Medical Device Tracking via QR Code and Efficiency Analyze

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***Abstract*--Anesthetic gases called Desflurane supplied by distributor Company to the hospitals. These anesthetic gases transferred to the patients in a controlled manner via medical devices named Vaporizer (VAP) which are integrated to the anesthesia devices; used especially in operating rooms. Updated hospital VAP inventories are reported to the head office by the sales team on a monthly basis. By tracking the monthly gas consumption of the VAP's, we are calculating the efficiency of devices per hospital. Thus, the performance metrics of the sales team can be evaluated. Which device; belongs to which hospital and under whose responsibility, device manufacturing date etc. can be easily observed at first look. However, missing/false statements have a huge negative impact on inventory, efficiency and performance indicators.**

The newly established tracking and analysis system, at the base of Clustering Method, comes with Quick Response (QR) Barcode systems which will be scanned via smartphones or tablets. The sales team easily share VAP's; current GPS Coordinates, correct inventory list and device data, responsible person etc. Analyzing and evaluation of inventory, efficiency and performance will be done clearly, trustable and easily. This will be an useful application, for such an integrated system already does not exist.

I. INTRODUCTION

Objective of this project based on QR Code Technology and it's environmental system which it belongs. QR code (Quick Response Code) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan.

The QR code system was invented in 1994 by Denso Wave. Its purpose was to track vehicles during manufacture; it was designed to allow high-speed component scanning. Although initially used for tracking parts in vehicle manufacturing, QR codes now are used in a much broader context, including both commercial tracking applications and convenience-oriented applications aimed at mobile-phone users. With this project, trackable hospital fixed assets like medical devices' inventories are reported to the head office by the sales team on a monthly basis. By tracking the monthly gas consumption of the devices', we are able to calculate the efficiency of device's per hospital. Thus, the performance metrics of the sales team can be evaluated. Which device; belongs to which hospital and under whose responsibility, device manufacturing date etc. can be easily observed at first look. However, missing/false statements have a huge negative impact on inventory, efficiency and performance indicators. VAP's; current GPS Coordinates, correct inventory list and device data, responsible person etc. Analyzing and evaluation of inventory, efficiency and performance will be done clearly, trustable and easily. This will be an useful application, for such an integrated system already does not exist

II. HISTORY OF BARCODE

The basic idea for the barcode came from Morse code but the dots where extended into lines that alternated black and white in a parallel fashion, and this is still the case today. The original method of scanning the barcode to identify the product was accomplished through high wattage light bulbs, 500 watts to start with, and was used in conjunction with a film industry photomultiplier. This increased the intensity of the light and made the scanning easier for the time being. As more and more companies needed to cut costs and wanted a system for inventory, more technology needed to be invented to make the system feasible. As the barcode history progressed, more ideas and innovations were developed and implemented.

The parallel lines we recognize as barcodes were not the only form of identification used in the development of barcodes. These are categorized as 2D barcodes or a matrix code. These complex codes were represented in patterns of dots, circles, and a variety and blending of geometric shapes. The complexity of the shapes allows this system to contain more data in a code, but wasn't used nearly as much as linear barcodes or 1D barcodes. These kinds of barcodes can be found in cellular phone applications such as encoding URLs and images, as well as purchased ticket information for movies and sporting events on a cellular phone. The barcode was initially created as a means to track retail store inventory. It originated in 1932 when students from Harvard created a card system to be used with printed catalogs.

The customer could pull the card out of the catalog and hand it to a store clerk. The store clerk would then use a mechanical reader to process the card, find product information, and then locate the item for the customer. Once the customer was delivered the item at the counter, store inventory information was updated and detailed, so that it could be accessed again when it was time to reorder. This kind of system naturally attracted attention from retailers, particularly grocers. Normal Woodland and Bernard Silver worked together to bring this solution to the grocery industry. Their quest began after eavesdropping on a conversation of the president of the Food Fair chain store, who was searching for a means of quick, easy product identification. After a few early versions, the barcode started out as a set of concentric circles, much like a bull's eye. With inspiration from Morse code, the inventors used concentric circles in a series of thicker & thinner lines. Initially, every item had its own unique ID, even for two items of the same product. They filed a patent for the new "Classifying Apparatus and Method," settling on what closely resembles the modern barcode.

Woodland and Silver sold the rights to their patent, which changed hands again, and wound up with RCA. The modern barcode, as we know it today, looks very similar to the original patent with lines of varying thickness but with digits lining the bottom. The modern barcode required a faster machine to read the codes, which was in the pipeline in the 1960s. The first recognizable commercial scanner was set up by RCA in a Kroger's grocery store. This new system was proclaimed the wave of the future. Other variations of the barcode had been implemented by this time — such as ones with reflective colors — and they all came together later in handheld scanners which were able to efficiently read codes with a laser.

IBM consultant George Laurer was assigned to create an optical code that could be used to identify products for merchants. He ended up creating a 12-digit code, which is still used to this day, known as the Universal Product Code (UPC). The UPC barcode's first 6 digits identify the manufacturer, while the last 6 digits identify the specific product. A thirteenth digit was later added as a country code to enable the UPC to be used all over the world. The first item to be scanned with Laurer's UPC was a pack of Wrigley's chewing gum at a Marsh supermarket in Ohio on June 26, 1974.

Fig 1. In the late 1960s, the Uniform Code Council was formed by grocery chains to find an easy method to speed up checkout. In 1984, the council helped apply the Uniform Communication Standards to Woodland & Silver's barcode so that data could easily be exchanged between barcodes and the store inventory systems across multiple retailers. The organization changed names again in 2005 and is now known as GS1 (US).

Owing to international adoption, a longer code was needed. The EAN — or International Article Number (originally European Article Number) — now made it possible for worldwide use. With the wide adoption of the EAN/UPC as standards, about 5 billion barcodes are scanned in the world every day. This allows retailers to track inventory supply and meet consumer demand. Global sourcing is made possible thanks to the UPC that allows manufacturing in one country and simple product identification in another.

2D barcodes, like the well-known "Quick Response" (QR) code, contain data horizontally and vertically rather than just horizontally as the traditional barcode does. This enables the storage of much more information, up to 7089 characters that can be accessed quickly. The very first 2D barcode was developed by Intermec Corporation in 1988, under the name Code 49. The current QR codes were rolled out in 1994 by a Japanese company named Denso-Wave. QR codes are public domain, so they can be generated for free at many websites. Even though QR codes can hold more data, they have not experienced the same level of widespread adoption as the UPC.

First revealed at the National Retail Federation's "Big Show" in 2014, the Digimarc Barcode represents the next evolution of the barcode. The Digimarc Barcode imperceptibly embeds the product's UPC/EAN data across the entire package, enabling all package surfaces to be scanned at checkout. This removes the need by cashiers to hunt for the traditional barcode at checkout. Digimarc-enabled packages can also be scanned by consumers via enabled smartphone apps to instantly access related mobile content and offers. [7]

Fig 2. Barcodes are mainly used to automate any process. However, there is not a complete automation when one uses a barcode as one has to scan the barcodes manually. Hence there is semi automation. Barcodes are used in various sectors and have many uses. It is used in retail sector (at the billing counter), pharmaceutical industries, hospitals (recording patient's data), packaging industries (for authenticity), manufacturing units (for efficient production line), warehouses (for inventory management), hotels. These are very few uses of barcodes in some of the sectors. They can be used to automate other processes too in the above mentioned sectors. Chia-Sheng Chang, 2013

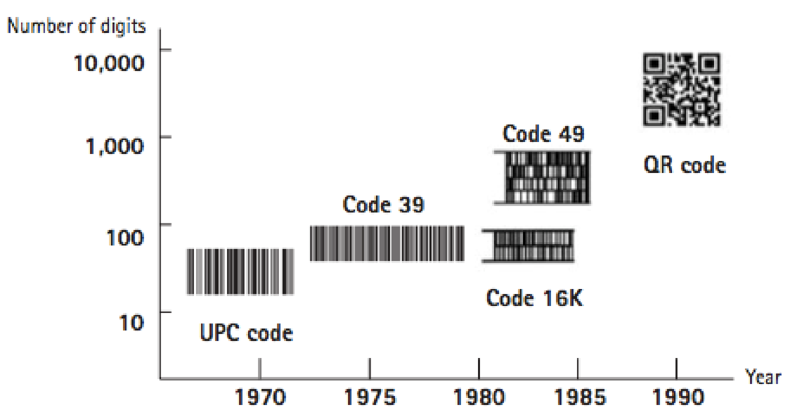


Figure 1 History of Barcode [7]

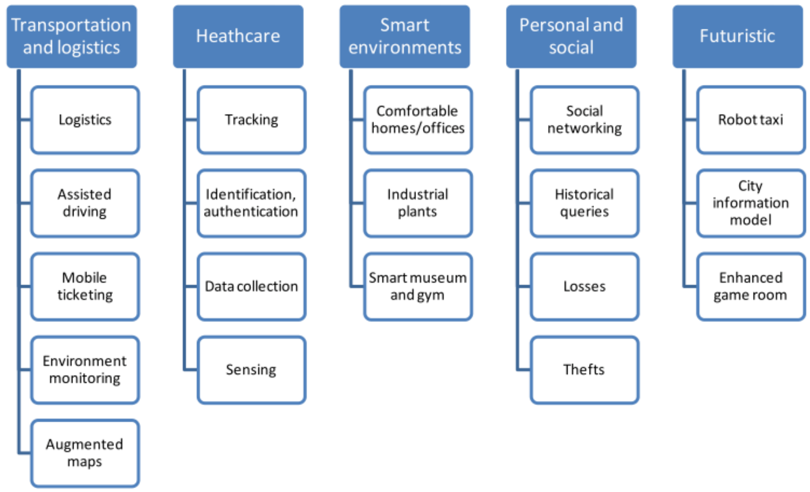


Figure 2 Usage areas of Barcode

QR code (abbreviated from Quick Response Code) is the trademark for a type of matrix barcode (or two-dimensional barcode) first designed for the automotive industry in Japan. A barcode is a machine-readable optical label that contains information about the item to which it is attached. Fig 3.A QR code uses four standardized encoding modes (numeric, alphanumeric, byte/binary, and kanji) to efficiently store data; extensions may also be used. [5]

The QR Code system became popular outside the automotive industry due to its fast readability and greater storage capacity compared to standard UPC barcodes. Applications include product tracking item identification, time tracking, document management, and general marketing. However, QR codes aren't just a stuffy technology used to track items in warehouses and scan products at the checkout counter. They've moved into the consumer realm, where they're found all over the place on advertisements, business windows, product packaging, billboards on the side of the road and even on some websites.[8]

A. Definition of Medical Device

Fig 4. A medical device is "an instrument, apparatus, implement, machine, contrivance, implant, in vitro reagent, or other similar or related article, including a component part, or accessory which is:

- recognized in the official National Formulary, or the United States Pharmacopoeia, or any supplement to them,
- intended for use in the diagnosis of disease or other conditions, or in the cure, mitigation, treatment, or prevention of disease, in man or other animals, or

intended to affect the structure or any function of the body of man or other animals, and which does not achieve any of its primary intended purposes through chemical action within or on the body of man or other animals and which is not dependent upon being metabolized for the achievement of any of its primary intended purposes.

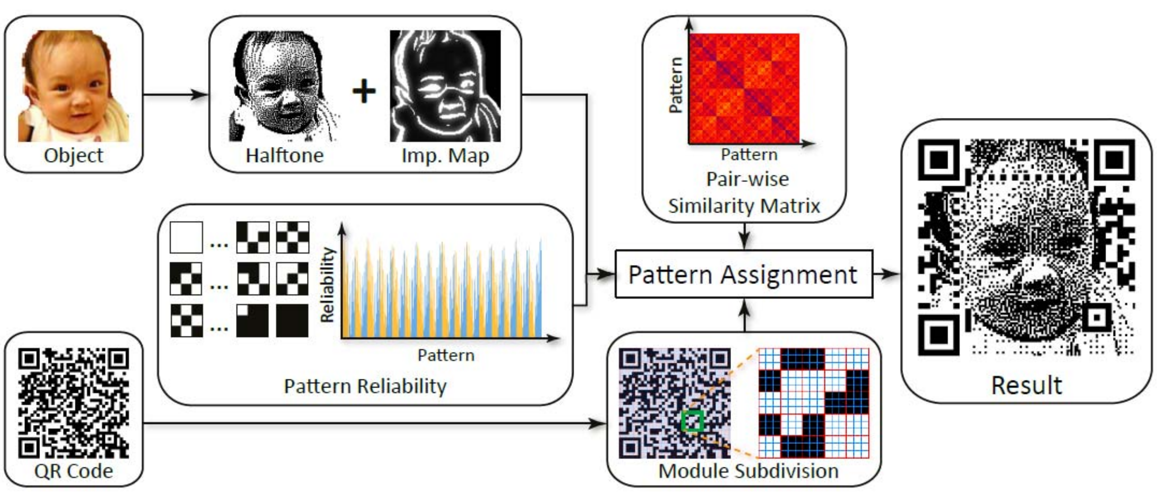


Figure 3 QR Creating QR Code [5]

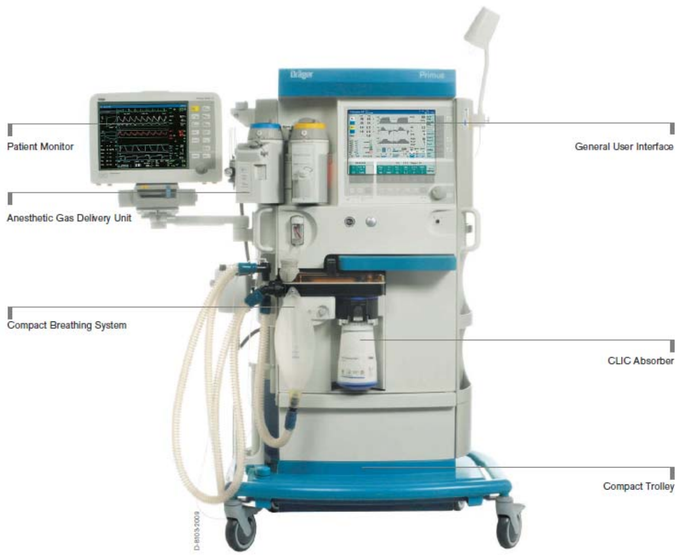


Figure 4 Anesthesia Device [6]

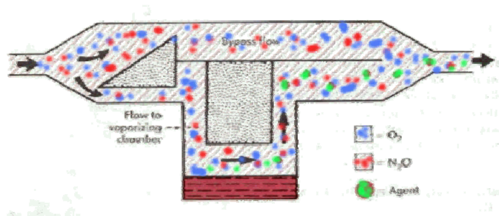
B. Anesthesia Device and Vaporizer

The anesthesia machine is a tool used by anaesthesiologists, nurse anaesthetists, and anaesthesiologist assistants to deliver anesthesia to patients undergoing surgical procedures. The most common anesthesia machines are designed to provide and deliver patients with an accurate and continuous supply of medical gases (oxygen and nitrous oxide), mixed with an accurate concentration of anesthesia vapor (isoflurane). Modern anesthesia machines incorporate a ventilator, suction unit, and patient monitoring devices.

Fig. 5 An anesthesia vaporizer is a device generally attached to an anesthesia machine which delivers a given concentration of a volatile anesthesia agent. It works by controlling the evaporation of anesthesia agents from liquid, and then accurately controlling the concentration in which these are added to the fresh gas flow. [6]

The design of these devices takes account of varying

- ambient temperature
- fresh gas flow
- Agent vapour presure



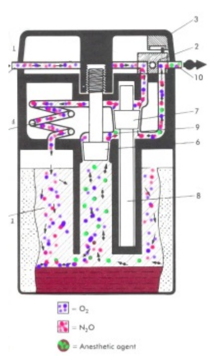


Figure 5 Vap [6]

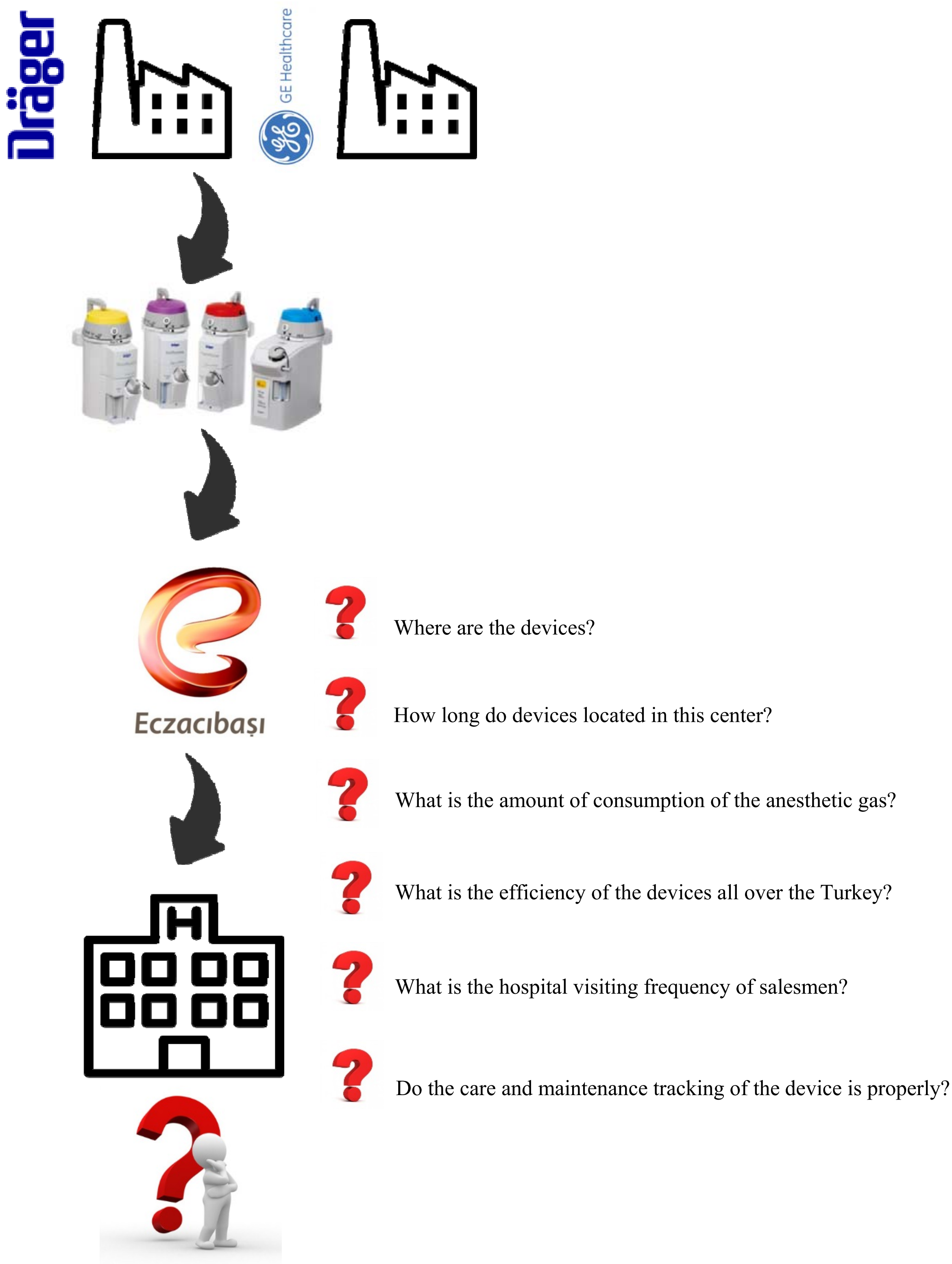
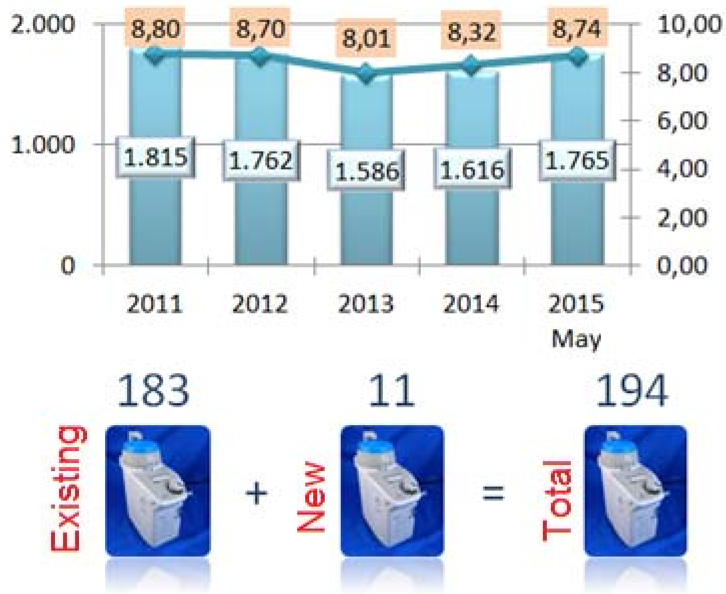


Figure 6 WorkFlow diagram without QR Code

Figure 7 WorkFlow diagram with QR Code

Istanbul VAP Efficiency



Low Efficiency Hospitals - ISTANBUL

*effiency below 5

Hospital	VAP (piece)	GAS CONSUMPTION						EFFICIENCY
		JAN	FEB	MAR	APR	MAY	TOTAL	
OKMEYDANI EĞİTİM VE ARAŞTIRMA HASTANESİ	16	68	84	83	90	64	389	4,86
AVCILAR MURAT KÖLÜK DEVLET	3	12	16	16	4	0	48	3,20
TEKİRDAĞ DEVLET HASTANESİ	2	0	0	0	0	30	30	3,00
HASEKİ EĞİTİM VE ARAŞTIRMA HASTANESİ	9	50	0	22	0	0	72	1,60

Amount of low efficiency VAP : 30

Amount of low efficiency Center : 4

Figure 8 Istanbul efficiency analyze

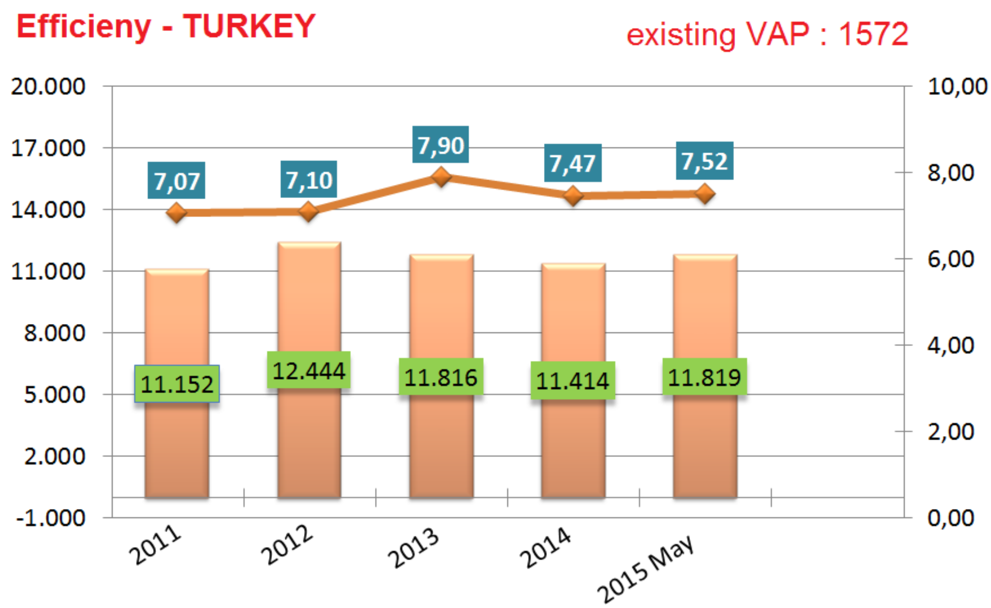


Figure 9 Turkey efficiency and consumption analyse

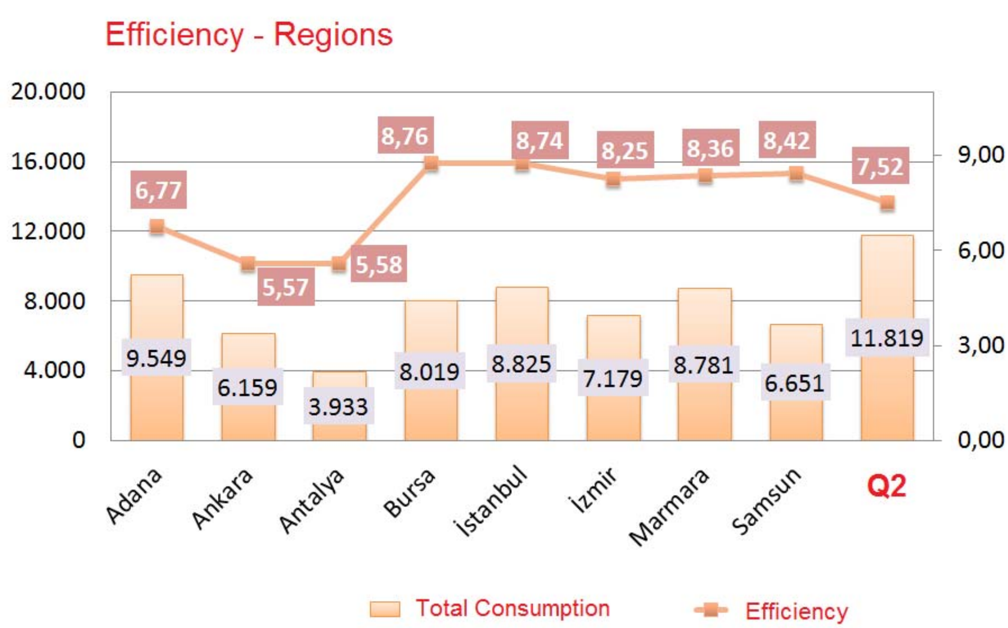


Figure 10 Region's efficiency and consumption analyze

III. METHODOLGY

The frequency of hospital visits according to customer segmentation and the efficiency of the indicator device according to the classification process, which is one of the multivariate statistical analysis is made by clustering methods.

A. Clustering

The goal of clustering is to reduce the amount of data by categorizing or grouping similar data items together. Such grouping is pervasive in the way humans process information, and one of the motivations for using clustering algorithms is to provide automated tools to help in constructing categories or taxonomies [Jardine and Sibson, 1971, Sneath and Sokal, 1973]. The methods may also be used to minimize the effects of human factors in the process.

Hierarchical clustering proceeds successively by either merging smaller clusters into larger ones, or by splitting larger clusters. The clustering methods differ in the rule by which it is decided which two small clusters are merged or which large cluster is split. The end result of the algorithm is a tree of clusters called a dendrogram, which shows how the clusters are related. By cutting the dendrogram at a desired level a clustering of the data items into disjoint groups is obtained.

Partitional clustering, on the other hand, attempts to directly decompose the data set into a set of disjoint clusters. The criterion function that the clustering algorithm tries to minimize may emphasize the local structure of the data, as by assigning clusters to peaks in the probability density function, or the global structure. Typically the global criteria involve minimizing some measure of dissimilarity in the samples within each cluster, while maximizing the dissimilarity of different clusters. [3]

B. Euclidean distance

The Euclidean distance between points p and q is the length of the line segment connecting them ($\overline{\mathbf{pq}}$).

In Cartesian coordinates, if p = (p1, p2,..., pn) and q = (q1, q2,..., qn) are two points in Euclidean n-space, then the distance (d) from p to q, or from q to p is given by the Pythagorean formula:

$$\mathrm{d}(\mathbf{p},\mathbf{q}) = \mathrm{d}(\mathbf{q},\mathbf{p}) = \sqrt{(q_1-p_1)^2+(q_2-p_2)^2+\cdots+(q_n-p_n)^2}$$

$$= \sqrt{\sum_{i=1}^{n}(q_i-p_i)^2}. \quad (1)$$

The position of a point in a Euclidean n-space is a Euclidean vector. So, p and q are Euclidean vectors, starting from the origin of the space, and their tips indicate two points. The Euclidean norm, or Euclidean length, or magnitude of a vector measures the length of the vector:

$$\|\mathbf{p}\| = \sqrt{p_1^2+p_2^2+\cdots+p_n^2} = \sqrt{\mathbf{p}\cdot\mathbf{p}}, \quad (2)$$

where the last equation involves the dot product.

A vector can be described as a directed line segment from the origin of the Euclidean space (vector tail), to a point in that space (vector tip). If we consider that its length is actually the distance from its tail to its tip, it becomes clear that the Euclidean norm of a vector is just a special case of Euclidean distance: the Euclidean distance between its tail and its tip.[3]

The distance between points p and q may have a direction (e.g. from p to q), so it may be represented by another vector, given by

$$\mathbf{q}-\mathbf{p} = (q_1-p_1, q_2-p_2, \cdots, q_n-p_n) \quad (3)$$

In a three-dimensional space (n=3), this is an arrow from p to q, which can be also regarded as the position of q relative to p. It may be also called a displacement vector if p and q represent two positions of the same point at two successive instants of time.

The Euclidean distance between p and q is just the Euclidean length of this distance (or displacement) vector:

$$\|\mathbf{q}-\mathbf{p}\| = \sqrt{(\mathbf{q}-\mathbf{p})\cdot(\mathbf{q}-\mathbf{p})}. \quad (4)$$

which is equivalent to equation 1, and also to:

$$\|\mathbf{q}-\mathbf{p}\| = \sqrt{\|\mathbf{p}\|^2+\|\mathbf{q}\|^2-2\mathbf{p}\cdot\mathbf{q}}. \quad (5)$$

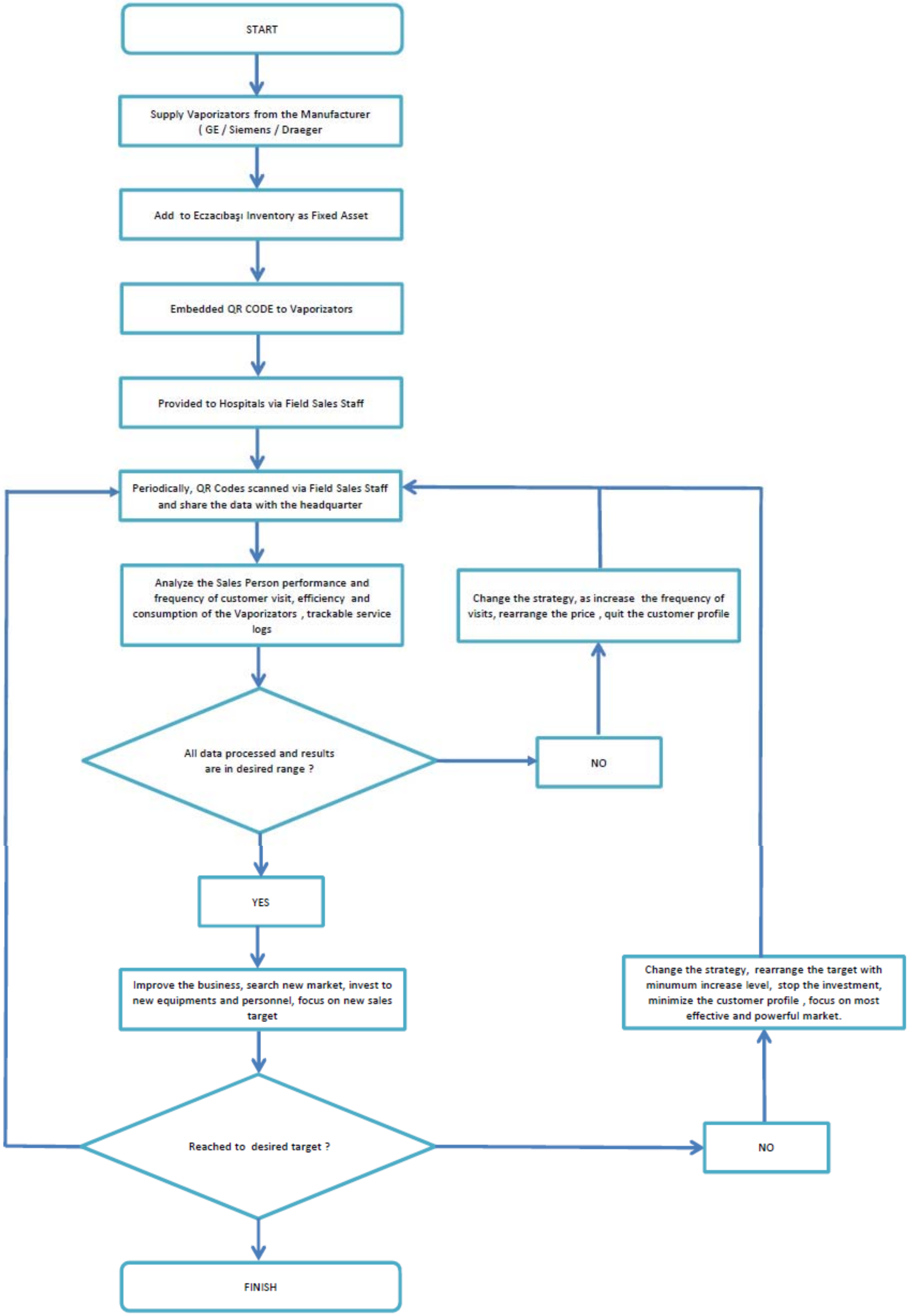


Figure 11 WorkFlow diagram of Project

IV. APPLICATION AND RESULTS

Used SPSS 22 software to configure the efficiency and consumption. As a result of the configuration, the printout listed below.

Analysis computed with “ *TwoStep Cluster Method* ”.
A list of hospitals from Marmara Region with different variables is listed above. With TwoStep Cluster method, inputs and outputs as shown below; Table 1.

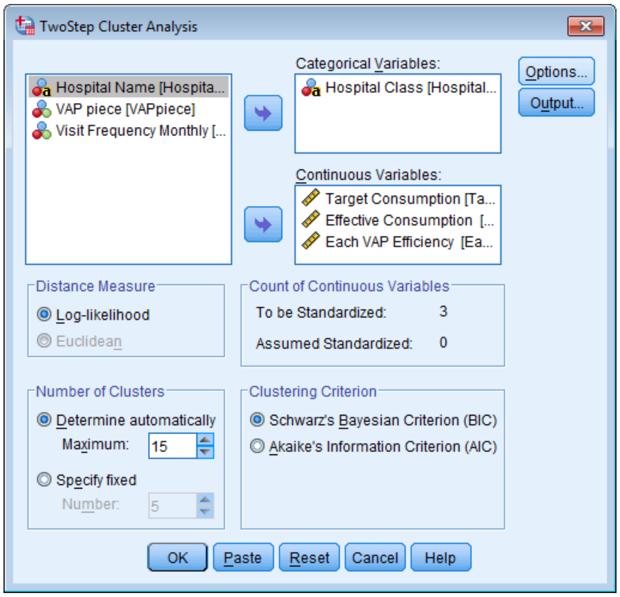
Categorical Variable; Hospital Class
Class C – Effective Gas Consumption 0 – 150 bottle*
Class B – Effective Gas Consumption 151 – 1000 bottle
Class A - Effective Gas Consumption +1000 bottle
*a bottle of desflurane gas is 240 ml

Continuous variables;
Target Consumption, Effective Consumption and Efficiency of each VAP. Table 2.

TABLE 1. LIST OF DATA

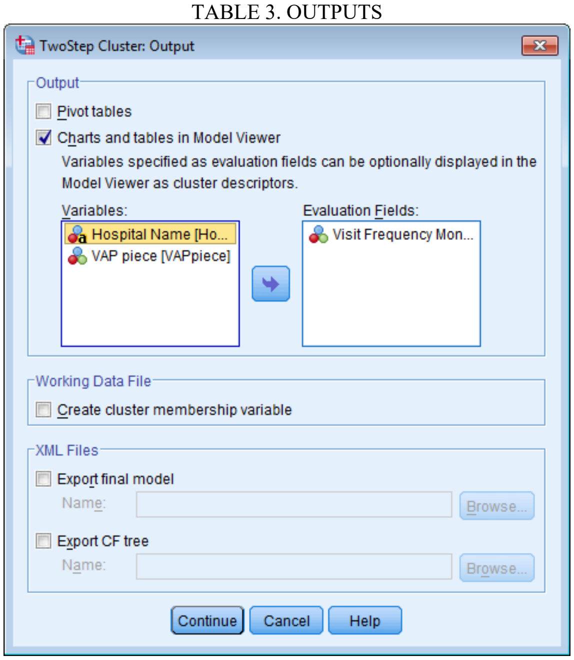
Hospital Name	Hospital Class	VAP piece	Target Consumption	Effective Consumption	Each VAP Efficiency	Visit Frequency Monthly
ACIBADEM HALKALI HOSPITAL	A	11	1250	1952	22,18	2
AMERİKAN HOSPITAL	B	14	1300	986	8,80	2
AVCILAR MURAT KÖLÜK DEVLET	C	2	100	48	3,00	3
BAĞCILAR EĞİTİM VE ARAŞTIRMA HOSPITAL	B	8	100	260	4,06	3
BAHÇELİEVLER DEVLET HOSPITAL	B	4	100	210	6,56	4
BAKIRKÖY RUH	B	2	250	170	10,63	2
BAKIRKÖY SADİ KONUK EA HOSPITAL	A	11	800	1210	13,75	2
BEZM-İ ALEM VAKIF ÜNİVERSİTESİ	C	3	100	10	0,42	4
CERRAHPAŞA TIP FAKÜLTESİ	A	25	1500	1500	7,50	5
ÇAPA TIP FAKÜLTESİ	C	29	1000	10	0,04	2
ETHİCA İNCİRLİ HOSPITAL	A	7	1100	1530	27,32	4
GAYRETTEPE FLORENCE NIGHTINGALE HOSPITAL	B	6	700	360	7,50	1
HASEKİ EĞİTİM VE ARAŞTIRMA HOSPITAL	C	5	500	10	0,25	2
İLGİ HOSPITAL	C	2	420	246	15,38	1
İSTANBUL EĞİTİM VE ARAŞTIRMA HOSPITAL	B	13	1150	550	5,29	4
KANUNİ S.S.EAH	C	5	100	150	3,75	3
KOÇ ÜNİVERSİTESİ TOPKAPI KAMPÜSÜ	C	6	500	204	4,25	5
MALKARA DEVLET	C	1	100	66	8,25	2
MEDICAL PARK BAHÇELİEVLER HOSPITAL	B	8	700	540	8,44	1
OKMEYDANI EĞİTİM VE ARAŞTIRMA HOSPITAL	B	14	800	560	5,00	4
ÖZEL BALAT HOSPITAL	C	2	100	120	7,50	4
ÖZEL ESENCAN HOSPITAL	C	1	100	30	3,75	3
ÖZEL İSTANBUL ANESTETİC	B	3	100	462	19,25	3
SARIYER DEVLET HOSPITAL	C	1	100	10	1,25	5
MEDİLİFE HOSPITAL	C	1	252	10	1,25	2
ÇAĞLAYAN FLORANCE	C	1	200	10	1,25	4
ŞİŞLİ ETFAL EA HOSPITAL	A	18	2330	1380	9,58	2
TEKİRDAĞ DEVLET HOSPITAL	C	1	100	300	37,50	1
TRAKYA ÜNİVERSİTESİ TIP FAKÜLTESİ	B	3	1200	600	25,00	3
YEDİKULE GÖĞÜS HASTALIKLARI HOSPITAL	C	1	100	10	1,25	1

TABLE 2. INPUTS



Evaluation Field selected as; Frequency of visit.Table 3.

TABLE 3. OUTPUTS



By this, observing and analyzing the frequency of customer visit via inputs will be available.

The Clustering via TwoStep result can be seen on Table 4.

TABLE 4. CLUSTERS AND MODEL

Clusters

Input (Predictor) Importance

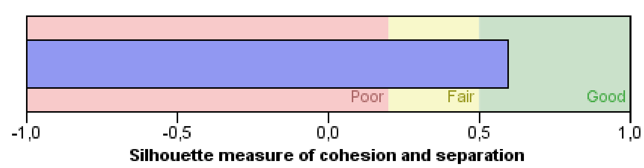
1,0 0,8 0,6 0,4 0,2 0,0

Cluster	3	2	1
Label			
Description			
Size	50,0% (15)	33,3% (10)	16,7% (5)
Inputs	Effective Consumption	Effective Consumption	Effective Consumption
	Hospital Class C (100,0%)	Hospital Class B (100,0%)	Hospital Class A (100,0%)
	Target Consumption 251,47	Target Consumption 640,00	Target Consumption 1.396,00
	Each VAP Efficiency 5,94	Each VAP Efficiency 10,05	Each VAP Efficiency 16,07

Model Summary

Algorithm	TwoStep
Inputs	4
Clusters	3

Cluster Quality



Algorithm is TwoStep,

4 inputs as ; Hospital Class, Target Consumption, Effective Consumption and Efficiency

The Quality of Cluster is in “Good” range with this outputs and inputs.

Means the focused target is Class C Hospital Group by %50 of whole customer visit (15/30). This logically shows that, low potential of customer profile with less target consumption can be improve by more customer visit via field sales/service specialists. 15 of 30 visits will be dedicated to class C to be more effective. It is more clearly to see with pie chart below. Figure 12.

New business model with this variables supports to penetrate the market with low consumption values. Class C Group Hospitals as in Table 5.

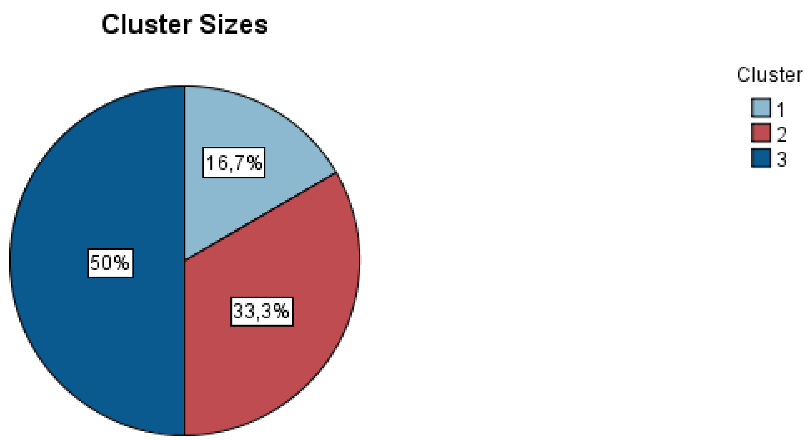
By dedicating % 50 of customer visit to Class C Group, VAP Efficiency and Gas consumption increase desired. At the end, this model will be applied to all Country.

Additionally inputs and outputs will be managed as; Frequency of visit and Hospital Class. Target Consumption will be set as an output. Evaluation of new target values will be done with 3 Clusters too.

Fig 12. Small size of cluster is dedicated to Class A Group which has a huge potential, efficiency and consumption. This group do not need to be aggressively focused on. Just % 16,7 is enough to keep the market stable for the moment as a result of business model.

TABLE 5. C CLASS HOSPITALS – NEEDS MORE FREQUENT VISIT.

AVCILAR MURAT KÖLÜK DEVLET
BEZM-İ ALEM VAKIF ÜNİVERSİTESİ
ÇAPA TIP FAKÜLTESİ
HASEKİ EĞİTİM VE ARAŞTIRMA HOSPITAL
İLGİ HOSPITAL
KANUNİ S.S.EAH
KOÇ ÜNİVERSİTESİ TOPKAPI KAMPÜSÜ
MALKARA DEVLET
SARIYER DEVLET HOSPITAL
MEDİLİFE HOSPITAL
ÇAĞLAYAN FLORANCE
TEKİRDAĞ DEVLET HOSPITAL
YEDİKULE GÖGÜS HASTALIKLARI HOSPITAL



Size of Smallest Cluster	5 (16,7%)
Size of Largest Cluster	15 (50%)
Ratio of Sizes: Largest Cluster to Smallest Cluster	3,00

Figure 12. Cluster Sizes

V. CONCLUSION

Approximately 3000 VAP devices' technical service transactions like annual and periodic maintenance, repair, scrap process, etc. will be tracked and monitored in real time via serial numbers.

The instant device can be provided to hospitals in urgent cases will be swapping. The device, on the basis of anticipated cost of services and, if necessary, The device may be scrapped if it is inefficient. Thus, the analysis of data are monitored in a transparent manner.

How many pieces of anesthesia gases consumption per device should be clearly identified and the relevant data of consumption of anesthesia agent the hospital where the device is located. Thus, hospital inventory and the device budget easily trackable and managable.

Main responsibility of the sales team is to keep the devices working. The devices gas consumption is optimized as 8 piece/month. If the hospital consumption is about 5 piece/ month, this center must be visited more than before to keep the consumption ratio around 8 or if the team could not manage to increase the ratio, company do not enter any tender belongs to that hospital anymore. Salesmen will focus on high potential centers.

Every since Smartphones hit the market, QR Codes have multiplied exponentially as a vital component of every self-respecting advertisement, product or company and have recently even began to appear on most people's business cards. QR Codes, easily scannable codes that redirect the scanner to a destination of the creator's choice, are used in numerously ingenious fashions and are an incredibly useful tool for making your product, company or site, accessible and engaging in a creative manner.

All types of information quickly and easily embedded into QR codes and rapidly share with the recipients.

Tracking with QR barcodes has different types and methods. Main aim is a trackable and an analyzable system. The advantage of this project is being dynamic. Acting rapidly and solution oriented.

Additionally, for the post, the project will be designed for other medical devices such as transfusion which is mainly used in the blood banks. In transfusion centers donors donate the blood and the blood center gets different kinds of cells such as Plasma, RBC (Red Blood Cell), WBC (White Blood Cell) etc. The Donor information, type of needed blood cell and the patient details will be available to track with this project.

Briefly, budget, work performance, devices efficiency and gas consumption are under control and easy to manageable. The main reason of the problems can easily solved. Critical points will be evaluated more detailed and the main focus oriented.

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VI. DISCUSSION

This project provides, tracking of hospital fixed assets like medical devices' inventories and reported to the head office by the sales team on a monthly basis. By this monthly, quarterly and annually, gas consumption of the devices', performance metrics of the sales team can be evaluated. And can be easily observed at first look. Also by getting the current GPS Coordinates of devices via software, this is critical to have, analyze and evaluate the correct inventory list and device data, responsible person etc.

Clustering method is useful in this case. Different types of attributes getting easily manageable and changeable. A "clustering" is essentially a set of such clusters, usually containing all objects in the data set. Additionally, it may specify the relationship of the clusters to each other such as "Number of hospital visit " and " Amount of sold product " etc. This two variables are in a strong relationship each other.

There are many ways of tracking but the main idea in deep is not only physical tracking. The current location via GPS is improved. By this exact point is clear when the device is stable. And the missing problem of devices is solved. Measuring the sales person performance is more clear. Evaluation of customer visits are certain and adjustable. Consumption and efficiency can be evaluated easily and rapidly. Business strategies are effectively manageable on time. All input variables are flexible and adjustable according to business models even outputs figures out the success of the strategy at the end.

This model will apply to whole regions and different market by adjusting the variables of inputs and outputs.

REFERENCES

[1] Wen-Yuan Chen, Jing-Wein Wang: 'Nested image steganography scheme using QR-barcode technique, 06 May 2009.

[2] Yue Liu, Ju Yang, Mingjun Liu: 'Recognition of QR Code with mobile phones' , Control and Decision Conference, 2-4 July 2008. CCDC 2008. *Chinese*

[3] Mu-Chun Su, Chien-Hsing Chou: '*A Modified Version of the K-Means Algorithm with a Distance Based on Cluster Symmetry' , Published by the IEEE Computer Society, Issue No.06 - June (2001 vol.23)*

[4] Andrew Y. Ng Michael I. Jordan Yair Weiss : '*Advances in Neural Information Processing Systems 14' , On spectral clustering analysis and algorithm, 2002*

[5] Chu, Hung-Kuo., Chang, Chia-Sheng: 'CM Transactions on Graphics' , *Halftone QR Codes Vol. 32, No. 6, Article 217,* 2013

[6] Dräger Medical GmbH Product Brochure, 2014

[7] Soon, Tan Jin: '*QR Code, Synthesis Journal', 2008*

[8] Irvine, Martin.; '*QR Code: Connection, interface and actant' , 2012*

[9] Tai-Wei Kan, Chin-Hung Teng, Wen-Shou Chou; '*Applying QR Code in Augmented Reality Applications' , Japan, 2009*

[10] D. Deugo; '*Using QR-Codes for Attendance Tracking' , Canada, 2015*