Inventory Management KPIs, Tools and Techniques with Conflict Handling

Suraj Kumar Tiwary[1], Prashant Barge[2], Vandana Sonwaney[3]

[1] Symbiosis Institute of Operations Management, Nashik, Symbiosis International University (Deemed University), Pune, India

[2] Assistant Professor, Symbiosis Institute of Operations Management, Nashik, Symbiosis International (Deemed University), Pune, India

[3] Professor, Symbiosis Institute of Operations Management, Nashik, Symbiosis International (Deemed University), Pune, India

Email: [1]suraj.tiwary@siom.in

ABSTRACT

Inventory Management is the vital part in the Supply Chain Management. Operations has been researched quite a lot but inventory management especially stock forecasting, conflict management in inventory and best practices has not been discussed fully. The various aspects of the inventory management are being discussed in this paper.

Inventory Management increases the profit for the organization. Better inventory Management Practices reduces the cost. The concept of JIT i.e. Just in time comes handy in this. In this, we procure only when the raw materials are required for production. So, forecasting what quantity of the specific material is required at the particular point of time is very much essential. In this regard, one model has been explained to explain or plan the amount of raw materials required as a stock in our inventory that will be exactly sufficient to cater the demand. It is also not desirable to maintain the stock of the finished goods in our warehouse. So, to forecast the demand also plays the vital role.

EOQ Model i.e. Economic order Quantity has been linked and various KPIs of the inventory management has been discussed. The role of strategically placing and storing the materials in the warehouse has been stated with example.

Good inventory management makes the good coordination between the different verticals of the organization and helps in better planning and execution. What concepts can be implemented to integrate the Top-line and Bottom-line is being brainstormed in the paper. Building a strategic inventory management plan is very much essential for the organization sustainability and success. Here in this paper, conflict management in inventory has been discussed.

The results and concepts explained of above pain points in inventory management like items forecasting according to demand at particular point, Inventory KPIs, allocating strategic place in warehouse, conflict management due to different interests and all will help future project managers to understand and to perform better in this particular field.

Keywords

Industry, Automotive, Services, key-performance-indicators, Workforce, Raw-items, Economic Order Quantity etc.

Introduction

Car wash industry has been started 200 years ago. So as mentioned, automotive industry is having cut-throat competition for capturing the market share because there are many players in the particular market boundary. This is because, the barriers to entry in this type of business is very low. Supplier dominance is little high as raw items used are scarce imported chemicals. There are many kinds of car wash services available in the market. Some of them are, water wash, waterless eco-wash, car-waxing, interior & exterior detailing, paint protection washes and etc. The car wash company which is into the wide range of services generally have higher market share and it is quite tough to have Various proficiency in workforce.

The service industry has been chosen who is into the car wash services. When it comes to service industry, the accuracy of the forecast of demand of services at particular time phase becomes important. If we are expecting a high erroneous demand then we may stock high quantities of raw items in our warehouse. In car wash industry, it will high impact the cash flow of the organization as the raw items i.e.; mainly chemicals used in car services are very costly and of less product life cycle. At the same time, we can't afford to lose the customer orders because of the stock-out of particular item as the competition is so high in this field and first impression generally makes a lasting impact.

Now, if we have correctly forecasted the raw items required in catering the demand of the particular time phase, checking the performance of the inventory becomes very important for the sustainability of the business. This can be best done by the key performance indicators. We will

discuss about the ideal value range of the KPIs in inventory management.

As different department of the management has different interests in maintaining inventory. The conflict and cold war ay be seen among departments. We will see how to resolve the conflicts in maintaining of inventory management. This is widely discussed in all platforms but the way ahead to cope or solution part is not discussed in full capacity.

We will just unfold some aspects of the inventory management that has been discussed above in the paper.

Literature Review

DR. ASHOK KUMAR PANIGRAHI (2013) has talked about the relationship between the inventory management and profitability of the organization particularly cement industries. He has talked of the efficient working capital management. He has talked of the cash flow, in other words frequent turning of the inventory for the organization. He has taken some finance ratios like regression analysis for determining inventory turnover against gross operating profit. The other Key-performance-ratios are not taken into considerations like ideal value of the inventory turnover ratio for the service industry, inventory days and inventory trendline and all. We will take other indicators in view in this paper.

Masudin and et. al (2018) ha stalked of the Impact of Inventory Management and Procurement Practices on Organization's Performance. He has talked about the inventory management practices and its framework. He has also touched upon the customer satisfaction part. The paper has lacked in showing the importance of the first impression to delight customer in the service industry. The paper has lacked showing the need to eliminate the stock-outs to lose the customer orders. The forecasting of the raw items to cater the demand in the particular time phase is so much essential in this part. We will see some forecasting methods in this paper.

Jan de Vries (2020) discusses about conflicts in inventory management. Inventory management is overall essential for business but some of the department has different interests with the same. Customer facing department is okay with having high stock at the warehouse to make sure that no orders are left out due to stockouts but accountant manager wants to invest minimum in warehouse and in maintaining of the inventory. So, accountant or finance manager wants to have exact sufficient amount of the items which can cater the demand. so, we will see how to deal with conflict in inventory management.

Chalotra V. (2013) talked about Inventory Management and Small Firms Growth. He has talked about in the analytical ways with the data. Here in this paper we will see that how inventory management can be boon to the small businesses. How the warehouse layout or in simple words, placing raw items at the designated place helps to retrieve items easily and will take less effort to pick and drop again. Streamlined inventory processes helps a lot in this regard.

We will overall talk about the various other aspects of inventory management too in this particular paper. Lot of effort has been done to bridge the gap of the various papers in the field of inventory management.

Some others articles that has been followed to write this paper are: -

Tliche and et al. (2020) has discussed about the supplier buyer relationships and their respective power position the market place. The industry that we have chosen to understand inventory management has supplier power on the upper side. This is because the chemicals are not being manufactured in the country and raw items are mainly not indigenous. There items are scarce and that is why supplier has the greater negotiation position in the deal.

Example: - finding the good supplier in this domain is so much important. There are some suppliers who import the items in bulk and provide in cheap over Indian market. Some supplier who are secondary or are not bulk sellers may charge on higher side. So, the buyer has to always look or the better supplier as there is less advertisement in this regard.

Tejesh and et al. (2018) has talked about the future of warehouse inventory management using IOT and sensors i.e.: industry 4.0 this is the latest and modern way to maintain the warehouse inventory. If we look into the internet for the inventory management tools then there are many open source codes available. This software will help to keep the track of the inventory items. Some android app has also been developed for the same purpose.

Yavari and et al. (2020) has discussed about the research in demand management to cope up with routes disruptions and in location-inventory-routing problem for perishable products. In this paper, we have also discussed about the inventory keeping strategy with labelling. The perishable products should be used first and kept in the front row to ensure the same. We will see some other techniques in this paper.

Plaza and et al. (2018) has talked about the effect in the inventory management part due to the fluctuations in the market. As we have discussed already that the supplier has the greater negotiation power in the marketplace. Fluctuations in the economy or related thing can increase the price of the raw items drastically. We have to always look forward in the regard of supplier relationship management to overcome this. In service industry, management generally keep more than 2 suppliers to overcome this sudden unforeseen issue.

Let us see and understand the concept.

Methodology

Based on the literature review and gap identified, the step by step methodology has been discussed…….

1st objective: -

I have chosen the Trend Projection methodology with some customization according to our organization and industry need.

Why I have chosen this specific forecasting method is that because it was the best suitable. Naïve forecasting is not all suggestable. Second, moving average is used when the all the past data that we have taken to forecast is of the same weightage. But here, this is not the case. We can see that in some months there is the surge of data and in some month the service demand reduced intensively. For example: - in car wash industry or in car automotive service, peak demand comes in the summer seasons and in festive seasons. In rainy seasons, we get less demand for services. We can explain this within the months also, we can see from the data that there is high demand in the weekends when people don't go for office and are free but less demand in the weekdays.

So, exponential forecasting is thought of. But the problem ahead was to determine the exponential forecasting factor. It should be calculated with taking lots of the factors influencing in mind and quantifying all the factors was not possible due to the experimental constraint and out of scope of the research paper.

So, for forecasting trend analysis has been done. To know about the Ups and down of the demand, seasonality has been calculated with averaging the particular month of demand divided by the average of the total periodic demand.

And this seasonality factor has been multiplied with the linearly extrapolated value to get the more accurate forecasting value.

2nd objective: -

To discuss about the KPI of the Inventory management. A set of the industry experts and operations management students has been interviewed with the set of questions related to scope of inventory management and the paper. It has been done to endorse the practices that has been used in the industry. It has been done to validate the range values of various KPIs that has been suggested.

Questions asked are here follows: -

- How much percentage of the revenue should be spent in maintaining of the inventory in the service Industry?
- What should be the tolerable inventory record inaccuracy in the service industry like the automotive industry
- What should be the Turnover Ratio of the Inventory in the service industry
- what forecasting model Should be used for less error in forecasting specially for the automotive industry
- what should be Inventory days sufficient in the field of the service industry specially in the automotive industry
- Any special important facts and events of conflicts about the inventory management in the service industry that you encountered or read

How the calculations have been done is step by step explained in the paper forward.

The results will be discussed in data analysis part.

First, we will understand the mechanism about the demand forecasting. Past data of at least last year or last 2 years will come in help in this.

Steps to follow: -

1. We will consolidate all the past orders in the form of month wise-past-orders. This we will do for last 2 years.

2. Secondly, we will look for the seasonality factors. As we know, we won't get equal no of orders in every month. Some months the demand will surge, some months it will be depressed. So, we can't give equal weightage to al the months while forecasting. For example: - in carwash industry, we my get less orders in the rainy seasons and huge surge of the orders in festive months and summer season.
Seasonality factor= (average demand of the particular month/ average demand of the overall period)
The variation of the particular month from the overall average of the period i.e.; seasonality, we will get to know here.
3. Now we will choose our forecasting period. Maybe we can forecast for next 6 months or next 1 year.
For this particularly, we will find the intercept and slope with the help of the past data in the excel with built-in formula. That particular calculation if we extrapolate for the forecasting period, we will get our forecasted value.
4. Now, in the last, we will check the error percentages in calculation of the forecast. We will calculate the, mean absolute error, mean square error, mean absolute percentage error etc. if the absolute percentage accuracy is above 90, then the model is good.
This is all about the forecasting part.

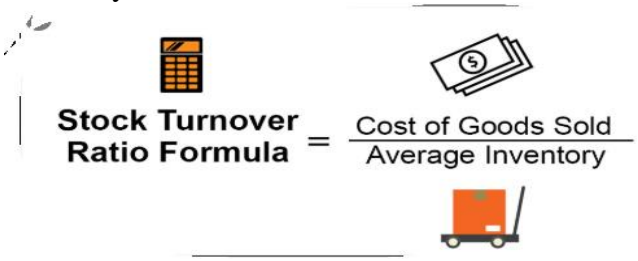
1.1 calculating the raw items required at every month to cater the demand i.e.: Inventory Forecasting steps to follow: -

1. drill down or segregate the demand into quantity of various types of services desired
2. calculate the quantity of required raw items to cater the particular type of demand
3. we will do this for other types of the services and will calculate the total quantity of raw items required from the warehouse inventory to cater the month wise demand

for example: lets suppose, there are 2 kinds of the services: -
Service A & B
The total items required are x, y, z
Now, say in service A 20ml of x and 40 l of z is required. So, for 10 services of A
200ml of x and 400ml of z is required in total for that particular month.
Service b requires 10 ml of x, 20 ml of y & 30 ml of z. So, for 100 services
1000mlof x, 2000 ml of y, 3000 ml of z in total for that particular month.
Through this mechanism, we calculate the total Stock required in particular period.

1.2 Key-performance-indicators
Key-performance-indicators is the measure of the performance of the processes. If we talk of the inventory management, some KPIs are Inventory no. of days, Inventory turnover, average cost of goods sold etc.
Steps to measure Inventory Turnover ratio
In car wash industry, we have to deal with lots of data.
We have forecasted the quantity of items required for the month or for the articular desired period.
Step 2: - we will calculate the total cost of the items required according to their respective costs.
Step 3: - we will similarly calculate the cost of the items required for next 12 months over which we want to calculate the inventory turnover and add them as cost of goods required for the year.
If the car wash company is the startup and we don't have data then we can average the cost of items for known months and then can multiply it with 12 to get yearly expected cost of goods sell.
Example: - if we have forecasted the inventory for the quarter only, then the relative cost of good we can calculate and average it out for the month. finally, after multiplying it with 12, we can get yearly cost of goods sell.
Step 4: - Calculating the average inventory of the year i.e. 1st KPI.
Average Inventory is the amount of inventory present at the store-house at any point of time on an average.
Formulae: - (cost of the amount of raw items present in the store house in maximum quantity - cost of the amount of raw items that must be present i.e. the minimum quantity in the store-house)/2
i.e., (cost of maximum inventory- cost of min inventory)/2
Step 5: Calculating the per day cost of the inventory needed.
This can be done by dividing the yearly cost of inventory needed by 365(i.e.; no of days in the year)

Step6: - calculating the inventory days sufficient i.e. our 2nd KPI.
We can calculate this by diving the average cost of the inventory with per day cost of inventory
i.e.; inventory days= (Average inventory/ per day inventory need)
Step 7: - Now the 3rd KPI i.e. Inventory turnover ratio
This can be calculated by dividing the yearly cost of the inventory needed by average cost of the inventory need.



As far as my industry is concerned i.e.; car wash industry. The good KPIs range values are: -
Inventory days if it is above 3 weeks then it is considered to be decent and if the inventory turnover is concerned it should be ideally in the range of 15-20.

3rd Part
Implementing the ERP kind in startups.
As We know, startups find a tough time in getting funding for the company. So, they can't get SAP ERP to implement in the company. It is obviously not financially possible.
So, we will discuss how to integrate the functions in the company. Writers have talked about a lot in the SAP Implementation but not discussed some techniques on which startups and small business can taste enterprise integration. I will talk of some techniques in my paper: -
Google sheet shared to all the responsible functions and cross functional teams for data management wrt. to business. For example: - order status should be known by all the functions, that data we can maintain in google sheet which is shared and accessible to all departments.
There are some apps and functions in the google sheet which can automatically send the data to the concerned department on regular period of time which can be set according to the different business team requirement.
There is various customization available. For data visualizations part, there are Tableau and POWER BI in the market which the industries at large are using. Tableau software costs huge in lakhs for licensing. So, we can replace the tableau dashboard with the google sheet charts visualization. We can automate the process too with the Macros and all. Everyday we just need to replace the data with new data. We will see the analytics summary too in the google sheet.
As startups don't have Ariba software to maintain their procurement. In which they can automatically initiate to the suppliers and vendors and request for quotations. They have the tool to compare the various quotations and compare. Organization can send request of proposals and negotiate with the help of the application. In the place of these applications and tools, they can have automated google excel sheets with macro enabled which will do the initiation, request and comparison based on the visual basics programming which has been fed.
The google sheet will be automatically be sent to the account and the purchase manager when the request of the purchase has been made by the purchase team. This helps in connecting and integrating all the functions in the same platform.
For the data management part, in small startups there is the absence of the portal or cloud on which we can save the data and retrieve when we want them for analyzation. So, in small businesses the one point to safeguard all the data is required. We can use different google excel sheets for the different purposes and can give the access to the relevant teams respective to the purposes.
In big organizations, they are slowly moving towards the industry 4.0 and using Machine learning and internet of things in the organization for various processes. They use Python and machine learning for their SKUs forecasting. Small business either don't know about the tools and techniques or they don't have such resources. In that case, small startups may use simple forecasting models and can implement that in excel and check the accuracy of the same.
For Example :- They might not have the RFID and Scanner machines to keep the track of the items in the warehouse and outside of the it But they can use free android scanners and free softwares available on the internet like web portal page and all to track the items involved in the service. In small scale businesses, labelling markings and all techniques can be implemented wisely with very less investments.

So, these are some tricks for better demand and inventory management.

Lastly, we have discussed about the conflicts that generally happen in maintaining the inventory at warehouse. Writers have covered these aspects too but I discuss some aspects and viewpoint which has not being discussed so far. There are different interests with the purpose of the inventory management. For example: - The Marketing team would like to have full stock of every variety of the services or the product available at every satellite store at every functional area so that it will be instantly available to the customers and they don't have to wait for the same. In the other hand, the finance and accounting team would like to invest less in the maintaining stock in the stores and they are less responsive wrt. to the marketing team. They would first like to get orders and then want to proceed with procuring items for the production or services.

In car wash industry, as it demands high responsiveness. The management needs to act accordingly. This conflict will reduce when the organization will be very much clear about the competencies and strategic advantages. What customer segment they want to cater and how. If the purpose and goal of the organization will be cleared to management and its functions then this conflict will be reduced. The integration of the organization is very much important for that matter and this part I have touched in the initial of the methodology part. So, these are some parts about service industry I wanted to discuss.

Findings And Results

With Analysis of the Data

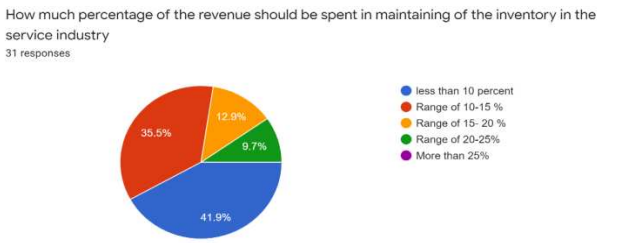
A total of 30 interviews has been conducted online in which 80% are studying operations as their majors and 20 % are industry experts.

Percentage of the revenue should be spent in maintaining of the inventory in the service industry

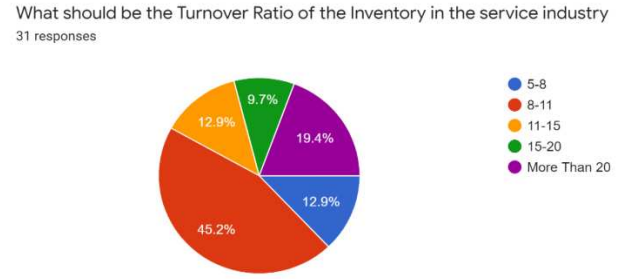
As per the interview being conducted, 75% of the people suggests to keep the cost of maintaining the inventory below 15 % of the revenue.

12% of the people thinks that the same can be in the range of the 15-20%

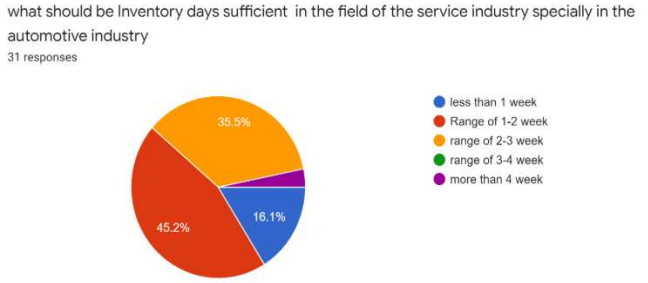
10% of the people thinks that the same can be in 20-25% at Max.



2. About KPI i.e. inventory Turnover 30% of the people interviewed, suggested the turnover ratio should be greater than 15. 60% of the people suggested that the same should be in range 8-15.



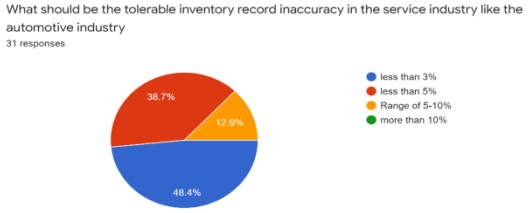
3. About KPI i.e. inventory Days 40% of the people interviewed, suggests the inventory days to be in range of 2-3 week. 45% of the people interviewed, suggests the inventory days to be in range of 1-2 week.



4. Inventory Streamlining Processes

Tolerable inventory record inaccuracy in the service industry Approx. 50% of the people interviewed, suggests to keep the inaccuracy in inventory record below 3%.

Approx. 40% of the people interviewed, suggests to keep the inaccuracy in inventory record in range 3-5%.



So, these are some results that has been found out by conducting 30 interviews and the results endorses our results and explanations and in line with the same.

Results and Conclusions

Objective 1: - About the forecasting of the service demand and the correspondingly forecasting of the Raw-items

In the multiple interviews, many people suggested to do the exponential forecasting. I have found the gap and suggested to go for the customized forecasting method of trend analysis with seasonality. The Mean absolute percentage accuracy was about 90%.

People in industry used to forecast the demand only, I have found the limitations and suggested to corresponding estimate the items needed to cater the demand.

Objective 2: About the ideal range of the KPIs values of the Inventory Management

In the multiple Interviews, 75% people suggested to keep the cost of maintaining inventory below the 15% of revenue.

Inventory Turnover

40% of the people interviewed suggested to have the Inventory Turnover above 10 and 30% of the people suggested above 15.

So, as range validated by the experts 10-15 good and 16-20 very good and above 25 is excellent.

Inventory days

40% of the people interviewed, suggests the inventory days to be in range of 2-3 week.

45% of the people interviewed, suggests the inventory days to be in range of 1-2 week.

So, the data is validated with the experts

Inventory days in range 1-2 is good 2-3 is very good and above 3 weeks is excellent in-service industry.

It is also somewhat linked with the EOQ Model (Economic order quantity). While framing the EOQ Model, the Inventory manager should keep the desired inventory Turnover and Inventory days in mind.

Inventory record inaccuracy

Approx. 50% of the people interviewed, suggests to keep the inaccuracy in inventory record below 3%.

Approx. 40% of the people interviewed, suggests to keep the inaccuracy in inventory record in range 3-5%.

So, we should keep the inventory accuracy below 5% as per experts. Strict inventory processes are the remedy of it. If the accuracy is above 5%, then we can implement cycle counting in which periodic counting of the inventory items is done and the mismatches in numbers are adjusted. In the process, we need to find out the root cause of the same and eliminate it.

Objective 3 About Managing the conflicts regarding the interests of Inventory management

Some of the industry experts shared their experience like, Order fulfillment in service industry is influenced by Employee engagement practices as well.

Some suggested to have the holistic view like not just inventory it should be cross functional from production to logistics etc.

So, if we can implement the integration either via SAP ERP Modules or via tools and techniques suggested in the paper like Goggle form, google sheet for various operational activities, conflicts will reduce.

Scope For Further Research

In the forecasting of the service demand, how to find the exponential smoothing constant considering all the factors and quantifying the same is the next thing for research purposes.

For demand forecasting, how to use mixed and customized forecasting techniques like using trend analysis with the linear regression will be a subject of further research. In liner regression also, we can't quantify each and every factor impacting the result of the forecasting. This can also be the extended scope of this project.

Finding new KPIs which can be used for inventory management is always the hot topic and matter of research. Finding KPIs for other service types can be the next steps of the research.

We have listed some scenarios for different interests in inventory management. Some new scenarios which are coming as we are moving towards the industry 4.0 should be researched.

SAP ERP alternative tools and techniques has been discussed in the paper but more feasible and implacable alternatives should be researched keeping bigger scope.

References

[1] Ashok, D., & Panigrahi, K. (2013). Relationship Between Inventory Management and Profitability: an Empirical Analysis of

Indian Cement Companies. *Asia Pacific Journal of Marketing & Management Review*_____ _____ *ISSN*, *2*(7), 2319–2836.

[2] Chalotra, V. (2013). Inventory Management and Small Firms Growth: An Analytical Study in Supply Chain. *Vision: The Journal of Business Perspective*, *17*(3), 213–222. https://doi.org/10.1177/0972262913496726

[3] Masudin, I., Kamara, M. S., & Zulfikarijah, F. (2018). Impact of Inventory Management and Procurement Practices on Organization's Performance. *Singaporean Journal of Business Economics and Management Studies*, *6*(3), 32–39. https://doi.org/10.12816/0044429

[4] Tliche, Y., Taghipour, A., & Canel-Depitre, B. (2020). An improved forecasting approach to reduce inventory levels in decentralized supply chains. *European Journal of Operational Research*, *287*(2), 511–527. https://doi.org/10.1016/j.ejor.2020.04.044

[5] Tliche, Y., Taghipour, A., & Canel-Depitre, B. (2020). An improved forecasting approach to reduce inventory levels in decentralized supply chains. *European Journal of Operational Research*, *287*(2), 511–527. https://doi.org/10.1016/j.ejor.2020.04.044

[6] Yang, Y., Chi, H., Zhou, W., Fan, T., & Piramuthu, S. (2020). Deterioration control decision support for perishable inventory management. *Decision Support Systems*, *134*(March), 113308. https://doi.org/10.1016/j.dss.2020.113308

[7] Tejesh, B. S. S., & Neeraja, S. (2018). Warehouse inventory management system using IoT and open source framework. *Alexandria Engineering Journal*, *57*(4), 3817–3823. https://doi.org/10.1016/j.aej.2018.02.003

[8] Plaza, M., David, I., & Shirazi, F. (2018). International Journal of Production Economics Management of inventory under market fluctuations the case of a Canadian high-tech company. *Intern. Journal of Production Economics*, *205*(September), 215–227. https://doi.org/10.1016/j.ijpe.2018.09.007

[9] Li, T., Fang, W., & Baykal-gürsoy, M. (2020). Journal. *International Journal of Production Economics*, 107915. https://doi.org/10.1016/j.ijpe.2020.107915

[10] Yavari, M., Enjavi, H., & Geraeli, M. (2020). Research in Transportation Business & Management Demand management to cope with routes disruptions in location-inventory-routing problem for perishable products. *Research in Transportation Business & Management*, (August 2019), 100552. https://doi.org/10.1016/j.rtbm.2020.100552

[11] Rawat, K. (2015). Today ' s Inventory Management Systems : A Tool in Achieving Best Practices in Indian Business, *VII*(I), 128–135.

[12] Castro, C., Pereira, T., Sá, J. C., & Santos, G. (2020). Logistics reorganization and management of the ambulatory pharmacy of a local health unit in Portugal, *80*(July 2019). https://doi.org/10.1016/j.evalprogplan.2020.101801

[13] Makaci, M., Reaidy, P., Evrard-samuel, K., Botta-genoulaz, V., & Monteiro, T. (2017). Computers & Industrial Engineering Pooled warehouse management : An empirical study. *Computers & Industrial Engineering*, *112*, 526–536. https://doi.org/10.1016/j.cie.2017.03.005

[14] Caridi, M., Moretto, A., Perego, A., & Tumino, A. (2014). Int . J . Production Economics The bene fi ts of supply chain visibility : A value assessment model, *151*, 1–19. https://doi.org/10.1016/j.ijpe.2013.12.025