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# Integration of People Counter Systems to Decision Support Systems in Clothing Retail Industry: A Preliminary Analysis and Possible Applications

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***Abstract:*** *In this qualitative study, it is aimed to investigate how people counter systems (PCS) support decisions for retail sector. 44 companies in clothing retail sector participated to this study. Data were collected via interviews from the managers of the companies. A content analysis of the data is conducted and seven main categories have been identified. Each category is evaluated separately and sample reports and decisions are exemplified according to managers' opinions.*

***Keywords:*** *People Counter Systems, Clothing Retail Sector, Business Intelligent, Decision Support Systems.*

## İnsan Sayma Sistemlerinin Giyim-Perakende Karar Destek Sistemlerine Entegrasyonu: Bir Ön Analiz ve Olası Uygulamalar

***Özet:*** *Bu nitel çalışmada insan sayma sistemlerinin (İSS) perakende sektöründe alınan kararları nasıl destekleyebileceği incelenmiştir. Çalışmaya giyim sektöründe hizmet veren 44 perakendeci katılmıştır. Veriler, işletmelerin yöneticilerinden görüşme yolu ile toplanmıştır. Verileri analiz etmek için içerik analizi yöntemine başvurulmuş ve yedi ana kategori belirlenmiştir. Her bir kategori ayrı ayrı değerlendirilmiş ve yöneticilerin görüşlerine göre örnek raporlar ve kararlar sunulmuştur.*

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**Introduction**

Due to rapid developments in technology, organizations are striving to improve their adaptation to business environment. The impact and contribution of technology on management in business are systematically investigated by studies in management information systems (MIS). Innovations in management dimension of management information systems include the use of cooperation and coordination software by managers, increase in virtual meetings and conferences, and proliferation of business intelligence software.

Besides innovations in management dimension, technological developments enable the usage of more sources for managerial reporting. Imaging systems are one these developments. Organizations mostly make use of imaging systems in the form of closed-circuit televisions (CCTV) as security applications. Both the examination of increasing digital camera records and the need to increase security in real time turn the usage of video content software to a necessity.

Video analysis software is capable of real time analysis due to improvements in computation power. Such developments in hardware enable not only basic video content analysis such as simple object extraction, but also real time intelligent video analysis applications. As a result real time semantic content analysis is also possible besides applications of complex artificial intelligence such as object extraction, object identification, and automatic classification. In the literature, there are various methods for video content analysis. These methods are begun to be used in video conference images, sport competitions, television broadcast, and commercial broadcasts (Yüksek & Karasulu, 2010). In addition, data that are acquired through videos can be utilized as new data sources for business intelligence applications. There are a limited number of studies that investigates the integration of proposed algorithms to business intelligence.

Organizations tend to use camera systems, which are previously used only for security applications, to detect customer behaviors and to make necessary relevant strategic regulations. For an organization, the data of number of incoming customers is an important factor for the arrangement of promotional activities and for efficient management of human resources. However, there are limited studies that directly focus on how such systems can be used in decision making process of organizations. Nowadays, people counter systems producers and developers mostly focused on the technical challenges whereas how can people counter systems (PCS) be used for decision making for stores is as important as the performance and accuracy of those systems. In this study, it is aimed to analyze people counter systems and investigate how retail sector can make use of people counter application in terms of reporting and decision making.

## 1. Literature Review

In this part of the study, firstly some general developmental approaches to people counter systems in algorithms level will be mentioned shortly. Second, image processing application in business environment will be mentioned.

### 1.1 People Counter Algorithms

People counter applications are the methods that are developed for surveillance, security and statistical analysis. Basically, it is aimed to determine the number of visitors passing through a particular place. To this aim, applications such as manual counting of doormen or security guards, using turnstile, or counting with sensors have been also used. However, these applications cause problems like customer dissatisfaction or not being able to count people that arrive as a group. Nowadays, these applications are based on data that is acquired through imaging systems for a more credible counting without any physical obstacles. People counter systems can be defined as software that are developed basing on image processing systems in order to count people that passes from a particular place in a particular time (Yılmaz, Karaman & Çınar, 2013).

In the literature, various methods basing on camera images are proposed. In these applications images from cameras that are placed to capture visitors from above are used. For example; Garcia, Gardel, Bravo, Lazaro, Martinez, & Rodriguez, (2013) proposed an algorithm that counts circular objects that remain after pre-processing including background subtraction and edge detection. These shapes passing through a particular region are taken as the heads of the visitors. Another approach to people counter applications is face detection. In such applications, camera is placed to capture the face of the visitors (Chen, Chen, Wang & Kuo, 2010). Study conducted by Alboil (2001) is the one that aims to count people getting on and off a train. In these system, which basis on the analysis of opening of the door and region of interest, people counter algorithms are developed via changes occur as a result of door and people movement, and the analysis of stack of these changes with morphological computations. In the method proposed by Bozzoli, Cinque & Sangineto (2007), edge subtraction based optical flow analysis is used to estimate the number of people passing through a particular region instead of determining that images of each person. Chen, Chen, & Chen (2006), Barandiaran, Murguia & Boto (2008), Zhang, Xu, Gao, Yang & Su (2013), and Oosterhout, Bakkes, & Kröse (2011) are another sample studies focused on people counter algorithms using spectral features, stereo pair images, virtual lines in addition to cues stated above.

In the present day, embedded people counting applications are possible due to power over Ethernet technology and programmable cameras. At this point, minimizing the computation and memory requirements to decrease cost increases the preference of people counting applications.

**1.2 People Counting Applications in Business**

Every organization needs to know their customer profile, which is one of the environmental factors, in the best possible way. Customer behaviors provide valuable information for the efficiency of sales and marketing costs and human resource management. One application that is developed in line with these analyses is people counting software. Besides the algorithms used in the development of people counting software, how to use data obtained from these systems to produce necessary information and knowledge for organizations is also a crucial. For e-commerce organizations it is possible to determine this data and processing the data to acquire information with web mining and data mining applications. For example, in the study of Kim, Yum, Song, & Kim (2005), they proposed a method for recommendation system basing on capturing customer behavior such as navigation pattern, purchasing behavior, clicking behavior. However, in traditional organizations, additional hardware and software investments are required to perform these analyses. Granbois (1968) proposed a method for understanding customer behavior and how behavioral analysis results can be used for improving retail decisions by arranging the variables of the store such as layout, price and display. In this relatively old paper, there is no, of course, technological approach.

Both the management model and business model must be compatible to the used technology in order to have high investment returns and not to have productivity conflict. Video analytics is one of the technology that can be used for technology side. Video analytics for business intelligence applications is tackled in the study by Shan, Porikli, Xiang, & Gong (2012) from wide perspective. However, this study also focused almost only on video processing techniques rather than recommendation and decision support issue. Mirzaei & Iyer (2014) conducted a literature review study about technical methods for customer relationship management function in terms of analytics and estimation.

Adequate match of the technology and organizations enables systems to have high return of investment and socio-technic features which is the core feature of information systems. Such a system provides high quality information that enables managers to make better decisions. Understanding the retail sector requirements about reporting and decision based on such systems may be considered as an obligation.

In this study, it is aimed to investigate how people counter system is used as a reporting and decisional tool for retailers. In this manner, qualitative data obtained from 44 retail companies serving in clothing industry is analyzed. The research questions of this study are as follows;

i) What are the decisions made by managers according to the number of customers in an organization?

ii) If number of customer is known, which decisions are made based on this value.

iii) If number of customer is unknown, how these decisions are made.

After analysis of the data obtained from the organizations, results are discussed from a business function perspective. Accordingly, how people counter systems can support retail decision is evaluated.

## 2. Methodology

In order to identify requirements about how people counter systems can be used by organizations, a questionnaire with open ended questions was developed to guide the interviews. In this part of the study, data collection instruments and participants are explained.

### 2.1 Data Collection Instrument

In the scope of the study, a four-part questionnaire with open ended questions to guide the interviews.is prepared based upon five MIS specialist opinion. In the first and second part of the interviews, demographic information of managers and retailers were collected. In the third part, decisions made based on number of customers are asked. In this part, participants have opportunity to consult to researcher as in structured interviews. In the last part, managers were asked how they make decisions that they propose in the third part without number of customer information.

### 2.2 Participants

The interviews were conducted to 44 clothing retailers carrying out their activity in Erzurum, Turkey and they have least 10 full-time staff. This means that, the participants selected from SMEs in Erzurum which are not in micro-scale. In addition, all retailers use barcode system, CCTV (Closed-Circuit Television) and sales information systems. Data was collected from store managers via interviews. The demographic data of managers is shown in Table 1.

**Table 1:** Demographic Information of the Firms Manager

| **Gender** | **Education Level** | **Working Period** | **Total** |
|---|---|---|---|
| Male : 12<br>Female : 32 | Under-graduate : 20<br>Higher Vocational : 23<br>High School : 1 | 1-5 years : 10<br>5-10 years : 23<br>10-15 years : 6<br>15- 15+ years : 5 | 44 |

As shown in Table 1, 12 of the participants are female and 32 are male. With one exception, all managers graduated from either a vocational school or an undergraduate program. Managers work in this sector 9 years in average (SD=5.3)

In the second part of the interview, store information about period of service, staff number, information systems, and target groups were collected (Table 2).

**Table 2:** Demographic Information of the Store (frequencies)

| **Period of Service** | **Avg. Staff Number** | **Information System** | **Target Group Age** | | **Target Group Income (TL)** | |
|---|---|---|---|---|---|---|
| 1-5 years: 8 | Full-Time:15.04 | Sales &Marketing: 30 | 0-12 | :6 | 500-1000 | :16 |
| 5-15 years:18 | Part-Time:6,44 | Human Resources:32 | 12-24 | :20 | 1000-1500 | :30 |
| 15+ years: 18 | SD Full-Time:8.43 | Acc. & Finance: 34 | 24-36 | :38 | 1500-2000 | :20 |
| | SD Part-Time:7.38 | | 36-48 | :28 | 2000-2500 | :24 |
| | | | 48+ | :6 | 2500 + | :16 |

In terms of period of service, stores are different in a wide range. Average age of stores is 18.81 years. Average number of full-time staff is 15.03, and part-time is 6.44. The questions about the target group questions are multiple options. 4 of all retailers participated in this study offers all ages groups. Customers between 24-36 ages and having monthly income between 1500 and 2000 are the large part of the target group. Eight retailers target all customer income groups.

In the third part of the questionnaire, managers were asked whether they are aware of number of customers/visitors during the day. They were also asked which decision/ reports/analysis they make based upon the number of customer data, if they know or if they have a chance to know the number of customers. Factors affecting the number of customers were also asked. In the last part of the questionnaire, participants were asked how they make the decisions and analysis mentioned in the third part without number of customer data.

Collected qualitative data via interviews analyzed with content analysis which is one of the major qualitative data analysis techniques. Researcher played active role during the survey development, data collection, data analysis and interpretation of the results processes.

### 3. Findings

Firstly, how retailers use number of customer data extracted from PCS (People Counter Systems) were coded to determine the factors. After analysis of these factors, it is observed that the data is clustered into seven categories i.e. promotion and advertisement, capacity usage, product layout, external factors, return rate, working hours and personnel working hours. The questions about how PCS data used to make better decisions answered by all managers and 114 responses were collected and 108 of those were categorized. The factors, categories, frequencies and percentages are represented in Table 3.

**Table 3:** Categories and factors

| **Category** | **Factor** | **f** | **%** |
|---|---|---|---|
| Promotion and advertisement | Promotion | 26 | 24.07 |
| | Advertisement | | |
| | Brochure | | |
| | Promotional activity | | |
| Capacity usage | Busyness / Capacity | 25 | 23.15 |
| | Staff number | | |
| | Product range | | |
| | Product stock / order | | |
| Working (opening) hours | Staff resting time | 16 | 14.81 |
| | Store opening-closing hours | | |
| | Cleaning and maintenance hours | | |
| Personnel working hours | Full-time staff working hours | 16 | 14.81 |
| | Part-time staff working hours | | |
| Product layout | Store design (hours-days) | 9 | 8,33 |
| | Product based store/section design | | |
| External Factors | Weather forecasting | 8 | 7.41 |
| | Traffic Jam | | |
| | Demographic data | | |
| | Special days | | |
| Return rate | Product base rate of return | 8 | 7.41 |
| | Staff based rate of return | | |
| ***Total*** | | ***108*** | ***100*** |

Retailer managers make decisions and analysis based on number of customer mostly related with promotion and advertisement (24.07 %) where as they do so at least about rate of return (7.43 %) and external factors (7.43 %). Explanation and sample statement for each category are presented below.

**3.1. Promotion and Advertisement:** In this category, retailer managers focused on decisions, reports and analysis concerned with both the effect of promotion and advertisement activities on number of customer and planning promotion and advertisement according to number of customer. 59% of managers participated in this study mention about factors classified in this category. In general, managers expect to see change of customer numbers in different period of time such as hours, days, months, seasons and years etc. and steer those facilities accordingly. Although these reports may have been extracted by using sales record, managers want to see the changes in potential customers and their purchasing behaviors in addition to sales figures. For example, an expression

like "*I would like to see increase/decrease rate of customer numbers after promotion*" can be seen. Moreover, managers also place an importance on these analyses to direct other promotional activities and public relations. They also expect that PCS provide advice about the promotion and advertisement. For instance, a manager participated to the study stated that "*PCS should inform me about abnormal changes in number of customers*."

**3.2. Capacity Usage:** Factors such as store density, product range, and number of staff are considered in this category. The better part of the participants (56 %), touch up on the factors that belong to this category. Managers think that instantaneous store density reports in terms of number of customer can be extracted via PCS, and this data may be used for evaluation of store performance. For example, *"I would like to know how many customers visit my store instantly", "according to the temporally increment in customer numbers, I can increase product range*" are some of the expressions that represents the importance of analysis and decision support for store capacity usage. Moreover, with some statements like *"I would like to compare store branches in terms of store density and customer number trends*", managers emphasize the necessity of store density comparison of branches and evaluation of customer number trends via PCS.

**3.3. Working Hours:** In this category opening hours, cleaning time, maintenance hours, resting periods and resting times are the major factors. 36% of managers pay attention to those factors. According to managers' opinion, it is expected that PCS should advice about decision and analysis about those factors according to number of customers. For example, *"PCS should advice according to the number of customer in which period I should have store cleaned", "I need to know which time is most suitable for mealtime and staff resting time*", *"I can decide opening hours*" are some statements of managers about this category and factors.

**3.4. Personnel Working Hours:** Factors in this category focus on full-time and part-time personnel working hours rather than store operation times mentioned in previous category. For example, manager of the largest retailer in terms of part-time staff number in this study stated that PCS may suggest part-time staff working hours by taking their constraints into consideration. Furthermore, it is also the case for full-time personnel since retailers open over than 8-10 hours a day and all week days. That is to say, managers also point out full-time personnel working hours. For example, *"I can change working hours of experienced full-time staff according to number of customers during a week or a month"* is one the expression about the issue.

**3.5. Product Layout:** Managers participated in this study mention that the aisle, shelf and store design can be changed according to number of customers. For example, a manager stated that "*I can change location of best-selling products when customer number is higher than in average*". Another manager stated that "*I can re-design the store and aisles in order to have more free-space when number of customer in store continue to rise*".

**3.6. External Factors:** According to the findings retailer managers want to see the effect of external factors on number of customers. Traffic jam, weather forecasting, special days are the factors that form this category. For example two managers verbalize that they would like to know the change in number of customers according to the weather. "*I want to know how many customers prefer our store during the heavy traffic hours*" and "*I would like to know the difference among braches in terms of number of customers according to demographic information*" are other sample statements considered in this category.

**3.7. Rate of Return:** In this category, there are factors related with the proportion of number of customer having purchased to total number of customer visited the retailer, the ratio of income with product and staff information. *"I would like to know how many customers having purchased", "I would like to see the product sales according to number of customers", "I would like to see the profitability rate based on the customer count"* are some of the sample manager statements evaluated in this category.

These categories were defined based on the factors mentioned by managers participated in this study. It can be summarized from business functions perspective. Although most of the processes in store is inter functional, we can summarize the categories as follows (Table 4).

**Table 4:** Categories from business function point of view

| **Business Function** | **Categories** | **f** | **%** |
|---|---|---|---|
| Sales & Marketing | Promotion and Advertisement | 26 | 24.07 |
| | Capacity Usage | 25 | 23.15 |
| | Product Layout | 9 | 8,33 |
| | External Factors | 8 | 7.41 |
| | Return Rate | 8 | 7.41 |
| Human Resources | Working hours | 16 | 17,28 |
| | Personnel working hours | 16 | 17,28 |
| | ***Total*** | ***108*** | ***100*** |

**3.8 Reporting and Decisions without PCS**

In the last part of the study, managers were asked how they make decision and analysis considered in the third section without number of customer data. For each category, traditional decisions and reports are presented in Table 5.

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**Table 5:** Decisions and reports without number of customer data

| Category | Traditional Decision/Analysis |
|---|---|
| Promotion and advertisement | Sales record |
| | Competitors data |
| | Producers suggestions |
| Capacity usage | Sales record |
| | Forecasting/Estimation |
| Working (opening) hours | Rules of Mall |
| | Weekend / Workdays |
| | Holidays/Special days |
| Personnel working hours | Staff demands |
| | Part-time staff program |
| | Estimated work load |
| Product layout | Producer suggestions |
| | Product combine/Seasons/ Gender |
| | Store area |
| External factors | Seasonal forecasting |
| Rate of return | Targeted-performed ratio |
| | Forecasting//Estimation |

As shown in Table 5, promotion and advertisement activities have been carried out according to sales record, competitor's data, and producers' standards. Decisions and reporting in capacity usage and rate of return categories have been made basing on sales records and estimations in general. Working hours have been determined in traditional ways such as weekdays-weekend difference, shopping-mall rules, and some standards. For example, cleaning and maintenance have been made before opening the store or in accordance with the availability of employee in charge of. Personnel working hours were determined according to personnel pleasures, academic prom for part-time students or estimated store density. Similarly, decisions and analysis of external factors and product layout have been made according to estimations and forecasting. For example, managers take only seasons into consideration as an external factor.

### 3.9 Data Integration for Reporting and Decisions

In this part of the study according to the findings of third and fourth part of the data collection instrument, data integration is taken into account. Managers mention about some factors which are used to make decisions without number of customer data. This question was also asked to determine which data can be integrated to PCS. You can see data, business function and reporting/analysis/decision in Table 6.

**Table 6:** Decisions and report according to data used

| **Data** | **Report/Analysis** | **Decision** | **Respective BF** |
|---|---|---|---|
| Number of Customer (NC) | NC in Hours | Staff Planning<br>Security planning | Human Resources (HR) |
| | Store Density | Staff Planning<br>In store discount | Sales & Marketing (SM), HR |
| | NC in Yearly, Monthly, daily | Product Range,<br>PA planning,<br>Staff Planning,<br>Working Hours,<br>Opening hours,<br>Store cleaning scheduling<br>Maintenance scheduling | SM, HR |
| NC + Accounting Data | Rate of Return (RR) | Planning of experienced staff<br>Security planning | SM, HR, Accounting & Finance (AF) |
| Sales Record + NC | Product Base RR<br>Section base RR | Product range,<br>Shelf placement<br>Store design | SM |
| Sales Record + Staff Data + NC | Staff based RR | Staff planning,<br>Education Planning | HR |
| PA data + NC | NC change during the facilities<br>Promotion Evaluation | PA planning<br>PA rearrangement | SM |
| Special Days + NC | NC change according to special days | PA planning<br>Staff Planning<br>Stock Estimation | HR, SM |
| External Data (Whether forecasting, traffic jam, competitors information, demographic inf, etc.) + NC | RR according to ED (External Data)<br>NC change according to ED | Staff planning,<br>Stock planning,<br>Product range,<br>Store design,<br>PA planning, | HR, SM |

**4. Suggestions and Possible Applications**

In this study, people counter systems and integration of those systems as a reporting and decision support tool for organizations is investigated. Since the development of people counter systems is a purely technical issue, it is not directly in the scope of this

study. Nevertheless, key technical approaches towards these systems are mentioned in the literature section. Shortly, raw data (number of customers) that is provided by the people counter systems consists of entrance and exit time data for each customer.

In this part of the study, sample reports and graphics are presented based on the raw data produced by people counter systems and categories extracted through content analysis in the findings part. The data used for graph and reports produced randomly to show how information can be acquired from such raw data.

**4.1 Promotion and Advertisement:** In this category, as mentioned in findings part, number of customer data is mainly used to report the change in number of customer, and planning promotion and advertisement issues. It can be inferred that retailer managers expect from people counter systems to see the change and suggestion about these activities. In this respect a sample graph that can be constructed via such systems is shown in Figure 1. It is important to note that in this part of the study all reports and graphs presented here are created by dummy data.

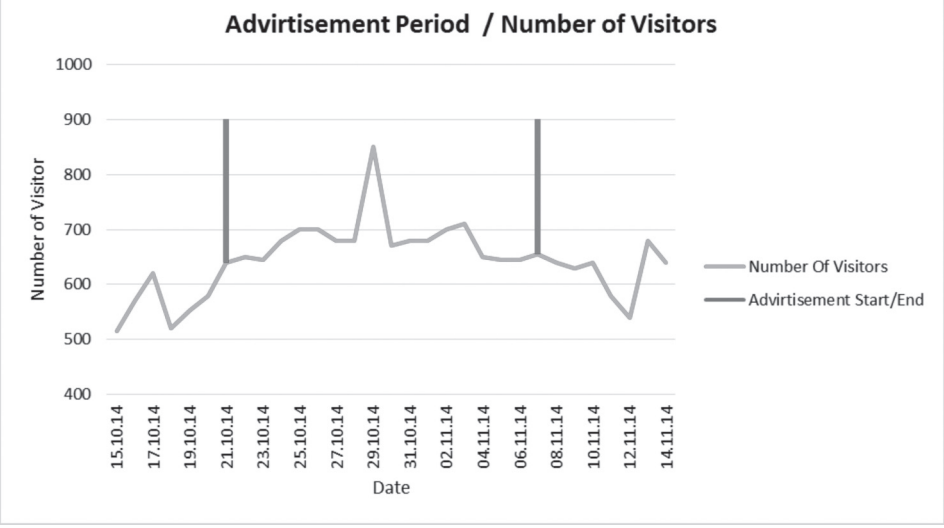


**Figure 1:** Number of customers through advertisement process

According to the managers opinions such graphs should be provided by people counter systems to see the effect of the advertisements. In addition to see this result, managers expected to see income change in this process. Such a graph can also be drawn by using sales records and it can be used for profitability analysis.

**4.2 Capacity Usage:** Managers of retailers wants to know the capacity usage ratio of their store in terms of personnel, service and product. By the raw data that people counter system produced, instant and hourly store density ratio can be extracted. For the

computation of this ratio, capacity of the store must be provided to the system (Figure 2). This value can be computed as store service capacity such as the number of customer that can be served in a given time. Moreover, active customer graph can be created with hourly entrance and exit numbers (Figure 3). This report may also include yearly, monthly, periodically and weekly change in customer number. As mentioned in the results, this analysis can also be made for comparison of branches. Managers mentioned that they can re-arrange product range basing on this reports. In short, this information can be used to apply yield management.

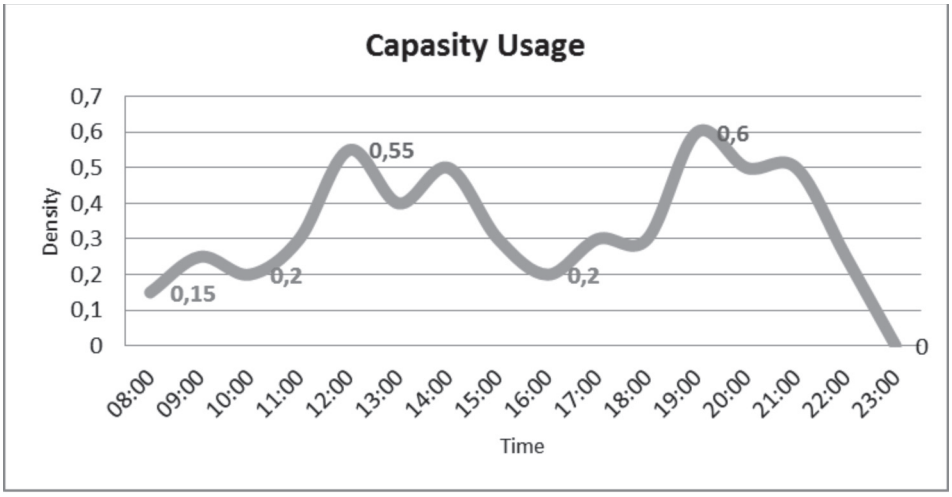


**Figure 2:** Capacity of store

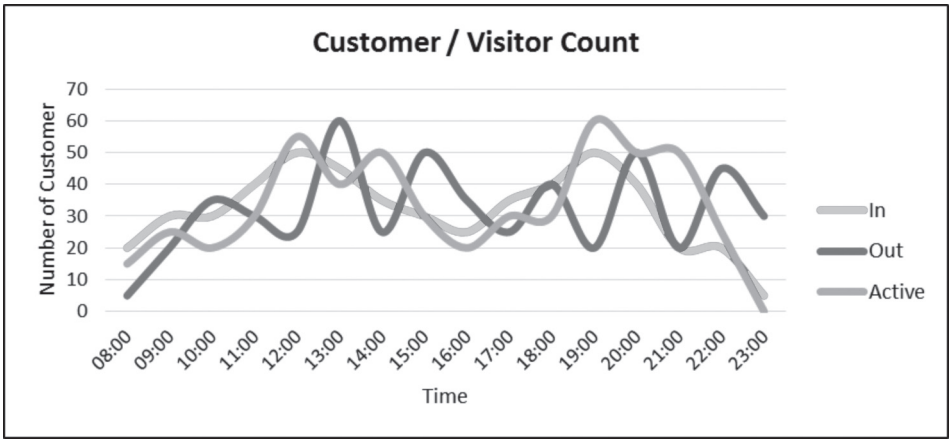


**Figure 3:** Number of customers

**4.3 Working Hours:** This category refers to staff breaks, opening hours of the store and cleaning/maintenance time factors. Managers expect decision support for such hours. For example, above data shows that 10:00 and 16:00 are the hours where the store density is the lowest (Figure 2-3). Accordingly, system can provide break time as 10:00 and 16:00 o clock. This can also be used to determine the appropriate hours for necessary activities such as shelf organization and store maintenance operations more efficiently.

**4.4 Staff Working Hours:** This category is specially related to planning human resources for full-time and part-time staff working hours. Although capacity usage information provided above can be used for part-time employment and staff planning in terms of quantity, the integration of the people counter data with sales record may also provide information to managers for personnel performance evaluation. For this, besides accounting reports, human resources data is also required. Furthermore, product or section staff can also be determined. Also, again, this analysis can be used for the performance comparison of part-time employees (Figure 4). To produce this graph, shopping rate value should be computed. Shopping rate is the ratio of number of customer purchasing and number of visitor. This is important for managers for planning experienced staff for the best fit of customer needs according to integration of number of customers and profitability analysis.

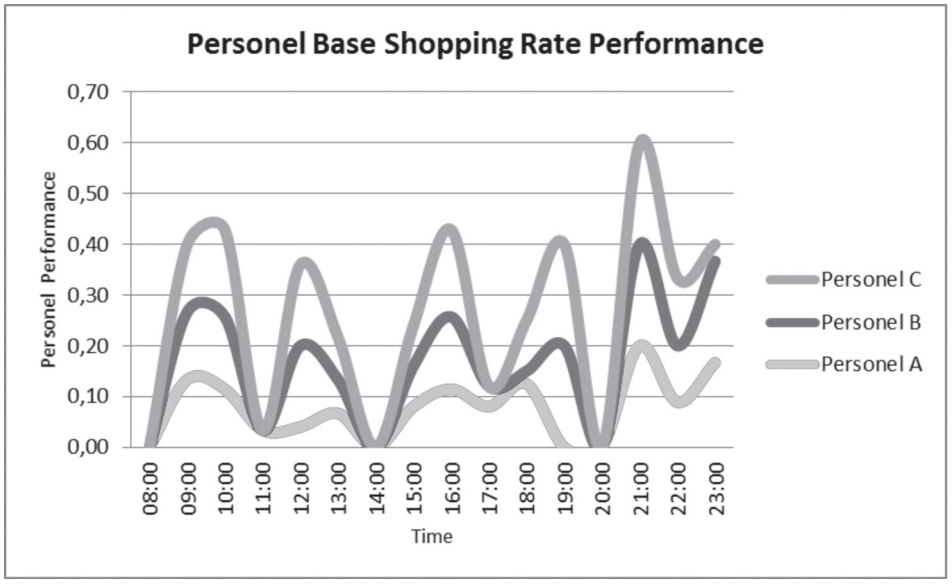


**Figure 4:** Personel performance based on number of visitor

**4.6 Product Layout:** In order to make decisions about product layout, sales record should be integrated with number of customers. This can be solved by using spatial analysis

techniques. However, it is out of scope of this study. Nevertheless, layout decisions may provide higher visibility and make customers to spend more time. This also provides change of potential customer to bona fide customers.

**4.5 External Factors:** Managers mentioned about the external factors such as whether condition, demographic information, and seasons that can affect number of customer. This analysis affects also their decision from staff planning to stock level as mentioned above. Sample demonstration of analysis produced by people counter system is shown in Figure 5. Other factors such as competitors, holidays, special days are evaluated in other categories.

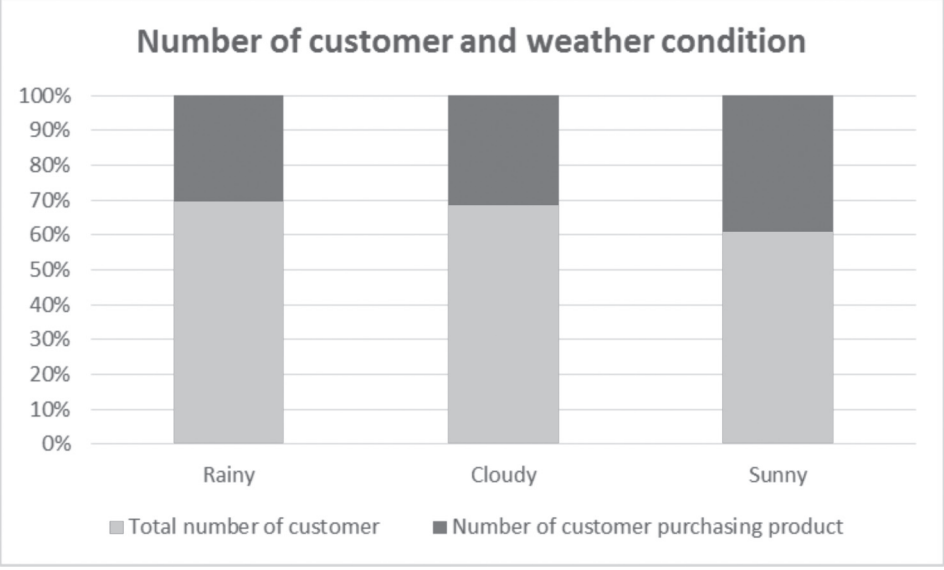


**Figure 5:** Sample demonstration about external factors category

**4.6 Rate of Return:** This category also can be named as shopping rate which show the rate of number of customer purchasing any items and number of visitor. The integration of accounting data such as receipts and visitor number may provide the purchasing ratio of potential customers. The proportion of daily numbers of customer exits to purchasing customers is used to compute this ratio. This ratio may also extracted by using number of sales data (Figure 6).

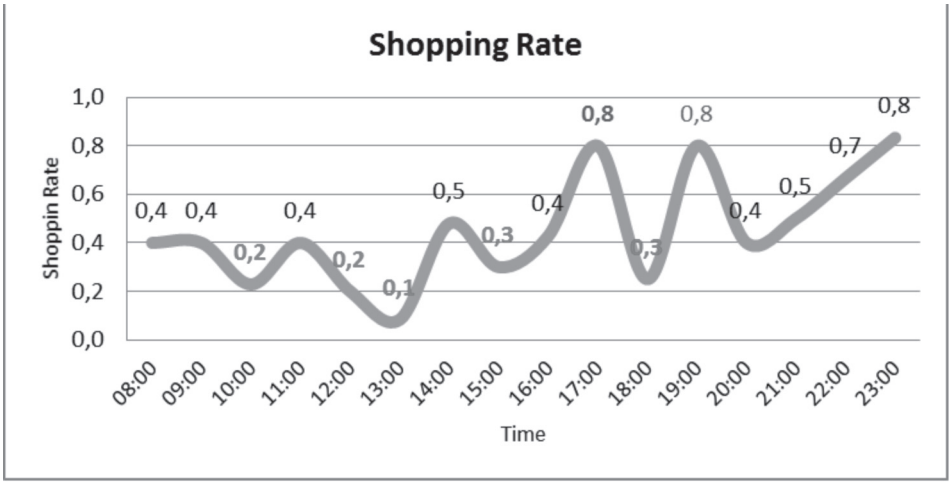


**Figure 6:** Shooping rate graph

For example, in the above graph, 80% of customers make a purchase between 17:00 – 18:00, whereas only 10% make a purchase between 12:00 – 13:00. This information also can be used both for sales and promotion planning, and for human resources management. However, all purchasing customers may not have a high profitability ratio. Yet, the proportion of hourly sales turnover to customer number provides information about profitability ratio (Figure 7). Information acquired through analyses can be used both for promotional activity planning and for staff planning for customer satisfaction (using experienced personnel in hours having high store density).

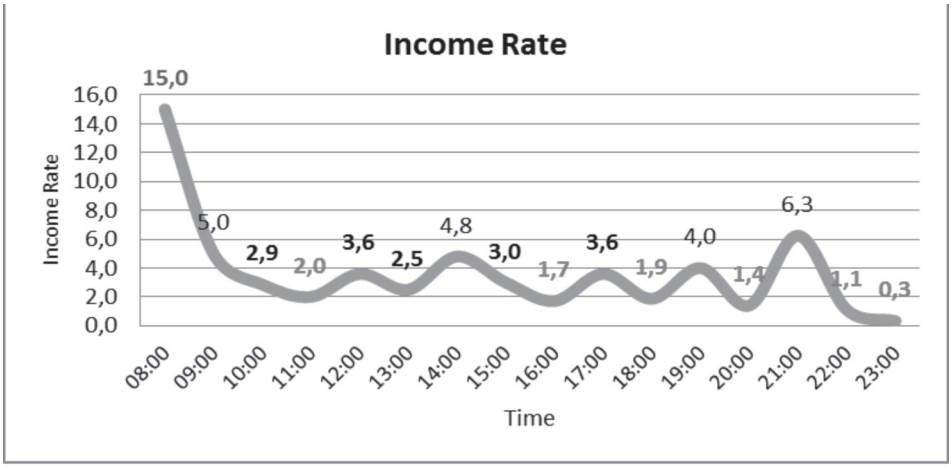


**Figure 7:** *Profitability ratio of customers*

For example, above graph indicates that customers with high profitability ratio visit the store between 08:00 – 09:00 and between 21:00 – 22:00. Similar to the above ones, these analyses can also be performed with averages of longer periods such as months or weeks.

Although, high sales hours can be determined by accounting records or sales records, product specific return proportions can help store managers to determine specifically layout decisions. Proportion of customer exits in a particular period of time and the sales amount of the relevant product provides product specific return ratio. Similar analyses can also be performed for each section of store (Figure 8).

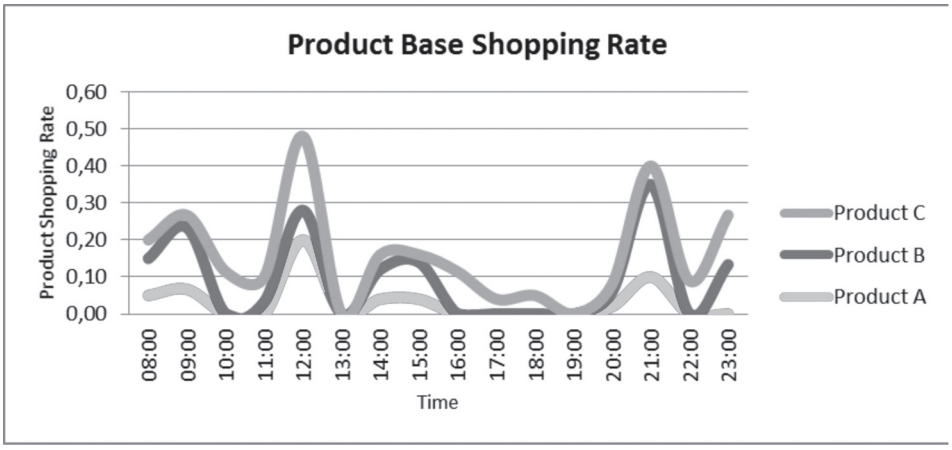


**Figure 8:** Shopping rate based on products

In the fourth part of the study, collected data will be used in conclusion part which is to define in which data PCS should be integrated in order to make managers to see common analysis with customer count data.

## 5. Discussion and Conclusion

People counting systems are the software, that are developed basing on image processing techniques, to count the number of people that passes through a particular region in a particular time period. There are limited studies that focus on the process of acquiring information from the raw data provided by this software in a way that is beneficial in operational decisions of organizations. This study, in addition to brief technical explanation and approaches of people counter systems, focuses on how managers can use the number of customer data from such application to make better decision. To do so, structured interviews were conducted with 44 clothing retail companies. In addition to managers and

companies demographic information, possible decision and reporting intention of those managers based on the number of customer data were collected. According to content analysis, seven main categories were identified based on the factors they mentioned. For each category, sample reporting and decision cases were exemplified.

It can be concluded that, the number of visitor or customer data can be used to produce different analysis and reports which support decision making process of managers. In order to increase the quality of such analysis, the data should be integrated with other data sources. This is also related about which data is used to be processed to extract information to support decision making. Stores having several branches can make above mentioned analysis and design for performance evaluation of each branch. Although it is not in the scope of this study, this information can be used for store comparison and evaluation for logistics, managers' performance, location decision making etc.

As previously mentioned, since people counter systems producers and developers mostly focused on the technical challenges, how PCS can be used for decision making for stores have not been made a point of. This study guide both developer and user of people counter systems to achieve the main aim of such technologies that focused on better decision making. However, people counter systems are not the silver bullet for whole possible decision model and analysis. This study may be extended to other retailer sectors such as food, furniture, technology, etc. Specification of other sectors requirements may provide more accurate and useful business intelligent applications and decision support systems. Moreover, integrating different technologies such as, gender detection, queue management, store heat analysis may support to make more accurate decisions.

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