 3.78) is needed by the hotel. In view of this, the important point here is that the implementers should recognise the service durations of businesses.

In addition, each business may have to consider its own unique situation. To illustrate, if Hotel BCD always renders 90% of its services between 08.00-12.00 hours, it will require more than four receptionists within this

period as a number of clients arriving at the same time may require more than one receptionist to meet their needs. Analyses of shifts, therefore, become helpful for managers to make strategic decisions.

To summarise, managers should primarily determine the required time for the sustainability of a business service. They should also determine the required number of employees for each shift by analysing the intensity of their customers' demands. Finally, the evaluated unused times of employees should be eliminated or should be directed to other areas to enhance the productivity of the company.

Removing the Uncertainty of Unused Capacity: A Theoretical Framework

The uncertainty of unused capacity is a significant issue for many managers, yet they can solve this problem by considering two new concepts created by the authors of this study: *Real Unused Capacity* and *Compulsory Unused Capacity*. The description of constructs within the two proposed concepts is as follows:

Practical Capacity (P_c): This represents the actual work duration. It can be calculated by subtracting time for scheduled breaks, training, meetings, maintenance and other sources of downtime from the theoretical capacity (Kaplan and Anderson, 2007a). The main logic of the theoretical capacity is that all personnel and equipment operate with utmost efficiency. In this regard, the theoretical capacity is unrealistic since it does not consider normal interruptions due to repairs, maintenance and scheduling fluctuations (Kaplan and Anderson, 2004). Furthermore, it is unattainable because, in real life, employees need refreshment breaks. "The practical capacity of one employee" and "the total practical capacity of all employees" realising the same activities are denoted by P_c and P_{ct} , respectively.

Time Spent on a Task (T_s): This is the time spent by employees on a particular task. The required times for each customer are totalled to calculate the time spent on a task. For example, if there are a total of 50 customers

(30 existing and 20 new) for Company X and an order from an existing customer takes 10 minutes, and if a new customer needs an additional 2 minutes, then the time spent on this task will be 540 minutes (30 existing customers*10 min + 20 new customers*12 min). (Note that an important assumption of the study is that when time spent on a task is higher than the shift duration, there is always a minimum of one employee on duty during a shift. It is also assumed that not all customers arrive at the same time, so time spent on a task reflects the work done throughout the shift)

Time Required For a Task (T_r): This is the shift time as stated by business policy. In other words, it is the service duration of the company. If each shift includes only one worker, the service duration (time required for a task) of a company may become higher than the time spent on a task. If each shift includes more than one worker, the time spent on a task may become higher than the service duration.

The two proposed concepts, *Real Unused Capacity* and *Compulsory Unused Capacity*, can now be explained as follows:

Real Unused Capacity (R_{uc}): This is the actual unused capacity for a business. It shows the number of employees who should be dismissed from the department. As an alternative to dismissal, if other departments need to recruit new staff and if employees to be dismissed have the necessary qualifications that meet the requirements of these departments, managers can direct these employees to other departments of the company.

The real unused capacity is calculated by multiplying “practical capacity of an employee” by the integer part of the decimal number. The decimal number is found by dividing the difference between “total practical capacities of employees” and “time required for a task” by “practical capacity of an employee”.

However, “time required for a task” is changed with “time spent on a task” in the formulae when the “time spent on a task” is higher than the “time required for a task”. Real

unused capacity can take only integer values. It is always equal to multiples of the practical capacity of an employee.

Compulsory Unused Capacity (C_{uc}): This is mandatory unused capacity, and it is necessary for the continuity of a business. Unlike real unused capacity, it shows the number of employees who should be directed to other productive areas such as sending e-mails to customers regarding reservation dates, informing customers about promotions, or any other job that is not listed in their job descriptions.

Each business has its own policy on sales, promotion and distribution. One of the most important policies of a business is the service duration policy. Regarding service duration, in general, many businesses are divided into three different groups; businesses rendering 8, 16, or 24 hour services. It is also important to emphasise that the service duration (capacity) should be larger than the expected demand due to the uncertainty of demand (Balanchandran et al., 2007).

The compulsory unused capacity is calculated by multiplying “practical capacity of an employee” by the decimal place of the decimal number. In addition, when the “time required for a task” becomes higher than the “time spent on a task”, the difference should be added to the value found by multiplying “practical capacity of an employee” by the decimal place of the decimal number. As is explained above, the decimal number is found by dividing the difference between “total practical capacities of employees” and “time required for a task” by “practical capacity of an employee”. However, the “time required for a task” is changed with the “time spent on a task” in the formulae when the “time spent on a task” is higher than the “time required for a task”.

The Real and Compulsory Unused Capacities can be expressed in formulae as follows:

Assuming that $T_s < T_r$, then

$$R_{uc} = X * P_c$$

Where “ R_{uc} ” is the real unused capacity,
 “ P_c ” is the practical capacity of an employee,
 “ X ” is the integer part of the decimal number.
 Consider a decimal number as $X.abc$ where X
 is an integer part and abc is a decimal place
 including the first three terms of the decimal
 number.

The decimal number can be found as:

$$\frac{P_{ct} - T_r}{P_c} = X.abc$$

$$C_{uc} = (T_r - T_s) + abc * P_c$$

Where “ C_{uc} ” is the compulsory unused
 capacity, “ T_r ” is the time required for a task,
 “ T_s ” is the time spent on a task, “ abc ” is a
 decimal place including the first three terms of
 the decimal number, “ P_c ” is the practical
 capacity of an employee.

Assuming that $T_s \geq T_r$, then:

$$R_{uc} = X * P_c$$

Where “ R_{uc} ” is the real unused capacity,
 “ P_c ” is the practical capacity of an employee,
 “ X ” is the integer part of the decimal number.

$$C_{uc} = abc * P_c$$

Where “ C_{uc} ” is the compulsory unused
 capacity, “ abc ” is a decimal place including
 the first three terms of the decimal number,
 “ P_c ” is the practical capacity of an employee.

When the formulae is analysed, it can be
 concluded that the total unused capacity,
 which includes real and compulsory unused
 capacities, is equal to the difference between
 “total practical capacity” and “time spent on a
 task”. In this regard, this difference, which can
 be considered as the proof of the formulae
 given below, is formulated as:

$$“R_{uc} + C_{uc} = P_{ct} - T_s” \quad (A)$$

The proof of the formulae (A) can be given as:

Assume that $T_s < T_r$ then:

$$R_{uc} + C_{uc} = (T_r - T_s) + X * P_c + abc * P_c$$

$$R_{uc} + C_{uc} = (T_r - T_s) + P_c (X + abc)$$

$$R_{uc} + C_{uc} = (T_r - T_s) + (P_{ct} - T_r)$$

$$\text{Total Unused Capacity} = P_{ct} - T_s$$

Assume that $T_s \geq T_r$ then:

$$R_{uc} + C_{uc} = X * P_c + abc * P_c$$

$$R_{uc} + C_{uc} = P_c (X + abc)$$

$$\text{Total Unused Capacity} = P_{ct} - T_s$$

The formulas demonstrate that without making
 a detailed analysis by separating unused
 capacity as real or compulsory capacities,
 managers cannot make accurate decisions
 about how many employees should be
 dismissed or directed to other, more
 productive areas. In view of this, the efficiency
 of the formulas can be seen quite clearly in the
 following case study.

Case Study

As mentioned in the previous sections, unused
 capacity determination and employee
 coordination become much more difficult in
 complex organisations. This complexity will
 be clarified in a case study in combination
 with a theoretical framework. Firstly, the
 research method will be summarised;
 following this, the case study will be
 presented.

Research Method

The method used in this study is a “Case
 Study”. This method has been selected as it
 provides a wide perspective for the research.
 The 24-hour service policy of hospitals helps
 to reveal the importance of unused capacity
 examination; hence, a hospital was selected in
 order to increase the validity of the study.

In this regard, a descriptive case study was
 first carried out to identify the current situation
 of the hospital. Following this, an exploratory
 case study was conducted to evaluate the
 applicability of the proposed concepts, where
 the aim is to minimise the uncertainty of the
 unused capacity of secretaries in the hospital.

The researchers visited the hospital regularly to investigate the current working environment of the secretaries. Thus, in this study, face-to-face interviews with the hospital management and secretaries were carried out, and comprehensive direct observations as well as documentation collection were used as data collection methods. Accordingly, the daily practices of secretaries in the hospital were analysed at least three times per month during the year 2010.

In addition to the observations and face-to-face interviews, researchers were able to obtain a significant amount of data through telephone calls with both the management and the secretaries. The data collected were analysed as follows.

The Case Study Company

The Hospital Alfa (The management of the hospital asked the researcher not to use its real name), where the case study was conducted, is a well-equipped private hospital which provides a 24-hour emergency service for patients. It is located in Adana, which is a province in the southern part of Turkey.

This study analyses the time spent by secretaries working in the General Surgery Department only. An analysis of capacity costs at departmental level provides insights into whether or not departmental managers are reacting effectively in response to market conditions (Yahya-Zadeh, 2011). Therefore, this study will facilitate the capacity management of the secretaries of the General Surgery Department.

As noted earlier, a shift is always an important tool for a manager in the decision making process. Thus, the shifts of the hospital are created and presented in Figure 1 in order to determine the unused capacities of the secretaries.

As shown in Figure 1, the secretaries work 24 hours (3 shifts) a day. On average, two, four and three secretaries render services to 60 patients (40 new, 20 existing), 160 patients (50 new and 110 existing), and 110 patients (40 new, 70 existing) in the first, second and third shifts, respectively. In total, there are nine secretaries in the General Surgery Department and the number of patients arriving at this department per day is approximately 330.

It is also important to emphasise that the data related to either the number of patients or the time needed for each patient represent the real values gathered throughout the one-year period. In other words, researchers did not calculate the average times, so the values presented in Figure 1, and the times used in the calculation of unused capacity can be considered as standard values.

The unused capacities of the secretaries will first be analysed using TDABC, then a new analysis of the real and compulsory unused capacities will be presented.

A Traditional Analysis of Unused Capacity

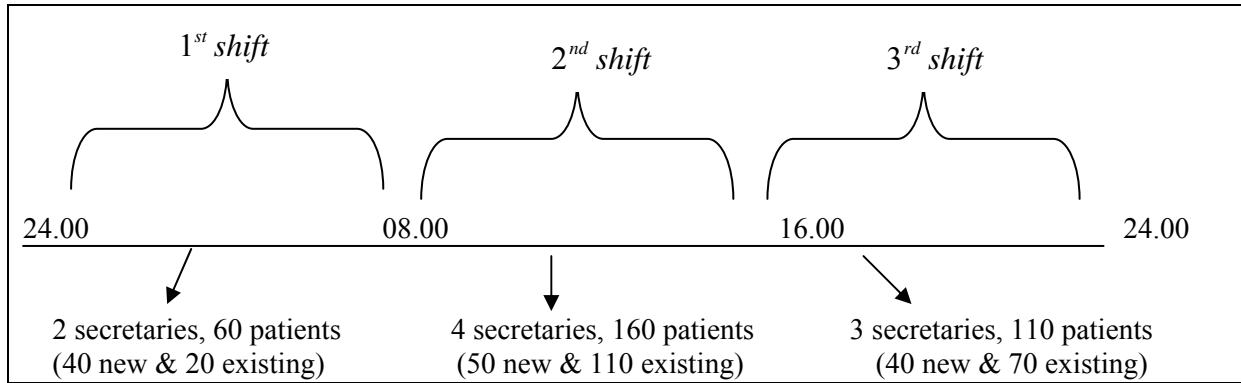
According to the interviews and observations, the secretaries used 20% of their time for breaks, training and education, while they spend 8 and 4 minutes for each new and existing patient, respectively. Taking into account all of these variables, calculation of unused capacity is given as below:

*The secretaries require 1,840 minutes (130 new patients*8 min per patient + 200 existing patients*4 min per patient) for patients per day.*

*Practical Capacity of the Secretaries: 9 secretaries*8 hours per day*60 min per hour*0.80 = 3,456 minutes (3,456/9 = 384 minutes are found to be the practical capacity for each secretary)*

This shows that the secretaries are able to work 3,456 minutes for the General Surgery Department; however, they currently work only 1,840 minutes, so the difference between these amounts is equal to the unused capacity (3,456 min - 1,840 min = 1,616 min). This means that four secretaries (1,616/384 ≈ 4.21) should be dismissed from the hospital or should be employed in other departments of the hospital if possible.

However, this result may be inaccurate since it does not provide sufficient information about how many secretaries should be dismissed or directed to other areas. Therefore, efficient decisions about the work force cannot be made based on these data. As a result, a new combined model is needed to improve efficiency.

Figure 1: Number of Secretaries and Patients

An Analysis of both Real and Compulsory Unused Capacities

Managers are able to see real situations in a more detailed way by analysing each shift. In this respect, they can make better-informed decisions about how many secretaries are needed for each shift.

A traditional analysis of the unused capacity has been modified by separating the unused capacity into two concepts.

Accordingly, the real and compulsory unused capacities per shift can be calculated as follows:

1st Shift:

$$T_s < T_r$$

$$P_c = 1 \text{ secretary} * 8 \text{ hours per day} * 60 \text{ minutes per hour} * 0.80 = 384 \text{ minutes}$$

$$P_{ct} = 2 \text{ secretaries} * 384 \text{ minutes per secretary} = 768 \text{ minutes}$$

$$T_r = 480 \text{ minutes}, T_u = 400 \text{ minutes}$$

$$\frac{P_{ct} - T_r}{P_c} = \frac{(768 \text{ min} - 480 \text{ min})}{384 \text{ min}} = 0.75$$

$$R_{uc} = X * P_c = 0 * 384$$

$$R_{uc} = 0$$

$$C_{uc} = (T_r - T_s) + abc * P_c = (480 \text{ min} - 400 \text{ min}) + .75 * 384$$

$$C_{uc} = 368 \text{ minutes}$$

Real unused capacity shows that no one should be laid off from the first shift since two secretaries are needed to meet the needs of patients.

In contrast to the real unused capacity, the compulsory unused capacity

indicates that secretaries should be directed to other productive areas for up to 368 minutes.

It also indicates that one of the secretaries could work part-time between 24.00-04.00 or 04.00-08.00 hours.

2nd Shift:

$$T_s > T_r$$

$$P_c = 1 \text{ secretary} * 8 \text{ hours per day} * 60 \text{ minutes per hour} * 0.80 = 384 \text{ minutes}$$

$$P_{ct} = 3 \text{ secretaries} * 384 \text{ minutes per secretary} = 1152 \text{ minutes}$$

$$T_r = 480 \text{ minutes}, T_s = 840 \text{ minutes}$$

$$\frac{P_{ct} - T_s}{P_c} = \frac{(1152 \text{ min} - 840 \text{ min})}{384 \text{ min}} = 0.8125$$

$$R_{uc} = X * P_c = 0 * 384$$

$$R_{uc} = 0$$

$$C_{uc} = abc * P_c = .8125 * 384$$

$$C_{uc} = 312 \text{ minutes}$$

In accordance with the real unused capacity, managers cannot lay off any of the secretaries since a minimum of three secretaries are required for the work to be done in this shift. However, the excess capacity (312 minutes)

should be minimised by directing them to other productive areas or by reducing the working hours of the employee who renders services in this shift up to that amount.

3th Shift:

$$T_s > T_r$$

$$P_c = 1 \text{ secretary} * 8 \text{ hours per day} * 60 \text{ minutes per hour} * 0.80 = 384 \text{ minutes}$$

$$P_{ct} = 3 \text{ secretaries} * 384 \text{ minutes per secretary} = 1152 \text{ minutes}$$

$$T_r = 480 \text{ minutes}, T_s = 600 \text{ minutes}$$

$$\frac{P_{ct} - T_u}{P_c} = \frac{(1152 \text{ min} - 600 \text{ min})}{384 \text{ min}} = 1.4375$$

$$R_{uc} = X * P_c = 1 * 384$$

$$R_{uc} = 1$$

$$C_{uc} = abc * P_c = .4375 * 384$$

$$C_{uc} = 168 \text{ minutes}$$

The compulsory unused capacity is found to be 168 minutes. Accordingly, secretaries should be directed to other useful and productive areas such as sending e-mails to customers about reservation dates, informing customers about promotions, and gathering information on potential customers through the distribution of questionnaires. The rate of real unused capacity, on the other hand, demonstrates that only one secretary should be dismissed from the hospital or should be employed in other department of the hospital if possible.

Analysis of the Results Obtained by the Case Study

In this case study, unused capacity was firstly analysed using the conventional method which indicated that four employees should be dismissed from the hospital. However, how many secretaries should be dismissed or directed to other productive areas for each shift is not certain. Thus, an accurate result can only be obtained by considering both the real and compulsory unused capacities for each shift.

In order to calculate unused capacity in a business, it is first necessary to calculate

practical capacity and then compare it to the total task duration required by customers. However, this calculation may lead to invalid results because the amount of unused capacity for each shift may become less than the practical capacity of an employee, but the total amount of unused capacity for all shifts of an activity may become higher than the practical capacity of an employee. Thus, it may appear that:

“the total amount of unused capacity is higher than the practical capacity of an employee, so some employees should be dismissed or employed in other departments of the hospital up to the amount of unused capacity”.

However, when the data is considered based on shifts, it becomes clear that the excessive amount of unused capacity is a result of the summation of values found in each shift. Therefore, the best decision is reached by analysing and considering the real and compulsory unused capacity for each shift.

The situation discussed in the above paragraph was clarified in the service sector case study. According to that study, a total of 848 minutes are compulsory unused capacity. An important point here is that the compulsory unused capacity can be considered as part of the cost of having hospitals “standing ready” to provide health care services for potential patients (Ferrier et al., 2009). Therefore, the cost of 848 minutes (compulsory unused capacity) should be incurred. However, so as to mitigate the effects of the compulsory unused capacity, the secretaries working in this hospital should take on additional productive tasks for up to 848 minutes. Meanwhile, the real unused capacities of shifts indicate that not four, but one secretary should be dismissed from the third shift only, or should be employed in another department of the hospital if possible.

Conclusion

Eliminating unused capacity is one of the main methods that companies can use to improve their productivity. However, it is not easy to minimise or dispose of unused capacity, especially in service companies, due to both the uncertain structure of unused capacity and the intangible characteristics of services. Thus,

in order to remove uncertainty it is necessary to consider two new concepts.

The first concept is Real Unused Capacity. *Real Unused Capacity* shows the capacity which should be eliminated. The value of Real Unused Capacity in terms of duration is compared with the practical capacities of employees in order to determine how many employees should be dismissed from the company or should be employed in other departments of the company if possible.

The second concept is Compulsory Unused Capacity. *Compulsory Unused Capacity* indicates the duration costs incurred due to companies' service policies such as rendering a 24-hour service.

This paper first analysed the unused capacity concept. Then, it combined the TDABC system, which was partially applied in the service sector, with the new unused capacity concepts. It is concluded that the TDABC system may lead to misinterpretation of the unused capacities of employees. In this study, the TDABC system has encouraged managers to lay off more employees (secretaries) than it should. Accordingly, this study demonstrates that the TDABC system can only provide accurate results related to both the number of employees to be dismissed from the each shift and the number of employees to be directed to other productive areas if it also considers the structure of unused capacity.

This paper makes four significant contributions to the literature. Firstly, it not only reinforces the significance of unused capacity analysis, but also increases the efficiency of the TDABC system. Secondly, this study provides strong evidence indicating that using the unused capacity concepts within the TDABC system provides more detailed and reliable information in decision-making processes. In view of this, the case study shows that eliminating unused capacity leads to cost efficiency, which can help to provide a competitive advantage. Thirdly, this paper contributes to a better understanding of the role of shifts in the strategic management process. In this context, it indicates that in order to obtain accurate results, unused capacity or any other information obtained by the TDABC system should be analysed on the basis of shifts. Fourthly, unlike previous studies, which used the TDABC system

directly to clarify the unused capacity, this study focused primarily on analysing the structure of unused capacity to create an efficient TDABC system.

This study provides an interesting avenue for future research which could be conducted in the manufacturing sector. Since services are created and consumed simultaneously, managers cannot change the shift time in service companies. However, when employees have reached the planned production volume in manufacturing companies, the shift time can be decreased so as to minimise the cost of compulsory unused capacity. In view of this, it could be interesting to clarify this issue with further research.

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