

# Improve Inventory Turns with Lean Logic

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**Abstract.** This session explains the lean logic of the Inventory Quality Ratio (IQR) and describes how UTC/Carrier Corporation used it to more than double their inventory turns.

## INVENTORY CHALLENGES AT CARRIER

Carrier has over 60 factories around the world, and manufactures tens of thousands of heating, cooling and refrigeration products, many customized for their local markets and applications. We back these with a commitment of 15 to 20 years of service parts availability. We also have nearly 200 wholly owned product distribution centers around North America.

Needless to say, we have inventory. LOTS of it.

Carrier's Lean Operations Development Group was formed of eight senior engineers and charged with bringing lean principles and other industry best practices to Carrier's business units. Eventually, we concluded that we needed a professionally designed, standardized strategy and toolkit to better manage the "opportunities" for increasing inventory turns at both area-wide and individual site levels.

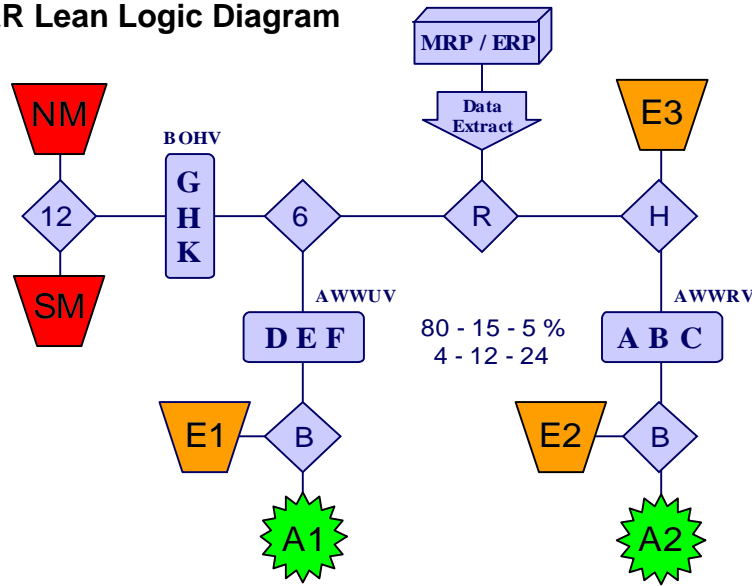
Unfortunately, the nearly 300 sites had acquired their MRP/DRP/ERP systems individually over a long time, and most newly acquired sites added their own systems to the chaotic collection. To make things even more challenging, formal user training turned out to be sparse, and training in materials management strategies even more rare; so buyers and planners were seldom using the query capabilities of their system, and system managers were limiting time and access even to the "competent" users.

## THE IQR LEAN LOGIC

Fortunately, it was about that time that we learned about the Inventory Quality Ratio (IQR) logic. This logic had been developed collectively by 35 materials managers and used to reduce inventories in their companies by 20% to 40% while improving on-time deliveries to their customers. We found this lean logic to be easily learned, non-intrusive and quickly linkable to any MRP/ERP host system. Further, it allowed us to use standardized analytical tools and queries for managing inventories and combining site databases for consolidated reporting and analysis across disparate systems.

As shown in Figure 1, the IQR lean logic divides inventory into three groups: items with future requirements, items with no future requirements but with recent past usage, and items with neither. The items in these groups are then stratified into typical ABC-type classifications based on their future dollar requirements (ABC), their past dollar usage (DEF), or their current dollar balances (GHI), respectively. A target inventory level or rule is set for each item based on its classification. The balance on hand of each item is compared to the rule, and the dollars of each item are categorized as either Active (A1 or A2), Excess (E1, E2 or E3), Slow Moving (SM) or No Moving (NM). These are called the inventory quality categories.

**Figure 1. IQR Lean Logic Diagram**



$$\text{IQR} = \frac{\text{A1} + \text{A2}}{\text{A1} + \text{A2} + \text{E1} + \text{E2} + \text{E3} + \text{SM} + \text{NM}} = \frac{\text{Active Inventory Dollars}}{\text{Total Inventory Dollars}}$$

The Inventory Quality Ratio is the ratio of the active inventory dollars to total inventory dollars. In a theoretically perfect situation (i.e., with no excess, slow moving or no moving inventories), the IQR would be 100%. Using very generous inventory rules of 4-12-24 weeks of supply for A-B-C items, respectively, the IQR for most manufacturing companies is in the 30% to 45% range (with the exception of the automotive industry). This means that approximately 60% of their inventory dollars are tied up in excess, slow or no moving items. Slow and no moving inventories account for about 10% of the dollars and one category, Excess 2 (E2), typically accounts for 30% to 50% of the total inventory dollars. Most companies using the IQR lean logic today, including Carrier, are using rules that are much more aggressive, like 2-6-12 weeks of supply or even 1-3-6 weeks of supply. This simple logic can be adapted to any MRP or ERP system.

Regardless of the systems being used or their manufacturing environments, planners and buyers find it difficult to control inventory investment without a dollar focus. The IQR lean logic uses both future requirements and past usage, along with dynamic A-B-C classifications and user-defined rules to manage inventories with a dollar focus. This enables planner and buyers to:

- Quickly identify good, bad and excess inventories
- Measure performance by inventory segment (product line, supplier, etc.)
- Avoid shortages of purchased parts and finished goods
- Set realistic reduction objectives and track improvement over time
- Highlight problem areas and prioritize corrective action
- Monitor inventory movement as the demands change
- Update MRP replenishment rules to keep them current
- Rebalance inventories among various supply chain locations
- Better manage financial reserves and avoid future write-offs.

These capabilities will be demonstrated during the Conference session.

## LEAN INVENTORY APPROACH AND RESULTS

At Carrier, our recommended implementation sequence and priorities were purposely set to build enthusiasm among users, create a low perceived risk with the tool, and yield measurable wins as quickly as possible. Our priorities were to:

1. Identify and fix database errors and omissions.
2. Predict and prevent potential stockouts or shortages.
3. Identify and eliminate dormant/obsolete stocks.
4. Systematically tackle excess inventory reduction opportunities.
5. Use IQR to better-balance planner/buyer assignments, and to provide a consistent performance metric.

The excess reduction strategies were deliberately selected for perceived low risk and included:

- ✓ Work down stocks over 30 days of supply, and reset bad parameters.
- ✓ Renegotiate minimum buy quantities greater than 30 days of supply.
- ✓ Resize safety stocks greater than lead time days of supply.
- ✓ Postpone prematurely scheduled new deliveries.

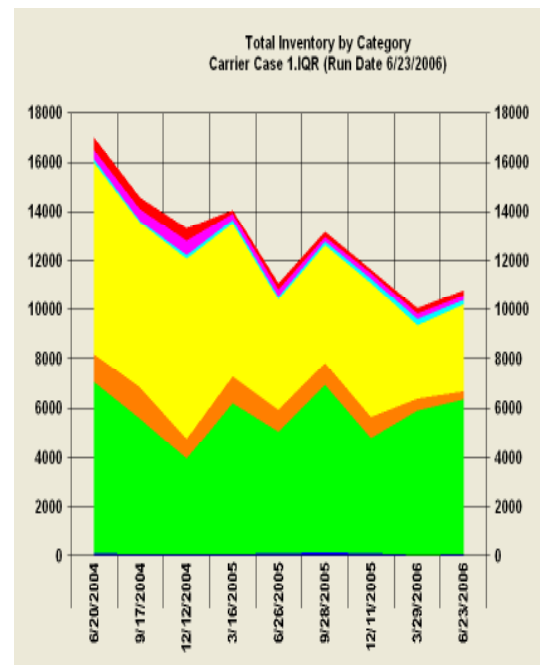
It sounds almost too easy, but the results have been quite dramatic, as you can see below.

**Figure 2. Stable factory site focused on improving to 28 turns.**

**UTC/Carrier Site 1**

	Mar-05	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06
ABC Rule	1-4-7	1-4-7	1-4-7	1-4-7	1-4-7	1-4-7
DEF Rule	1-4-7	1-4-7	1-4-7	1-4-7	1-4-7	1-4-7
Active 1	81	129	141	121	51	79
Active 2	6,148	4,930	6,803	4,690	5,877	6,297
	6229	5059	6944	4811	5928	6376
Excess 1	1,052	889	878	869	455	320
Excess 2	6,230	4,505	4,828	5,408	3,006	3,524
Excess 3	150	86	131	191	241	165
	7,432	5,480	5,837	6,468	3,702	4,009
Slow Moving	274	298	189	215	204	208
No Moving	84	211	191	125	191	176
	358	509	380	340	395	384
<b>Total</b>	<b>14,018</b>	<b>11,047</b>	<b>13,162</b>	<b>11,619</b>	<b>10,025</b>	<b>10,769</b>
<b>IQR Ratio</b>	<b>44%</b>	<b>46%</b>	<b>53%</b>	<b>41%</b>	<b>59%</b>	<b>59%</b>

Notes: Location & currency unspecified, rules set to target 28 turns/yr.  
Target turns reflect site history, material types and supplier lead times.



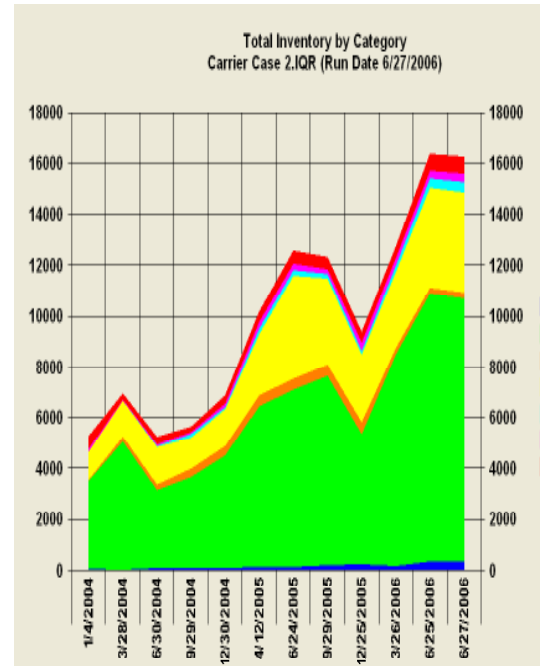
This exhibit is typical of the result at our sites with stable demand (green inventory is good!). Note that most of the inventory reduction is in Excess 2 (yellow) indicating improved cash flow.

Figure 3. Rapidly growing site focused on maintaining 18 turns.

### UTC/Carrier Site 2

	Jun-05	Sep-05	Dec-05	Mar-06	Jun-06	Jun-06
ABC Rule	2-4-12	2-4-12	2-4-12	2-4-12	2-4-12	2-4-12
DEF Rule	2-4-12	2-4-12	2-4-12	2-4-12	2-4-12	2-4-12
Active 1	160	229	263	198	383	380
Active 2	6,981	7,471	5,093	8,340	10,522	10,368
	7141	7700	5356	8538	10905	10748
Excess 1	440	418	491	248	218	205
Excess 2	4,046	3,385	2,669	2,975	3,931	3,937
Excess 3	209	167	166	260	370	388
	4,695	3,970	3,326	3,483	4,519	4,530
Slow Moving	245	214	319	296	320	325
No Moving	475	438	373	402	621	631
	720	652	692	698	941	956
<b>Total</b>	<b>12,555</b>	<b>12,321</b>	<b>9,373</b>	<b>12,718</b>	<b>16,365</b>	<b>16,234</b>
IQR Ratio	<b>57%</b>	<b>63%</b>	<b>57%</b>	<b>67%</b>	<b>67%</b>	<b>66%</b>

Notes: Location & currency unspecified, rules set to target 18 turns/yr.  
Target turns reflect site history, material types and supplier lead times.



Note that inventory is increasing but this is good because it is Active inventory and the IQR ratio is also increasing. This is typical of what we have come to expect and appreciate, even at sites with rapidly growing or highly seasonal demand.

## CONCLUSIONS

It may sound unorthodox for a \$15 billion global corporation to select simple logic, a PC-based tool, and low-risk strategies to regain control of inventories, but perhaps our greatest learning is that “the simplest solution is often the most effective”.

Our bottom line results?

- Sales have now doubled with no increase in inventory levels.
- Obsolescence losses are down by half.
- Shortages have been reduced by as much as 75%.
- Normal MRP functioning is improved due to fewer database errors and omissions.
- Managers, planners and buyers feel more empowered.
- Inventories are being managed more effectively.

It was personally gratifying to learn that other United Technologies companies have taken note of Carrier’s inventory successes and are in the process of acquiring the IQR lean logic tools for their own operations.

## **About the Authors**

Eric Matson is the Principal Engineer at United Technologies / Carrier Corporation's Global Lean Operations Group, and has been closely involved with all facets of Carrier business, worldwide, for nearly 40 years. Implementing inventory management initiatives and supporting Carrier users is a key piece in Matson's process improvement strategies, and has accounted for some very significant materials wins over the last seven years. Matson graduated from Lehigh University with a B.S. in Industrial Engineering and has done graduate studies at the Maxwell School, Syracuse University, and the Lean Enterprise Institute at the University of Tennessee. Matson can be reached at Eric.Matson@carrier.utc.com and (315) 432-6014.

Gary Gossard is President of IQR International. He has over 30 years experience as a materials management practitioner and consultant. Gossard was previously the Chief Operating Officer of a high-tech manufacturing company and a Partner in an international CPA firm. He is a graduate of the USC School of Engineering and the Stanford Executive Management Program and is a frequent speaker at APICS and ISM. Gossard can be reached at Gary.Gossard@iqr.com and (949) 487-5400.