Material Requirements Planning System (MRP) for Assembly Line of the Ground Phone (CID-103) in the Electronic Industries Company (EIC).

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Abstract:

This paper aims to define the possibilities and methods of the practical application for one of the modern industrial systems in the control and production planning which is called Material Requirements Planning (MRP) system, in an attempt to introduce a system that help to overcome what weakness suffered by the Iraqi industry or to mitigate the impact of these weak points at least, basing on the big advantages achieved by the MRP system when applied in many industrial companies all over the world.

So it has been performed a case study in order to apply the above system in the electronic industries company (EIC) / The factory of telephones and PBX production / the assembly line of ground Phone (Model CID-103). The most significant conclusion of this paper is that the MRP system can be applied and adopted in Iraqi industry environment to achieve various advantages associated with the use of this system, if its requirements are well and accurately prepared.

Keywords: material requirements planning (MRP) system, control and production planning, industrial systems.

1. Introduction

Manufacturing organizations are required to deal with complexity because of numerous products, processes, parts, and uncertainties. The typical manufacturing company may have thousands of products and parts to manage, constantly shifting priorities and unpredictable demand. It is possible to manage this situation through use of the Materials Requirements Planning (MRP) system [8]. MRP is a widely used method for production planning and scheduling that allows for more efficient and effective use of resources. It is one of the important tools for inventory controlling and production planning [3]. In order to Implement and operate an efficient MRP system, it is important to have [11, 1, 3]:

- A computer and necessary software.
- Accurate and up-to-date:
  - Master production schedules (MPS).
  - Bills of materials (BOM)
  - Inventory records.
- Integrity of data.

2. Where MRP technique can be applied?

MRP technique has application in industry as well as in service sectors.

2.1 MRP in industry

MRP technique was first applied to mobile and airplane industry in the 1960s. Later on it is being used in a wide range in industries with a job-shop environment and assembly operations [10].

It should be noted that MRP is most valuable to companies involved in assembly operations and least valuable to those in fabrication; also MRP does not work satisfactory way in companies that produce a low number of units yearly. Especially for companies that producing complex, expensive products requiring advanced research and design, where lead time tend to be very long and very uncertain, and the product structure very complex. Such companies require the control properties that network- scheduling techniques offer. **Table 1.** shows the examples of different types of industry and the expected advantage from MRP [9].

Table 1. different types of industry and the expected advantage from MRP System [9].

Type of Industry	Examples	Expected Advantage
Assemble-to-stock	watches, tools and appliances	High
Fabricate-to-stock	Piston rings and electrical switches.	Low
Assemble-to-order	trucks, generators and motors	High
Fabricate-to-order	bearings, gears and fasteners	Low
Manufacture-to-order	turbine generators and Heavy machine tools	High
Process	foundries, rubber and plastics, Specialty paper, chemicals industry, paint, drugs and foods processors.	Medium

2.2 MRP in Service

Service organizations can also benefit from the use of MRP systems, such Restaurants, hospitals & electric power companies that have large inventories of facilitating goods to support their service delivery systems. The concept of MRP application in the service industry is represented in replacing the BOM by the bill of labor or bill of activities [8].

3. Literature Review

Patty W. Cheng, [6]: presented a scanning research of manufacturing and industrial firms in Virginia and Tennessee to evaluate to what extent computer systems is being used In manufacturing applications, the performance of related software to support industry, and the advantages and disadvantages derived from it.

Salih Al-Mayah, [14]: Presented a study in (the National Company of foam rubber and plastic / the plastic tube plant) to define the possibilities and methods of adapting the Yemeni

industry environment to the application of the modern system in planning and control of production which is Material Requirements Planning (MRP) system. The study aimed to overcome the weak points of the Yemeni industry and mitigate this weakness by using MRP system.

Salaheldin Ismail, [7]: Studied the variables that influence on application of (MRP & MRPII) systems in Egyptian manufacturing firms using an advanced statistical technique named Alternating Coordinal Expectations (ACE). (AEC) is applied to locate the relation between the successful application and its determinant parameters.

Mahmoud abbas, [4]: Studied concept and requirements of the three main production planning and control approaches (MRP-type systems, OPT, and JIT) to discover their suitability for adoption in Iraqi industries environments. The requirements for successful implementation of MRP-type systems in Iraqi industries environments were identified in this study.

Jamal Amghar, [13]: This study applied to an industrial Algerian Company (ENAMC Company in Eleulma – Setif) to discuss the employment of MRP system as a tool for planning the products supply in determined time and quantities, reducing the inventory levels & increasing customer service.

Jonsson P., [5]: studied four different groups of Swedish companies to explore the problems effect on the performance of planning with various materials planning approaches (MRP, ROP and kanban system). The study concluded that there is a different in application methods of Materials planning due to the existing surroundings of planning, and MRP system should be adjusted for each individual company.

Yolanda and Tania, [12]: discussed the required factors to ensure successful Implementation of MRP system and the relationship between these factors. The research was applied in SME'S industrial estates.

Dinesh, et-al, [2]: proposed a direct applying of MRP system to an automobile servicing plant for purchasing spare parts & reduce vehicle servicing time. The orders are released to purchase materials and the materials are stocked. The objective is procuring materials in right time.

4. Practical work

4.1 product selection

In this paper it has been selected the ground Phone product (Model CID-103) that assembled in electronic industries company (EIC), where the production system is an assembly-to-stock type, and the product is manually assembled. The concept of dependent and independent demand is clearly embodied, and this product

is fully compatible with the basic requirements to apply the intended MRP system.

4.2 The Current MRP Procedure in the Company

The current MRP Procedure to produce the ground phone (CID-103) in the company is very simple, performed manually and depending mainly on the personal experience. Therefore many problems are expected to be faced by the company in planning and controlling of the product such as; the shortage of some components that are not provided in the suitable time, or the over providing of the others in large quantities which require an extra storage area and locking money in the stores.

also problems relevant to unexpected changes in the annual production plan that are happening from time to time like issuing extraordinary production orders or vice.

Hence, in this paper the using of MRP system can be served as an effective tool to solve and prevent such problems.

4.3 data collection

Below description of the collected and prepared data:

a. Master Production Schedules (MPS):

In order to apply MRP system it is required to develop master production schedule and to specify the required quantities in each time bucket along the time horizon of this master production schedule.
In this paper, time bucket is expressed in months and master production schedule is developed for the first half of the year 2015 which is the first six months (January, February, march, April, May, June).

b. Forecasted Demand:

It has been reviewed and limited the monthly demand quantities of the finished product phone (CID-103) for the previous five years (2010, 2011, 2012, 2013 and 2014). and then they were entered into WINQSB program as shown in **Fig. 1.** in order to forecast the value of the monthly demand for the first half of the year 2015 using a simple linear regression method and related calculations as shown in **Fig. 2**. Also the relationship between the two sets of quantitative variables (time and monthly demand that have been predicted) shown in **Fig. 3** in WINQSB program.

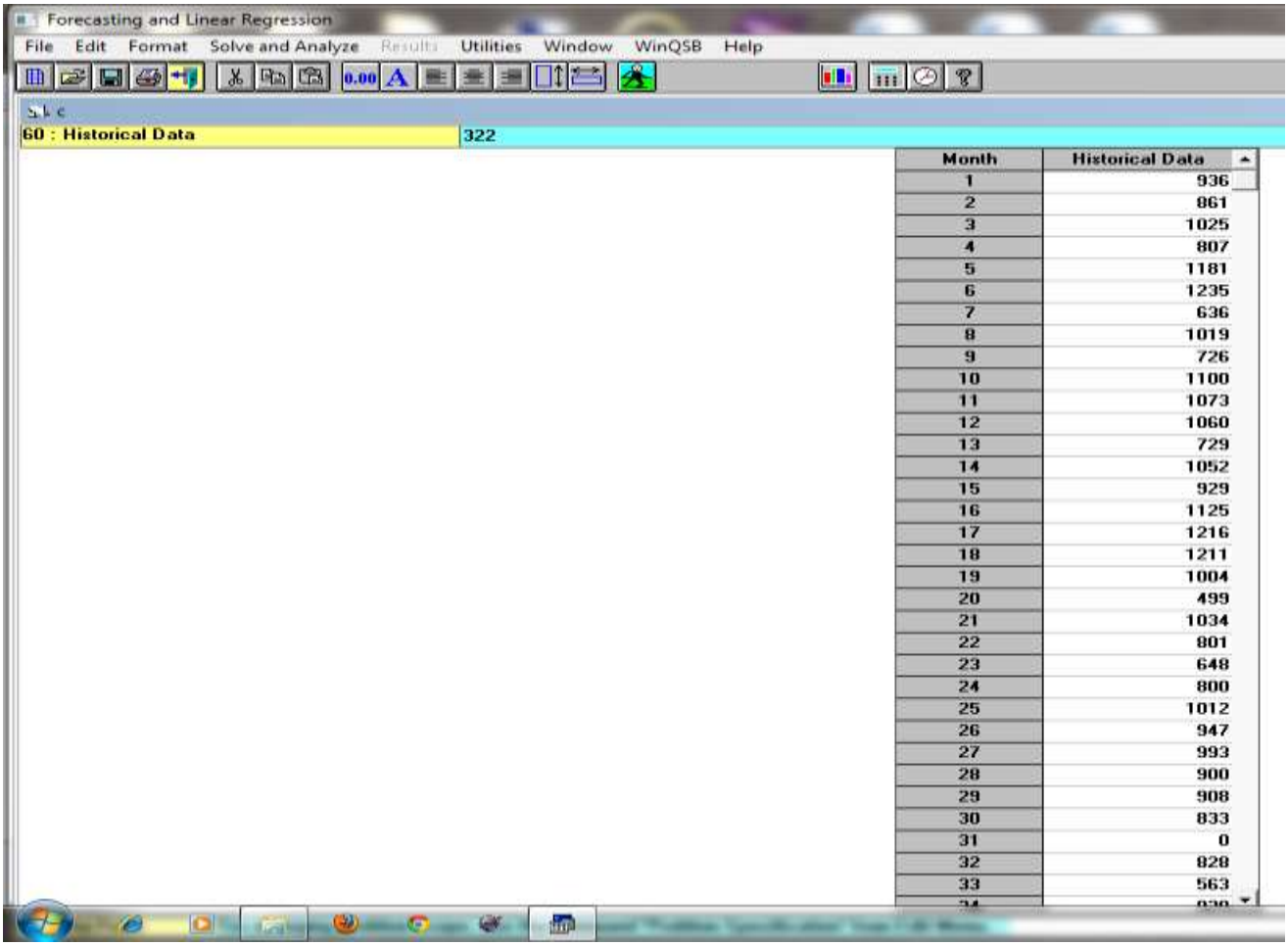
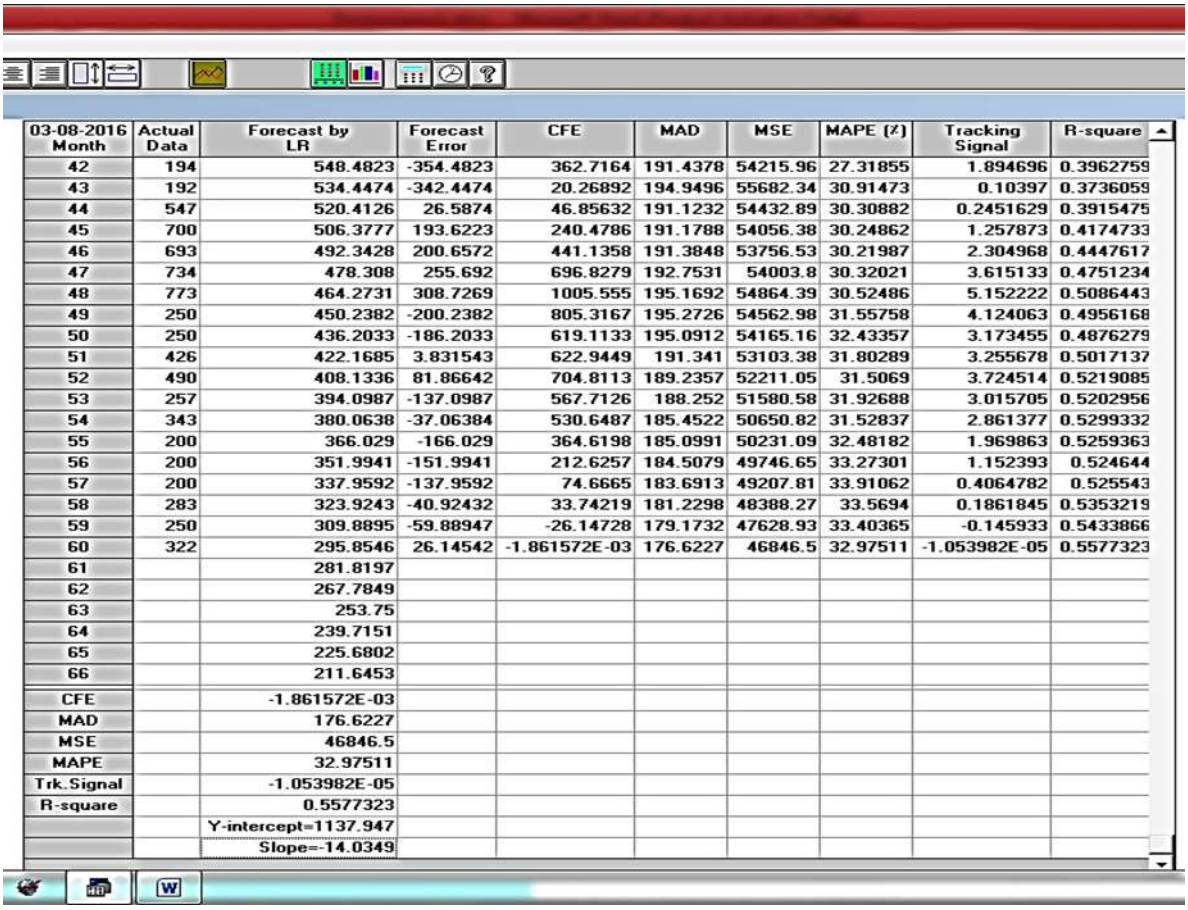


Fig. 1 the monthly demand quantities of the finished product (phone).



03-08-2016 Month	Actual Data	Forecast by LR	Forecast Error	CFE	MAD	MSE	MAPE (٪)	Tracking Signal	R-square
42	194	548.4823	-354.4823	362.7164	191.4378	54215.96	27.31855	1.894696	0.3962759
43	192	534.4474	-342.4474	20.26892	194.9496	55682.34	30.91473	0.10397	0.3736059
44	547	520.4126	26.5874	46.85632	191.1232	54432.89	30.30882	0.2451629	0.3915475
45	700	506.3777	193.6223	240.4786	191.1788	54056.38	30.24862	1.257873	0.4174733
46	693	492.3428	200.6572	441.1358	191.3848	53756.53	30.21987	2.304968	0.4447617
47	734	478.308	255.692	696.8279	192.7531	54003.8	30.32021	3.615133	0.4751234
48	773	464.2731	308.7269	1005.555	195.1692	54864.39	30.52486	5.152222	0.5086443
49	250	450.2382	-200.2382	805.3167	195.2726	54562.98	31.55758	4.124063	0.4956168
50	250	436.2033	-186.2033	619.1133	195.0912	54165.16	32.43357	3.173455	0.4876279
51	426	422.1685	3.831543	622.9449	191.341	53103.38	31.80289	3.255678	0.5017137
52	490	408.1336	81.86642	704.8113	189.2357	52211.05	31.5069	3.724514	0.5219085
53	257	394.0987	-137.0987	567.7126	188.252	51580.58	31.92688	3.015705	0.5202956
54	343	380.0638	-37.06384	530.6487	185.4522	50650.82	31.52837	2.861377	0.5299332
55	200	366.029	-166.029	364.6198	185.0991	50231.09	32.48182	1.969863	0.5259363
56	200	351.9941	-151.9941	212.6257	184.5079	49746.65	33.27301	1.152393	0.524644
57	200	337.9592	-137.9592	74.6665	183.6913	49207.81	33.91062	0.4064782	0.525543
58	283	323.9243	-40.92432	33.74219	181.2298	48388.27	33.5694	0.1861845	0.5353219
59	250	309.8895	-59.88947	-26.14728	179.1732	47628.93	33.40365	-0.145933	0.5433866
60	322	295.8546	26.14542	-1.861572E-03	176.6227	46846.5	32.97511	-1.053982E-05	0.5577323
61		281.8197							
62		267.7849							
63		253.75							
64		239.7151							
65		225.6802							
66		211.6453							
CFE		-1.861572E-03							
MAD		176.6227							
MSE		46846.5							
MAPE		32.97511							
Trk.Signal		-1.053982E-05							
R-square		0.5577323							
		Y-intercept=1137.947							
		Slope=-14.0349							

Fig. 2 the forecasted demand quantities of the finished product (phone).

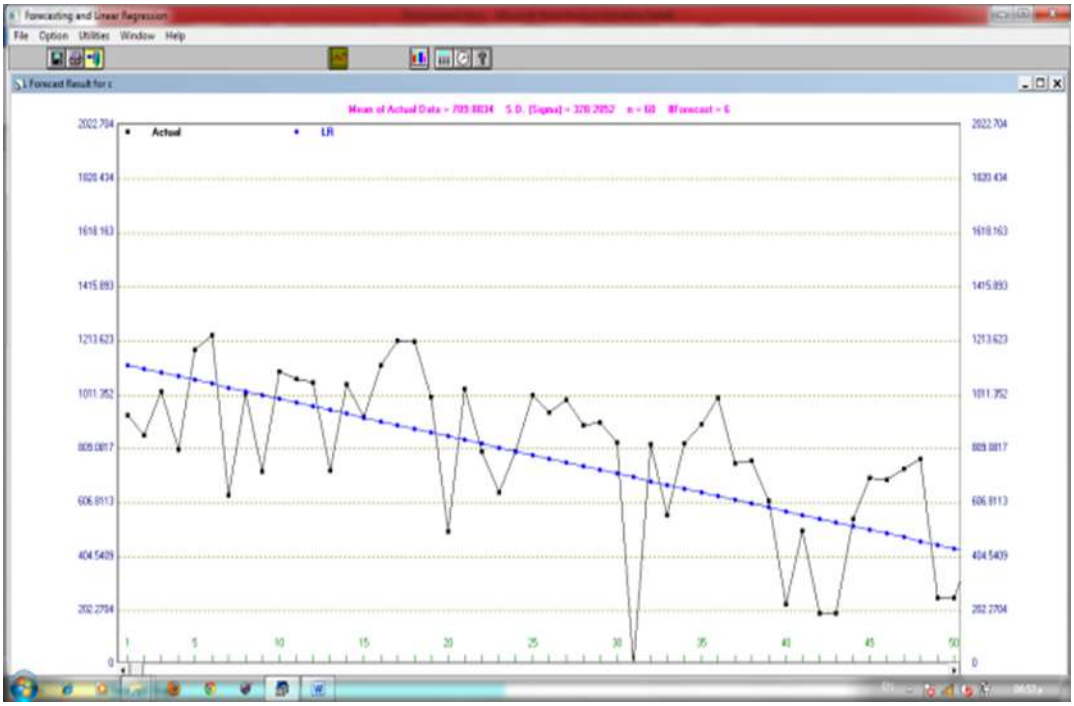


Fig. 3. the relationship between the time and monthly demand.

c. Bill of Material (BOM):

The subsequent step after developing the master production schedule is the construction of an accurate bill of material for the ground phone (CID-103).

Using the lists of imported, purchased and manufactured parts and by following up the sequences of activities in which the product is assembled, bill of materials for the phone production has been created as shown in **Fig. 4**. The following remarks are notice from this bill of material:

- The product structure tree of "The ground Phone (CID-103)" is consisting of four levels (from level 0 to level 4).

- The total number of the items in the structure is 64 items.

- The item "4321011112" exists in three levels (2,3,4) and according to the low level coding rule it brought down from level (2) and level (3) to the lowest level (level 4). The same for the items "32101111613" and "321011312" that exist in level (2) and brought down to lowest level (level 3).

d. Lead Time (L):

As exposed in **Fig. 4** the bill of material of the ground Phone (CID-103) consists of different items; assemblies, subassemblies, sub subassemblies, parts and raw materials. Some of these are manufactured in the company and the others are purchased. Each of them has a lead time that has been recorded and expressed in month.

e. Inventory Records:

The Inventory records file includes the data that describes the full inventory status for each item like; projected on hand inventory H(t), safety stock (S.S) and schedule receipt S(t). The researcher has reviewed the inventory records in the company to collect this data and rearranged as required for the application of the MRP system.

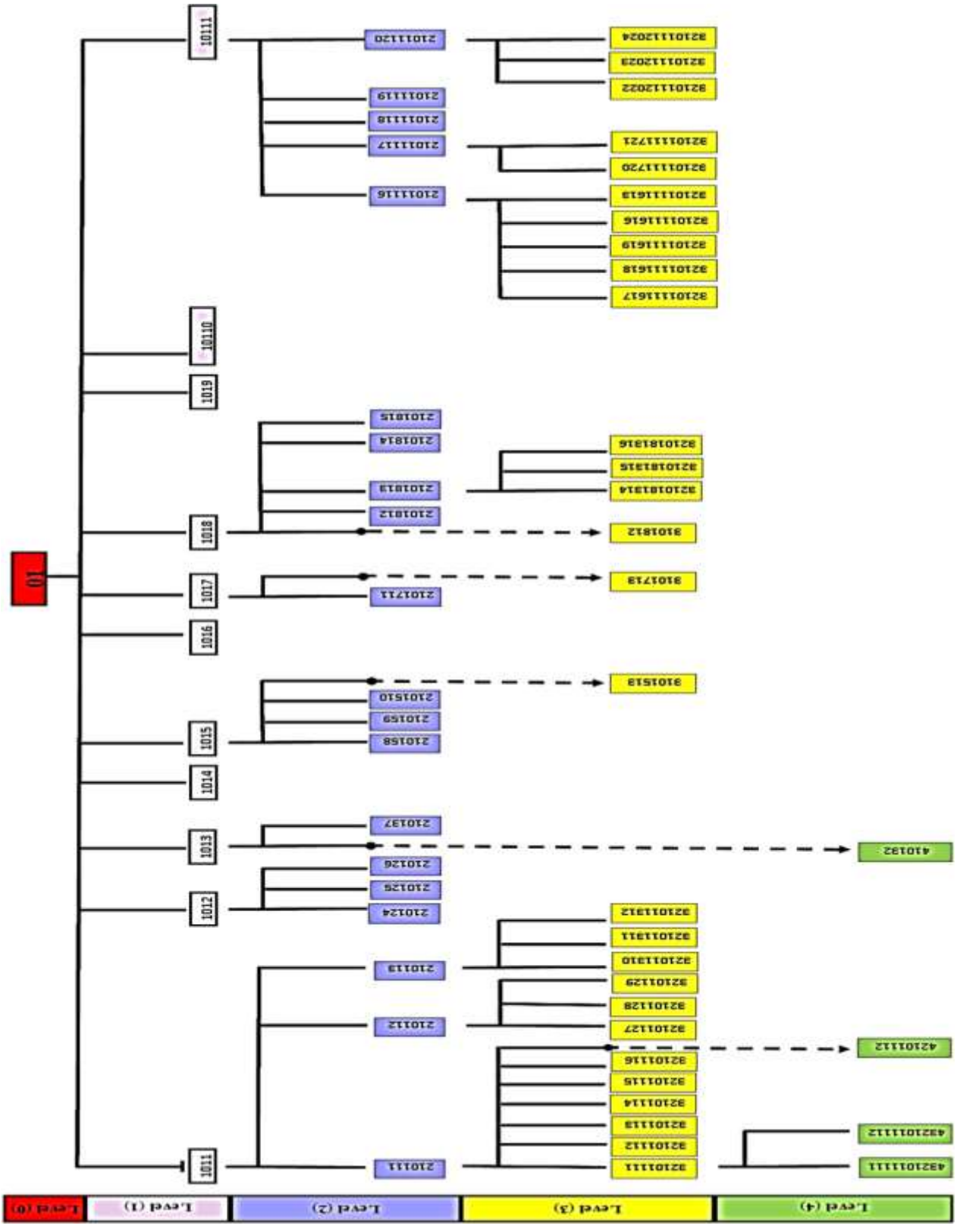


Fig. 4 bill of materials for the ground phone (CID-103).

4.4 Application of MRP system within the case study and obtaining the results.

Based on the inputs of case study above, it has been applied the MRP system using (IS-MRP) program and obtaining the results. **Table 2** shows an example of these results for 10 items only.

6. Conclusion

1- This practical application shows clearly that MRP system is an effective tool to support production planning and control operation, inventory control, and many other managerial decisions concerning with the questions of what, when and how many to be produced.

2- This application of the MRP system comes to give a practical answers on the questions above, through providing continuous reports about the calculated: (gross requirements, net requirements, projected on hand inventory, planned order receipts and planned order releases) for each item of the finished product in each time period as shown in **Table 2**.

3- This paper shows that MRP system can be applied and adopted in Iraqi industry environment to achieve various advantages associated with the use of this system.

4- from the other hand this paper also shows that the Iraqi industry environment itself can adapts with the MRP system application requirements, just after preparing these requirements properly which are the three basic inputs to the system (master production schedule, bill of material, and inventory record) as it performed within this paper for assembly line of ground phone (CID-103).

5- The application of MRP system has led to adjust the inventory levels to meet exactly the production process requirements. Hence no over stocks and reducing the inventory cost as least as possible.

6- The application of MRP system ensures provision of the required materials in the specific dates to be used, through releasing the orders of purchase, work and production. Hence meet demand and improve customer service.

Tabel 2. the output results of the case study (example of ten items only).

Items Description	Requirements Planning	Period1	Period2	Period3	Period4	Period5	Period6
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Telephon (finished product)	Gross Requierments	283	269	255	241	227	213
Code:01	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	283	269	255	241	227	213
Source Type:manufactred	POH Inventory|0	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	283	269	255	241	227	213
Lead Time:1	Planned Order Releases	(-1) (283)	(-1) (269)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Plastic frame ass.	Gross Requierments	269	255	241	227	213	0
Code:1011	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	269	255	241	227	213	0
Source Type:manufactred	POH Inventory|0	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	269	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (269)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Speaker D-57 ass.	Gross Requierments	269	255	241	227	213	0
Code:1012	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	248	255	241	227	213	0
Source Type:manufactred	POH Inventory|21	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	248	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (248)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Key board ass.	Gross Requierments	269	255	241	227	213	0

Items Description	Requirements Planning	Period1	Period2	Period3	Period4	Period5	Period6
Code:1013	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	249	255	241	227	213	0
Source Type:manufactred	POH Inventory|20	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	249	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (249)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Handset cord	Gross Requierments	269	255	241	227	213	0
Code:1014	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	269	224	165	92	5	-295
Source Type:imported	POH Inventory|20	51	96	155	228	315	315
Lot Sizing:EOQ	Planned Receipts	300	300	300	300	300	0
Lead Time:2	Planned Order Releases	(-2) (300)	(-2) (300)	(-2) (300)	(-2) (300)	(-2) (300)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Lock hole ass.	Gross Requierments	269	255	241	227	213	0
Code:1015	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	248	255	241	227	213	0
Source Type:manufactred	POH Inventory|21	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	248	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (248)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Rubber keypad	Gross Requierments	538	510	482	454	426	0
Code:1016	Scheduled Receipt	0	0	0	0	0	0
Quantity:2	Net Requierments	537	447	329	183	309	-291
Source Type:imported	POH Inventory|21	83	173	291	137	311	311
Lot Sizing:EOQ	Planned Receipts	600	600	600	300	600	0

Items Description	Requirements Planning	Period1	Period2	Period3	Period4	Period5	Period6
Lead Time:2	Planned Order Releases	(-2) (600)	(-2) (600)	(-2) (600)	(-2) (300)	(-2) (600)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Battrey metal (+ve & -ve) ass.	Gross Requierments	269	255	241	227	213	0
Code:1017	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	248	255	241	227	213	0
Source Type:manufactred	POH Inventory|21	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	248	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (248)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Main board (B.C) ass.	Gross Requierments	269	255	241	227	213	0
Code:1018	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	248	255	241	227	213	0
Source Type:manufactred	POH Inventory|21	0	0	0	0	0	0
Lot Sizing:LFL	Planned Receipts	248	255	241	227	213	0
Lead Time:1	Planned Order Releases	(-1) (248)	(-1) (255)	(-1) (241)	(-1) (227)	(-1) (213)	0
Planning Data=	Scheduled Periods=	January/2015	February/2015	March/2015	April/2015	May/2015	June/2015
Items Name:Line cord	Gross Requierments	269	255	241	227	213	0
Code:1019	Scheduled Receipt	0	0	0	0	0	0
Quantity:1	Net Requierments	269	224	165	92	5	-295
Source Type:imported	POH Inventory|20	51	96	155	228	315	315
Lot Sizing:EOQ	Planned Receipts	300	300	300	300	300	0
Lead Time:2	Planned Order Releases	(-2) (300)	(-2) (300)	(-2) (300)	(-2) (300)	(-2) (300)	0

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نظام تخطيط الاحتياج من المواد (MRP) لخط تجميع الهواتف الارضية (CID-103) في شركة الصناعات الالكترونية (EIC).

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بغداد- العراق

الخلاصة:

يهدف هذا البحث الى تحديد امكانيات و سبل التطبيق العملي لاحدى النظم الصناعية الحديثة في التخطيط و السيطرة على الانتاج و هو ما يسمى بنظام تخطيط الاحتياج من المواد (MRP), في محاولة لادخال نظام يساعد في التغلب على ما تعانيه الصناعة العراقية من ضعف او للتخفيف من حدة تاثير تلك النقاط على الاقل مستندين في ذلك الى المزايا الكثيرة التي حققها نظام (MRP) عند تطبيقه في العديد من الشركات الصناعية و في مختلف البلدان.

عليه تم اجراء حالة دراسية بغية تطبيق النظام اعلاه في الشركة العامة للصناعات الالكترونية (EIC) / معمل انتاج البدالات و الهواتف الارضية / خط تجميع الهواتف الارضية (نوع CID-103).

و يقع ابرز ما توصل اليه هذا البحث من استنتاجات بانه بالامكان تبني و تطبيق نظام تخطيط الاحتياج من المواد (MRP) في البيئة الصناعية العراقية للاستفادة من المزايا المتعددة المقترنة باستخدامه, شرط اعداد و تهيئة متطلباته بشكل صحيح و دقيق.

الكلمات المفتاحية : نظام تخطيط الاحتياج من المواد (MRP) ،التخطيط و السيطرة على الانتاج ، النظم الصناعية.