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March 23-26, 2015
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Analytics: Big Data & Data Mining

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Presented by:

Matt Kulp – St. Onge Company / Director, Principal

**Matt Toburen – Dematic Corp / Director, Software
and IT Consulting Services**

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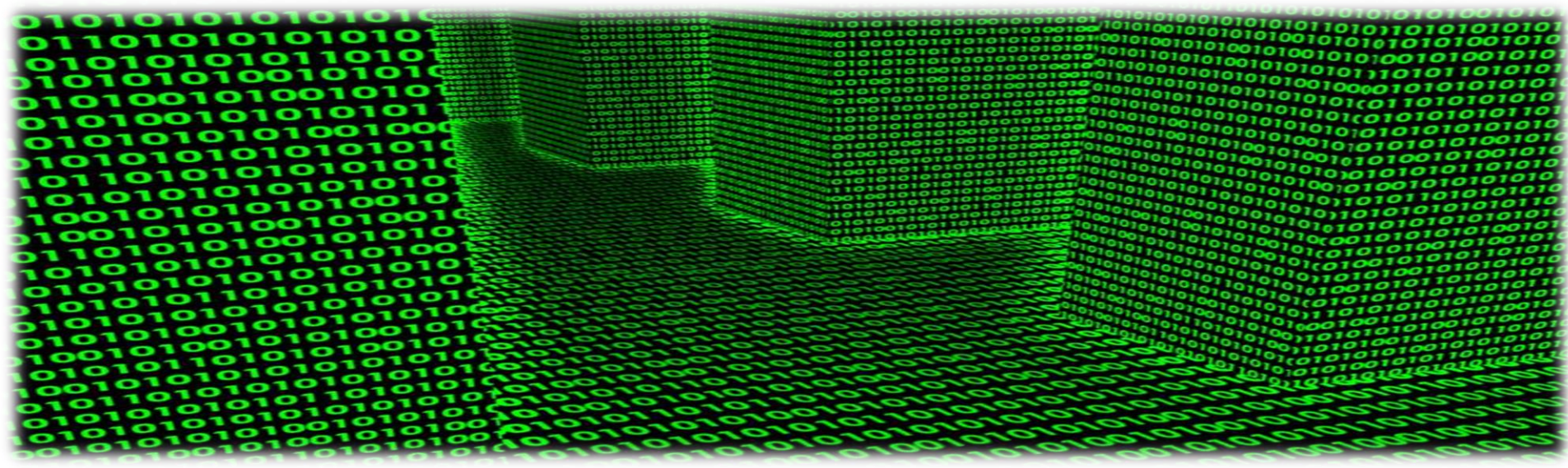
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Topics

- Using Big Data
 - Strategic planning
 - Operational visibility
 - Actionable results



THE INDUSTRY THAT MAKES SUPPLY CHAINS WORK™

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WHAT IS BIG DATA?

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DATA



What is Big Data?

From Wikipedia

- “**Big data** is an all-encompassing term for any collection of data sets so large and complex that it becomes difficult to process using traditional data processing applications.”
- What is considered "big data" varies depending on the capabilities of the organization managing the set, and on the capabilities of the applications that are traditionally used to process and analyze the data set in its domain.
 - Magoulas, Roger; Lorica, Ben (February 2009). ["Introduction to Big Data"](#). *Release 2.0* (Sebastopol CA: O'Reilly Media)
- Big Data is a moving target; what is considered to be "Big" today will not be so years ahead.
 - Magoulas, Roger; Lorica, Ben (February 2009). ["Introduction to Big Data"](#). *Release 2.0* (Sebastopol CA: O'Reilly Media)



What is Big Data?

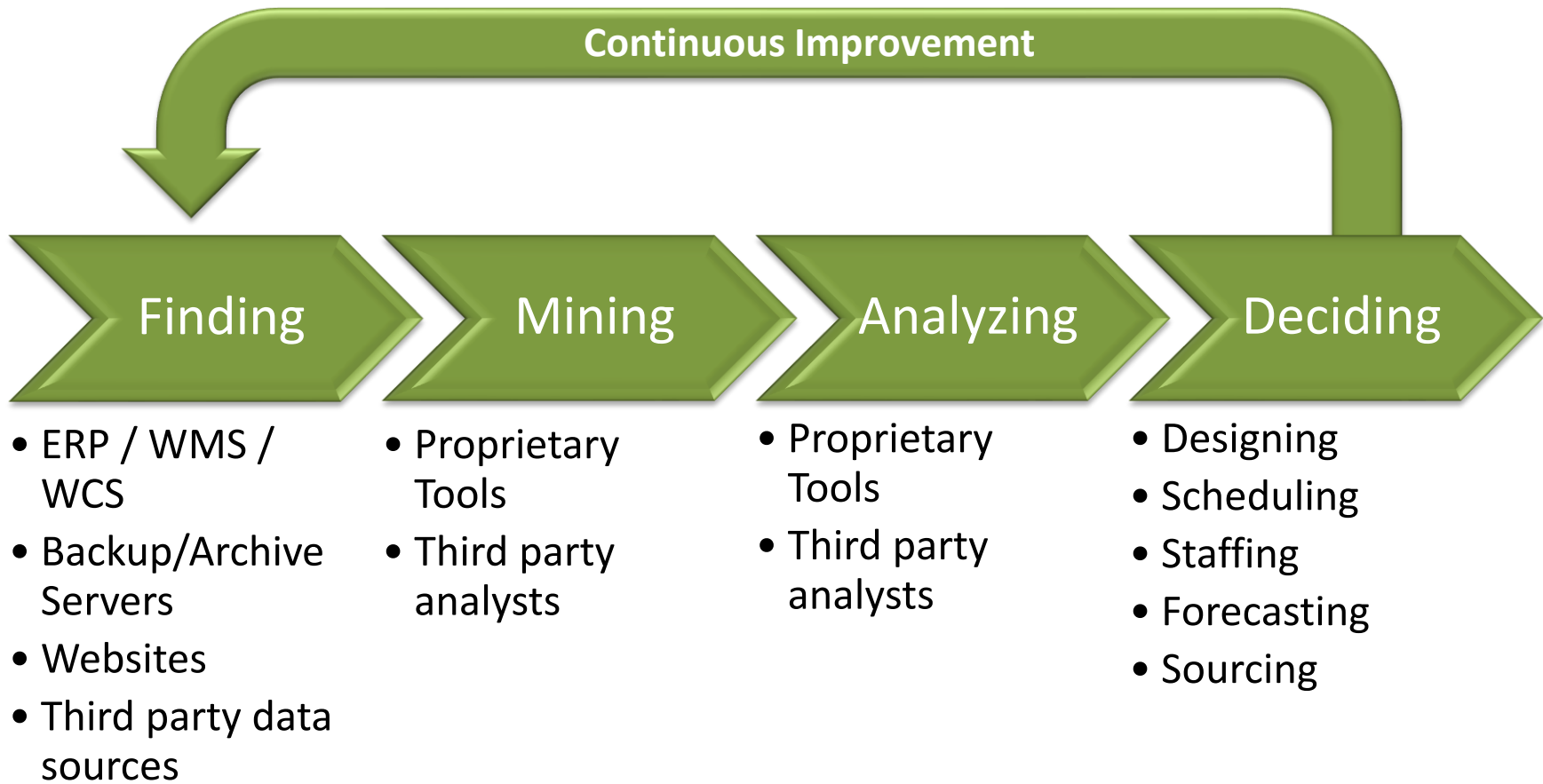
What does it mean for MHI?

- How can it be used to influence:
 - Strategic Thinking?
 - Day to Day Operations?
- Big Data is your next competitive advantage
- Figuring out how to use it will help you outpace competitors





Using Big Data in the Supply Chain



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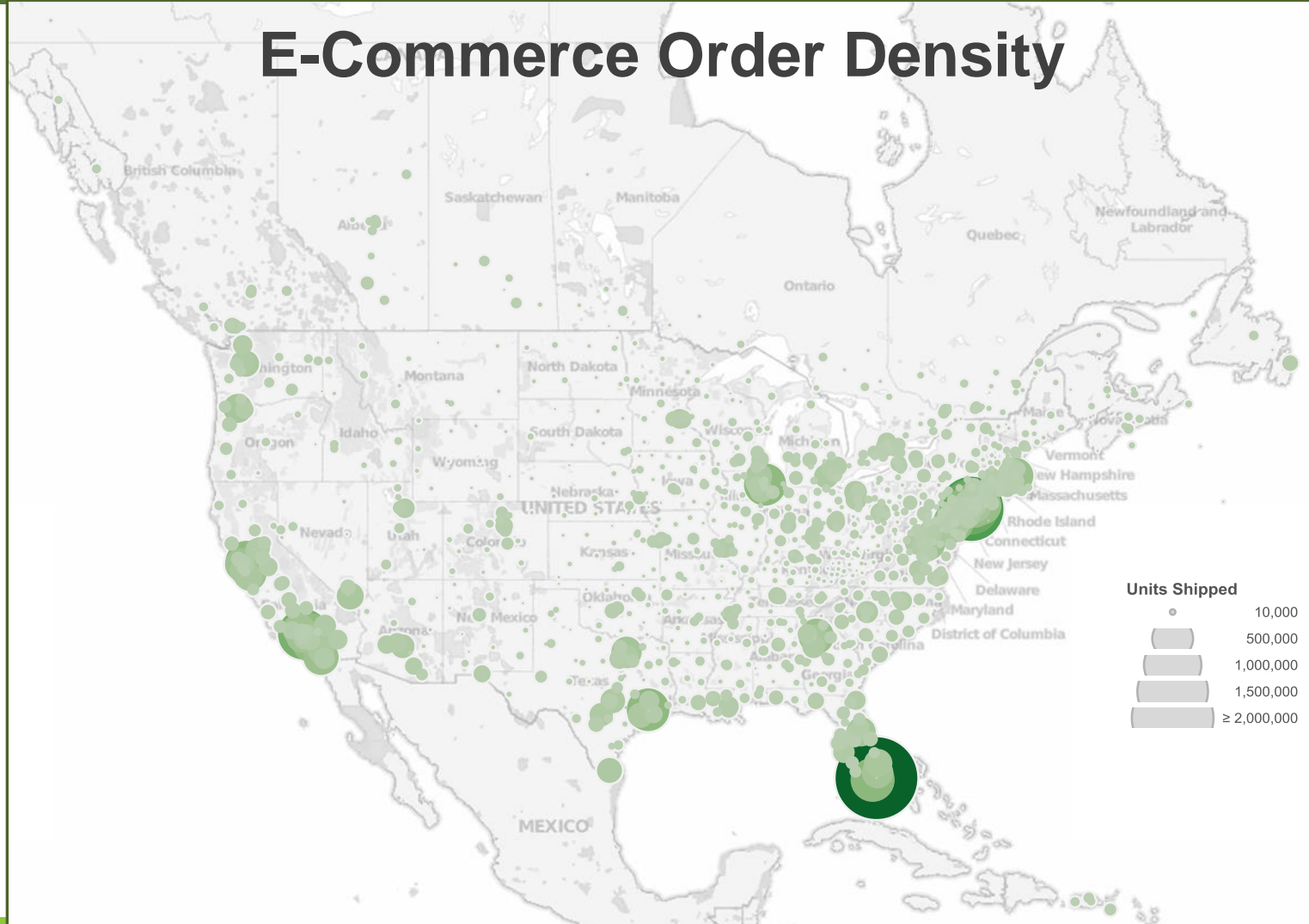
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SUPPLY CHAIN STRATEGY AND DESIGN

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E-Commerce Order Density



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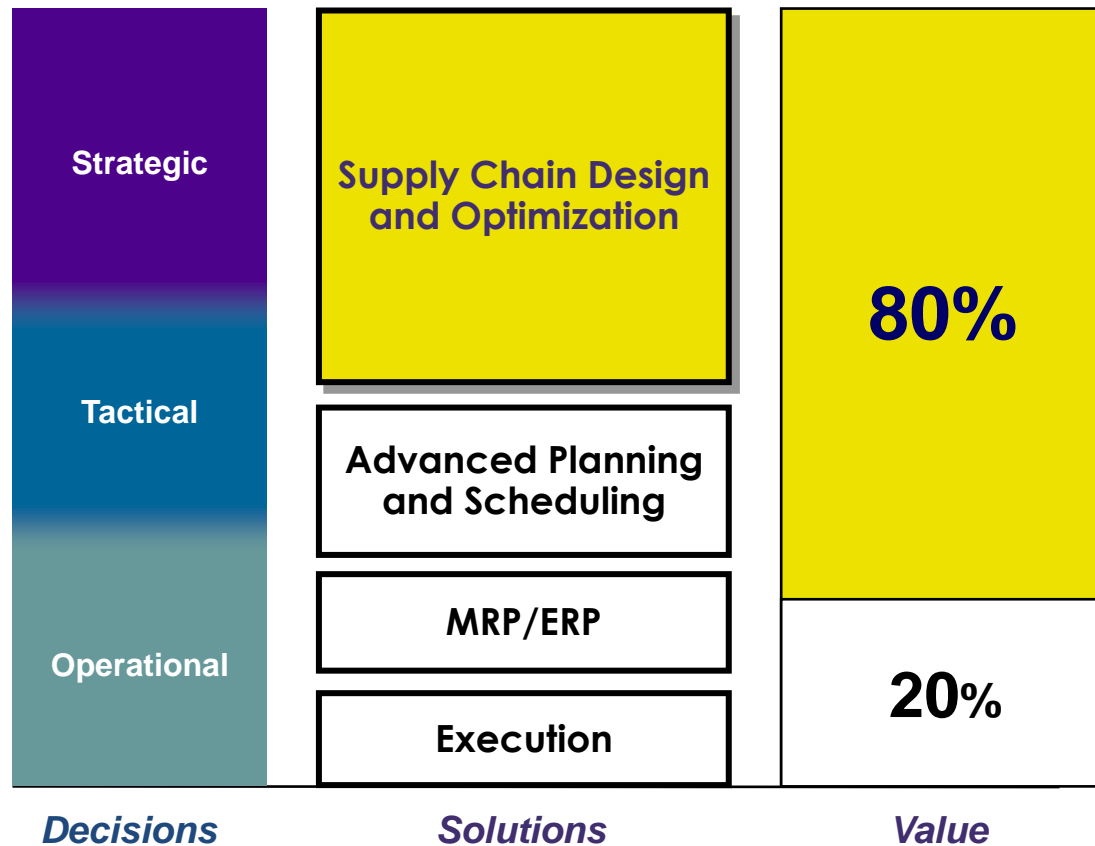


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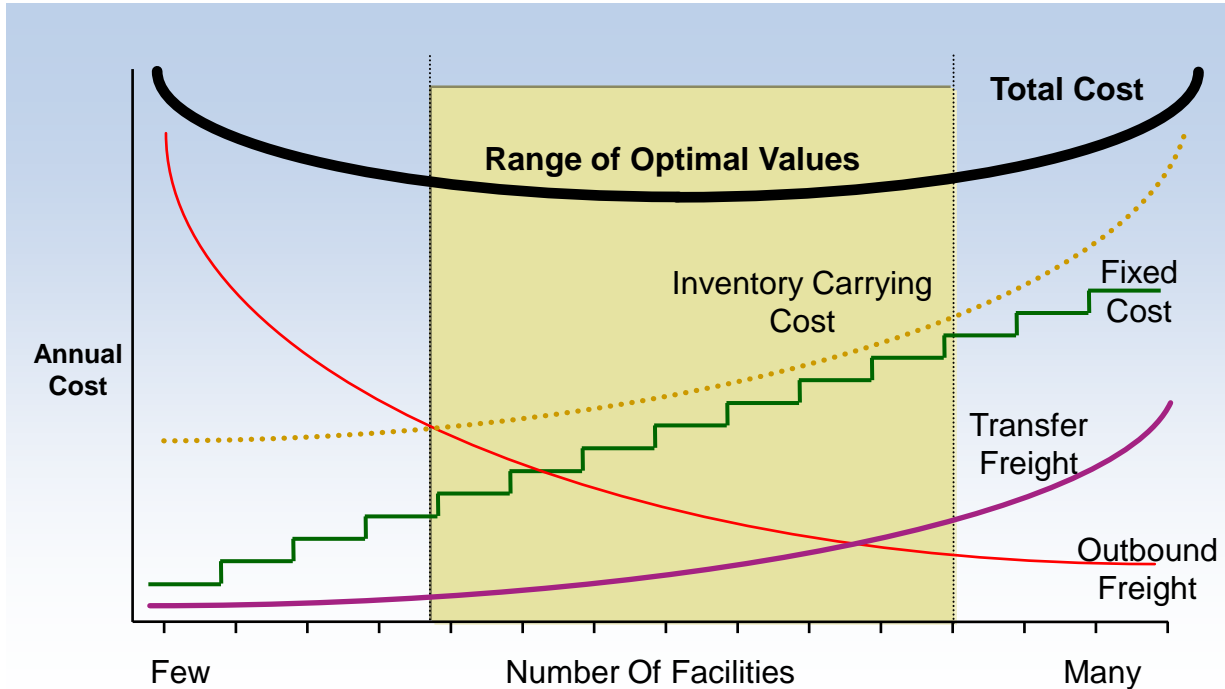
Supply Chain Network Modeling



Source: AMR Research



Supply Chain Network Modeling



The objective is to optimize total cost and maintain or improve delivery service levels:

- Order lead time
- On-time delivery
- Fill rate

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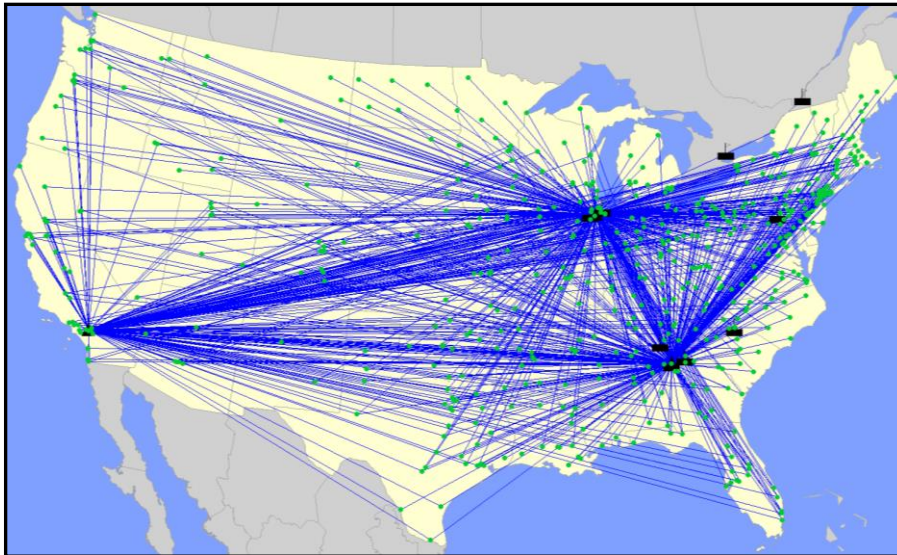
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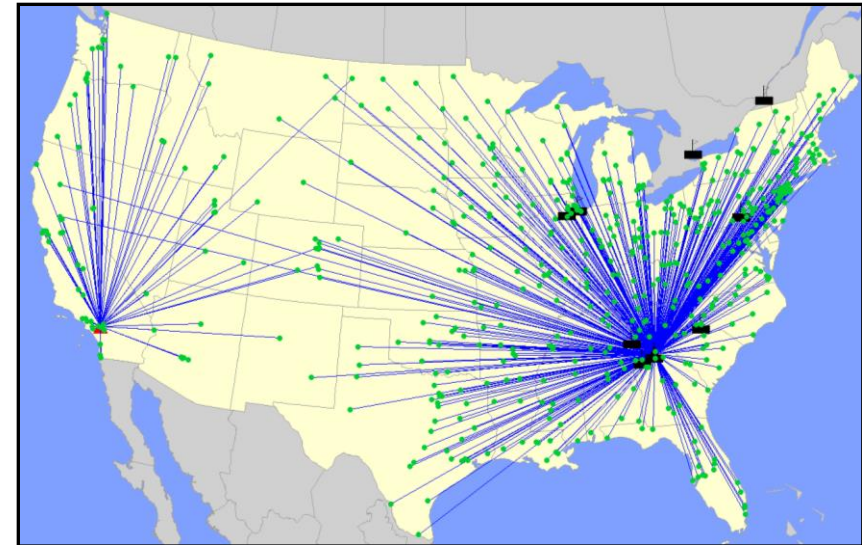
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Supply Chain Network Modeling

Before

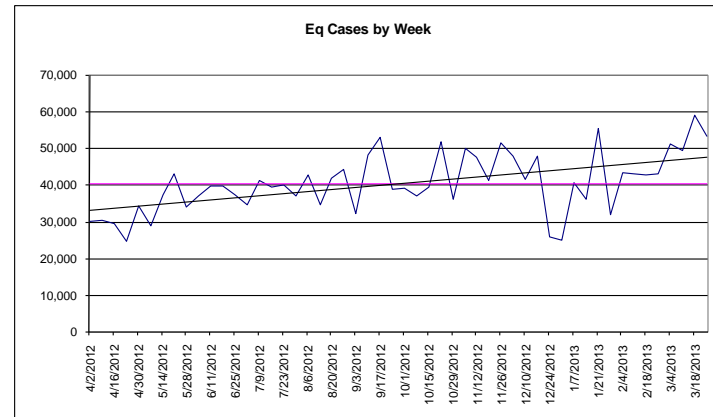


After



Order Analysis

Days	257				
Category	Total	Avg	Min	Max	Std
OrderNumbers	4,166	21	1	68	9
SKUs	240	72	2	111	21
ShipToIDs	541	17	1	43	6
Lines	32,676	127	2	270	51
Eaches	497,288,475	1,934,975	20,300	4,260,440	721,709
Eq Cases	2,101,175	8,176	73	18,456	3,027
Eq Layers	346,945	1,350	13	3,077	501
Eq Pallets	64,434	251	2	558	91
Loose Eaches	-	-	-	-	-
Full Cases	20,337	79	-	203	39
Full Layers	26,336	102	-	312	51
Full Pallets	58,838	229	1	514	85
Eaches On Cases	4,804,549	18,695	-	44,029	9,428
Eaches On Layers	43,088,654	167,660	-	518,478	85,456
Eaches On Pallets	449,395,272	1,748,620	9,900	3,895,412	664,445
Eq Cases As Eaches	-	-	-	-	-
Cases On Layers	164,703	641	-	1,933	324
Cases On Pallets	1,916,135	7,456	30	16,978	2,817
Eq Layers As Eaches	-	-	-	-	-
Eq Layers As Cases	3,159	12	-	30	6
Layers On Pallets	317,450	1,235	5	2,847	468
Eq Pallets As Eaches	-	-	-	-	-
Eq Pallets As Cases	622	2	-	6	1
Eq Pallets As Layers	4,974	19	-	57	10
Loose Each Lines	-	-	-	-	-
Full Case Lines	7,495	29	-	77	14
Full Layer Lines	11,644	45	-	133	23
Full Pallet Lines	19,250	75	1	170	31
Cube (cu ft)	6,103,901	23,751	221	53,381	8,671
Weight (lbs)	44,123,598	171,687	1,697	375,055	63,004



Line Type	Lines	%
Lines with EAs + Cases + Layers + Pallets	0	0.0%
Lines with EAs + Cases + Layers	0	0.0%
Lines with EAs + Cases + Pallets	0	0.0%
Lines with EAs + Layers + Pallets	0	0.0%
Lines with Cases + Layers + Pallets	860	2.6%
Lines with EAs + Cases	0	0.0%
Lines with EAs + Layers	0	0.0%
Lines with EAs + Pallets	0	0.0%
Lines with Cases + Layers	2,198	6.7%
Lines with Cases + Pallets	214	0.7%
Lines with Layers + Pallets	1,712	5.2%
Lines with EAs Only	0	0.0%
Lines with Cases Only	4,235	13.0%
Lines with Layers Only	6,918	21.2%
Lines with Pallets Only	16,539	50.6%
Extra Lines	0	0.0%

Order Type	Orders	%
Orders with EAs + Cases + Layers + Pallets	0	0.0%
Orders with EAs + Cases + Layers	0	0.0%
Orders with EAs + Cases + Pallets	0	0.0%
Orders with EAs + Layers + Pallets	0	0.0%
Orders with Cases + Layers + Pallets	1,777	37.6%
Orders with EAs + Cases	0	0.0%
Orders with EAs + Layers	0	0.0%
Orders with EAs + Pallets	0	0.0%
Orders with Cases + Layers	146	3.1%
Orders with Cases + Pallets	109	2.3%
Orders with Layers + Pallets	562	11.9%
Orders with EAs Only	0	0.0%
Orders with Cases Only	676	14.3%
Orders with Layers Only	159	3.4%
Orders with Pallets Only	1,297	27.4%
Extra Orders	0	0.0%

Day Of Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday	TotalDays
Days Analyzed	1	49	49	51	51	50	6	257

Day Of Week	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Min Lines	7.0	3.0	54.0	50.0	31.0	16.0	2.0
Avg Lines	7.0	153.9	134.5	141.3	106.1	117.5	7.3
Stdev Lines		56.0	40.0	39.2	43.1	41.3	7.6
Max Lines	7.0	270.0	240.0	226.0	217.0	244.0	22.0

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Order Analysis

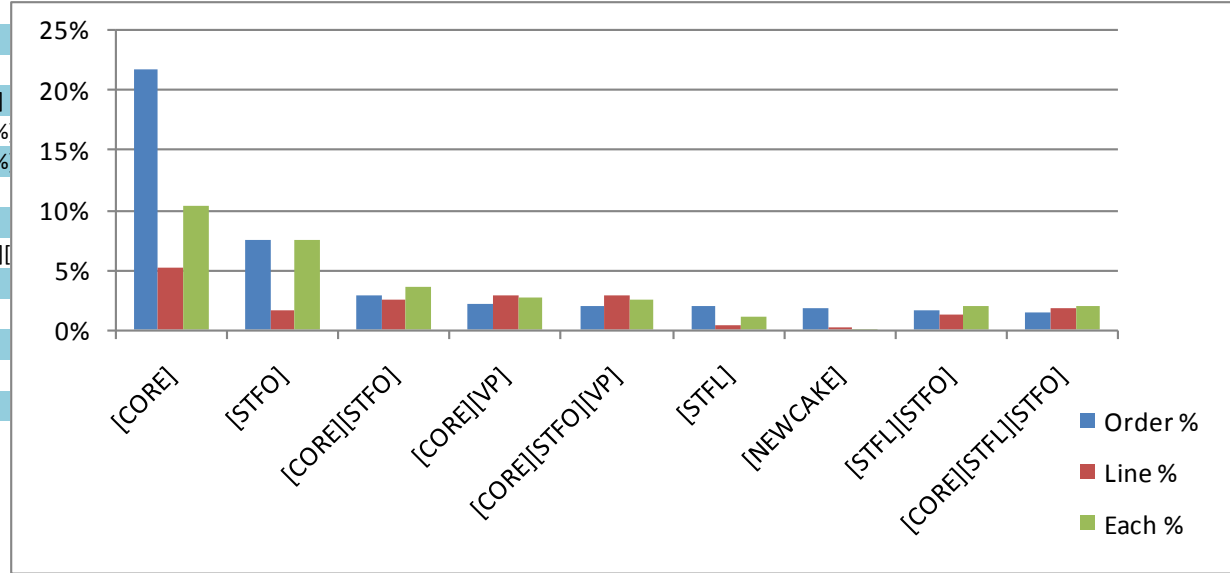
Ship Date	Day Of Week	DOW	Days Shipped	Customer Order IDs	SKUs	SKU Type 1s	SKU Type 2s	SKU Type 3s	Facility IDs	Facility Type1s	Facility Type2s	Customer IDs	Customer Order Type 1s	Customer Order Type 2s
4/1/2012	Sunday	1	1	1	7	3	1	3	1	1	1	1	1	1
4/2/2012	Monday	2	1	20	62	3	1	12	1	1	1	13	2	6
4/3/2012	Tuesday	3	1	19	56	4	1	9	1	1	1	16	2	5
4/4/2012	Wednesday	4	1	20	95	3	1	12	1	1	1	14	1	7
4/5/2012	Thursday	5	1	17	63	4	1	10	1	1	1	12	2	6
4/9/2012	Monday	2	1	13	64	4	1	12	1	1	1	11	3	7
4/10/2012	Tuesday	3	1	31	98	3	1	14	1	1	1	22	1	9
4/11/2012	Wednesday	4	1	19	78	4	1	10	1	1	1	14	1	5
4/12/2012	Thursday	5	1	10	37	4	1	11	1	1	1	7	1	5
4/13/2012	Friday	6	1	15	39	5	1	8	1	1	1	14	4	9
4/16/2012	Monday	2	1	14	75	4	1	12	1	1	1	12	3	6
4/17/2012	Tuesday	3	1	14	62	3	1	8	1	1	1	13	1	5
4/18/2012	Wednesday	4	1	12	72	3	1	12	1	1	1	9	1	4
4/19/2012	Thursday	5	1	9	29	3	1	8	1	1	1	6	2	4
4/20/2012	Friday	6	1	18	74	4	1	14	1	1	1	19	4	9
4/23/2012	Monday	2	1	17	71	4	1	14	1	1	1	18	3	8
4/24/2012	Tuesday	3	1	12	61	4	1	12	1	1	1	14	1	6
4/25/2012	Wednesday	4	1	14	73	4	1	14	1	1	1	16	1	7
4/26/2012	Thursday	5	1	10	54	4	1	10	1	1	1	11	1	5
4/27/2012	Friday	6	1	14	68	4	1	14	1	1	1	16	1	7
4/30/2012	Monday	2	1	16	81	4	1	16	1	1	1	19	1	8
5/1/2012	Tuesday	3	1	12	70	4	1	14	1	1	1	15	1	7
5/2/2012	Wednesday	4	1	9	44	3	1	8	1	1	1	6	2	4
5/3/2012	Thursday	5	1	13	57	4	1	13	1	1	1	15	1	7

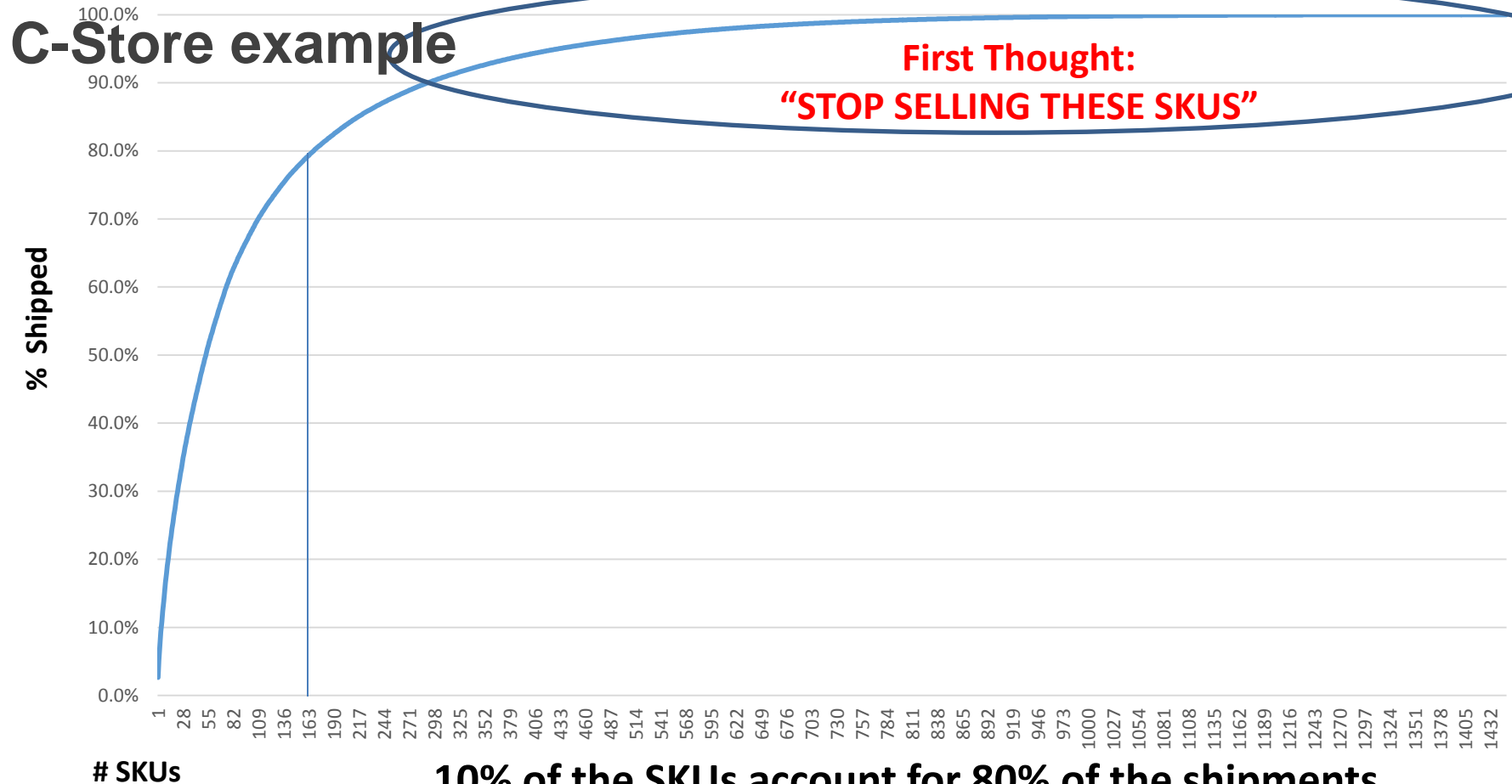
Ship Date	Ship To IDs	Shipment IDs	Ship Type 1s	Ship Type 2s	Total Lines	Total Cube	Total Weight	Eas	Eq Cases	Eq Layers	Eq Pallets	Loose EAs	Full Cases	Full Layers	Full Pallets	EA On Cases	EA On Layers	EA On Pallets
4/1/2012	1	1	1	1	7	2,031	15,167	100,550	507	108	24	0	0	24	0	100,550		
4/2/2012	18	20	2	1	86	23,470	172,759	2,084,902	8,201	1,354	250	0	33	48	240	8,874	83,746	1,992,282
4/3/2012	18	19	2	1	81	16,504	119,112	1,264,036	5,619	938	175	0	65	75	159	17,718	117,550	1,128,768
4/4/2012	19	20	2	1	209	25,023	184,732	2,006,932	8,273	1,373	263	0	143	210	217	33,820	355,372	1,617,740
4/5/2012	14	17	2	1	89	20,834	149,480	1,911,624	7,323	1,126	213	0	18	104	193	3,356	161,048	1,747,220
4/9/2012	11	13	2	1	86	15,161	109,535	1,178,570	4,895	859	167	0	58	94	146	13,866	154,002	1,010,702
4/10/2012	27	31	2	1	198	31,885	222,347	2,482,307	10,914	1,795	343	0	143	166	307	33,891	268,518	2,179,898
4/11/2012	17	19	2	1	136	21,125	155,312	1,673,142	7,144	1,177	221	0	84	76	204	20,612	102,510	1,550,020
4/12/2012	8	10	2	1	48	6,480	43,041	435,130	2,165	364	68	0	67	35	59	15,130	51,800	368,200
4/13/2012	14	15	2	1	47	14,680	103,869	1,158,150	5,073	774	156	0	26	36	149	5,046	56,132	1,096,972
4/16/2012	13	14	2	1	107	23,940	174,159	1,753,344	7,720	1,335	253	0	90	80	236	23,534	125,030	1,604,780
4/17/2012	14	14	1	1	105	12,955	99,451	1,257,578	4,372	717	136	0	54	98	115	14,030	158,738	1,084,810
4/18/2012	10	12	2	1	122	19,471	137,730	1,332,460	6,008	1,067	205	0	80	84	187	21,914	119,904	1,190,642
4/19/2012	8	9	2	1	37	12,267	87,882	992,560	4,303	718	130	0	15	11	127	3,900	18,650	970,010
4/20/2012	15	18	2	1	127	19,723	141,269	1,750,900	6,932	1,116	213	0	109	168	178	28,442	281,378	1,441,080
4/23/2012	17	17	2	1	88	13,008	101,397	1,071,356	4,284	754	142	0	53	88	124	9,586	148,770	913,000
4/24/2012	12	12	2	1	130	16,831	120,065	1,326,578	5,728	899	172	0	79	154	140	17,494	242,974	1,066,110
4/25/2012	14	14	2	1	113	16,153	118,243	1,303,092	5,701	904	172	0	47	68	157	12,012	121,180	1,169,900
4/26/2012	10	10	1	1	31	4,965	39,022	471,996	1,742	265	56	0	39	26	50	9,382	47,744	414,870
4/27/2012	11	14	2	1	104	21,406	150,893	1,633,526	7,051	1,142	223	0	76	78	206	16,168	120,974	1,496,384
4/30/2012	15	16	2	1	141	28,597	203,136	2,259,190	9,878	1,582	302	0	61	90	283	13,944	133,536	2,111,710
5/1/2012	11	12	2	1	93	18,182	128,152	1,187,208	5,822	992	194	0	66	66	179	14,030	93,700	1,079,478
5/2/2012	9	9	2	1	86	13,009	86,447	994,994	4,353	759	136	0	40	65	122	9,620	114,014	871,360
5/3/2012	13	13	2	1	131	16,770	116,813	1,489,847	5,809	934	176	0	74	124	150	18,896	198,377	1,272,574

Order Commonality

For this analysis, the order groups were product families

Order Group	EachQtySplits	LineSplits	Orders	Order %	NumSKUs	TotalLines	Line %	Eaches	Each %
[CORE]	[100%]	[100%]	909	22%	137	1,713	5%	51,668,645	10%
[STFO]	[100%]	[100%]	313	8%	37	506	2%	37,086,160	7%
[CORE][STFO]	[49.3%][50.7%]	[72.5%][27.5%]	116	3%	108	797	2%	18,204,384	4%
[CORE][VP]	[77.4%][22.6%]	[81.5%][18.5%]	87	2%	96	915	3%	13,942,691	3%
[CORE][STFO][VP]	[59.5%][20.3%][20.2%]	[64%][17.6%][18.4%]	80	2%	100	944	3%	12,868,428	3%
[STFL]	[100%]	[100%]	80	2%	12	92	0%	5,480,700	1%
[NEWCAKE]	[100%]	[100%]	75	2%	13	78	0%	234,750	0%
[STFL][STFO]	[13%][87%]	[29.4%][70.6%]	69	2%	16	385	1%	10,407,330	2%
[CORE][STFL][STFO]	[47.6%][8.1%][44.4%]	[56.4%][15.1%][28.5%]	63	2%	96	564	2%	10,082,282	2%
[CORE][STFO][STFR]	[56.5%][35.6%][7.9%]	[66.9%][19.1%][14%]	59	1%	100	598	2%	10,621,962	2%
[STF52R3]	[100%]	[100%]	55	1%	1	63	0%	426,300	0%
[STFR]	[100%]								
[PL]	[100%]								
[SANDWEDGE]	[100%]								
[CORE][STFL][STFO][STFR]	[43.9%][7.5%][41.4%][7.3%]								
[CORE][STFO][STFR][VP]	[49.1%][26.7%][8.3%][15.9%]								
[CORE][STFL][STFO][VP]	[40.7%][5.6%][40.9%][12.8%]								
[FREEDS]	[100%]								
[STF202]	[100%]								
[CORE][STFL][STFO][STFR][VP]	[47.8%][5.9%][27.1%][5.6%]								
[CARCUP]	[100%]								
[CORE][STFR]	[75%][25%]								
[CORE][STFR][VP]	[68.5%][13.2%][18.3%]								
[STFL][STFO][STFR]	[22.8%][53.2%][24%]								
[VISIBLYFRESH]	[100%]								
[CORE][CRYSTALFRESH][VP]	[59.8%][19.5%][20.7%]								

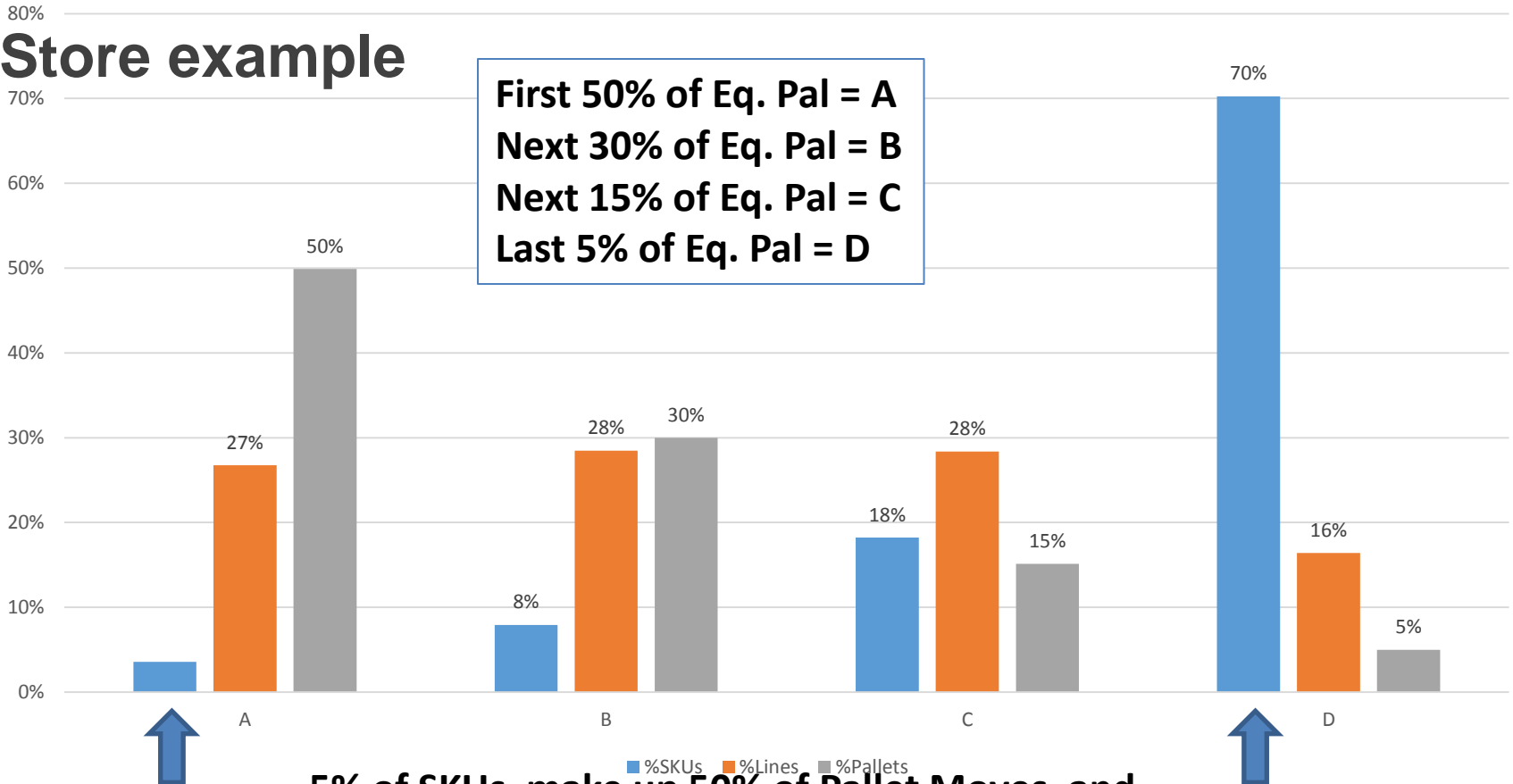




10% of the SKUs account for 80% of the shipments
Steep Pareto – Initial Thoughts? Remove SKUs?



C-Store example

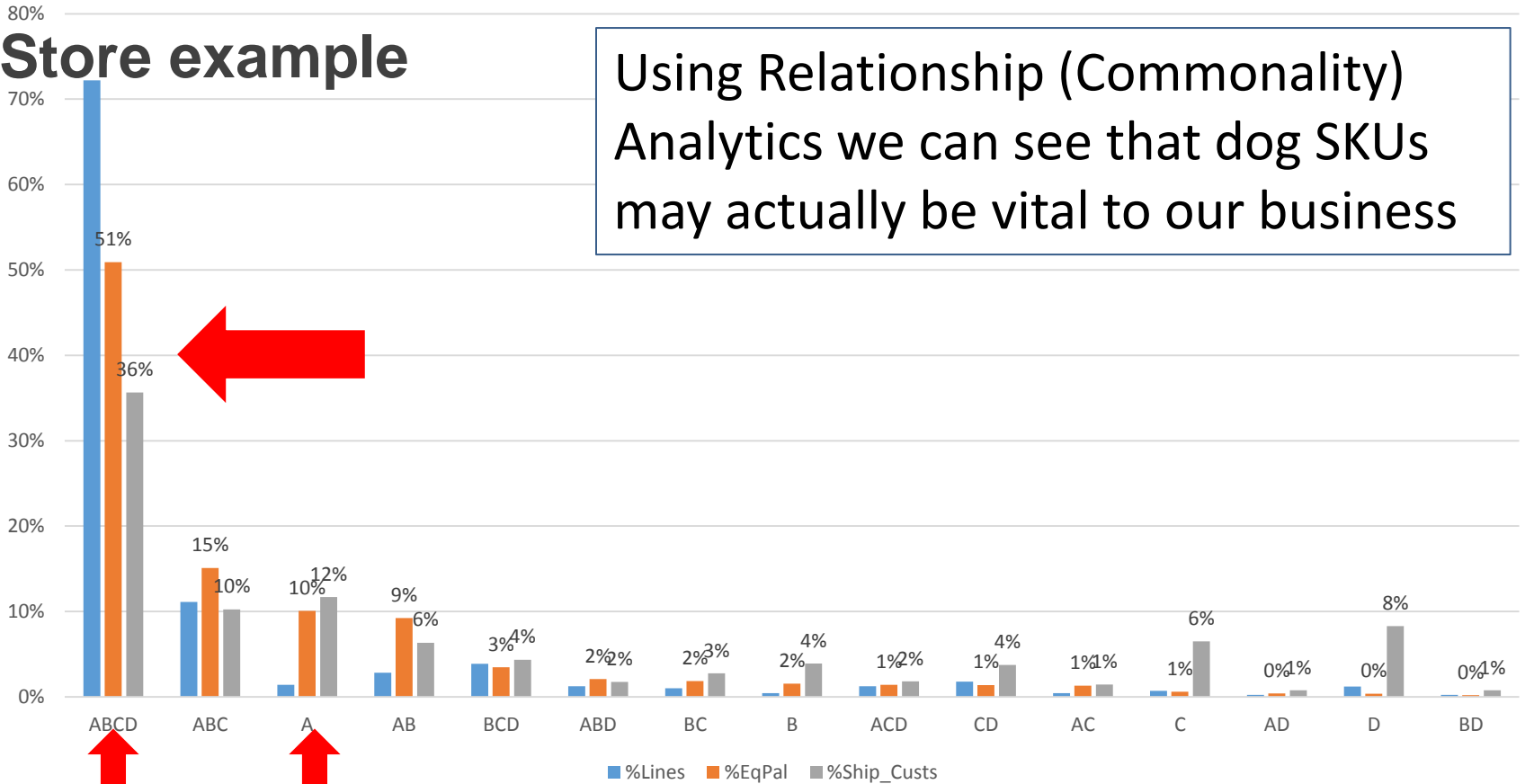


First 50% of Eq. Pal = A
Next 30% of Eq. Pal = B
Next 15% of Eq. Pal = C
Last 5% of Eq. Pal = D

5% of SKUs make up 50% of Pallet Moves, and 70% of SKUs make up only 5% of Pallet Moves.
Our suspicion is confirmed – D items are “dogs”

C-Store example

Using Relationship (Commonality) Analytics we can see that dog SKUs may actually be vital to our business



The challenge – 36% of the shipments have D items. Those customer shipments account for over 70% of total lines shipped.

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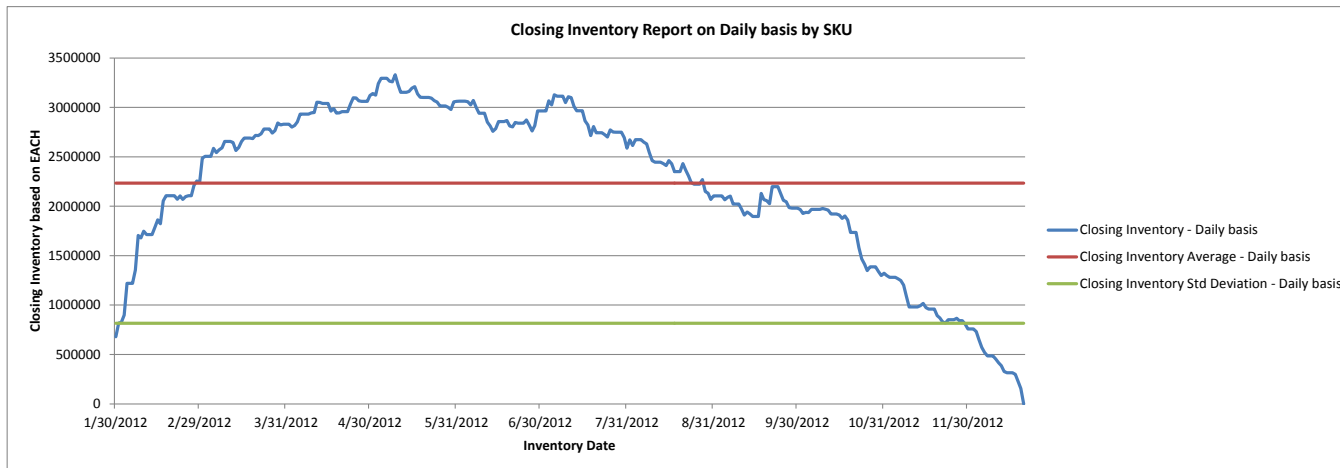
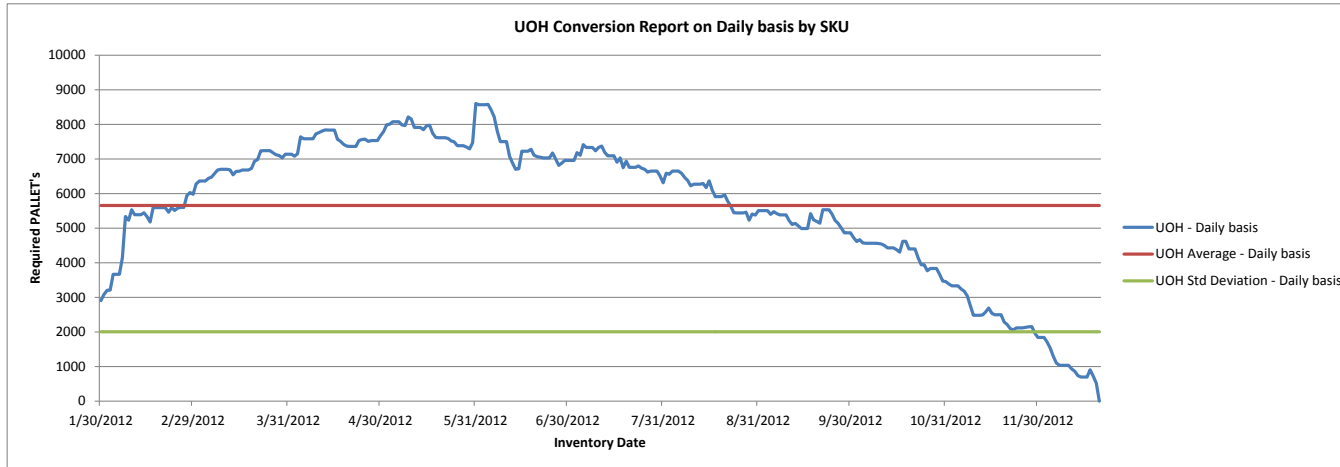


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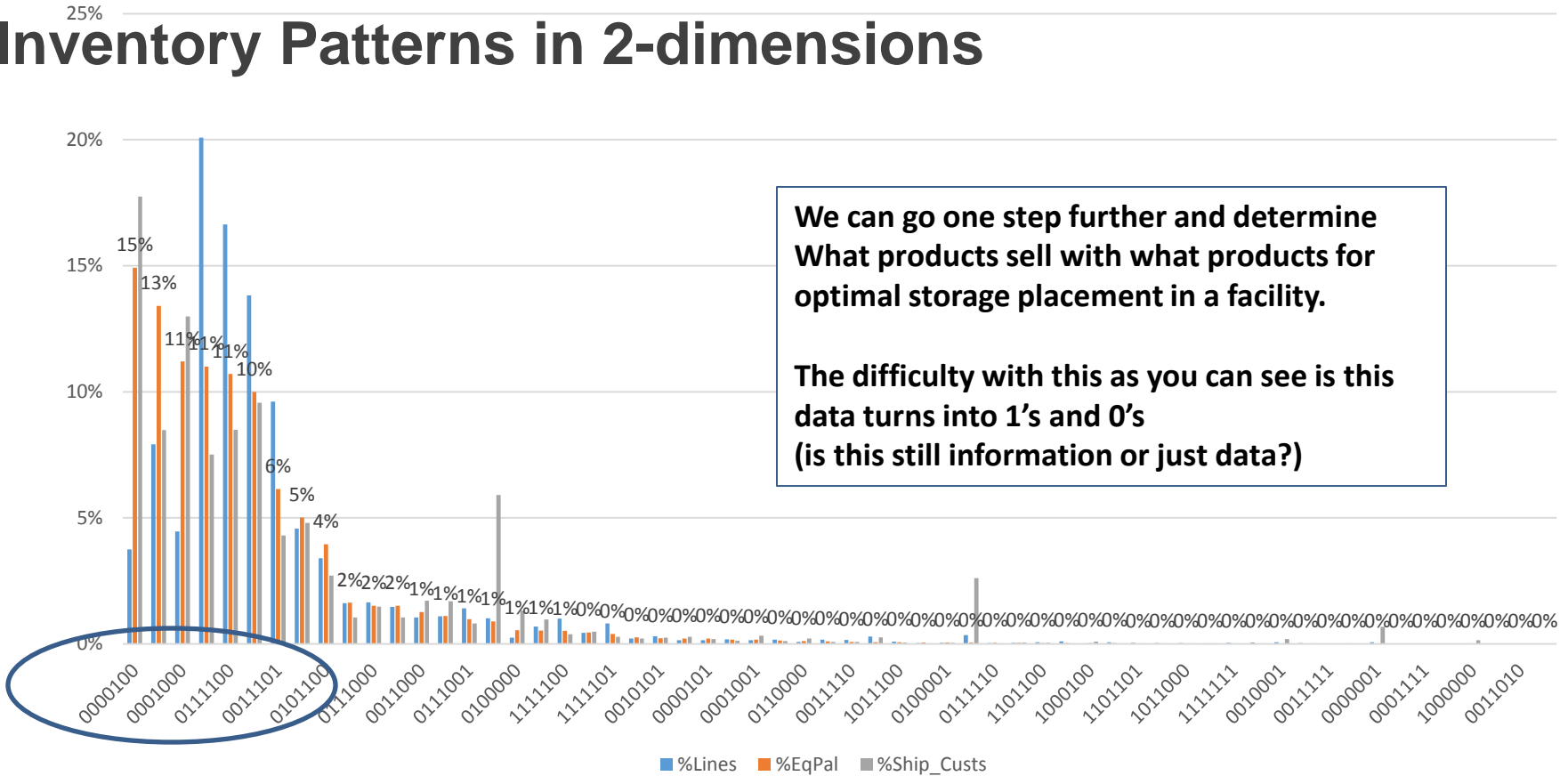
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Inventory Patterns



Inventory Patterns in 2-dimensions



82% of Eq. Pals and 72% of Customer Shipments come from limited Combinations Suggests these Product Types could be stored in the same warehouse zones

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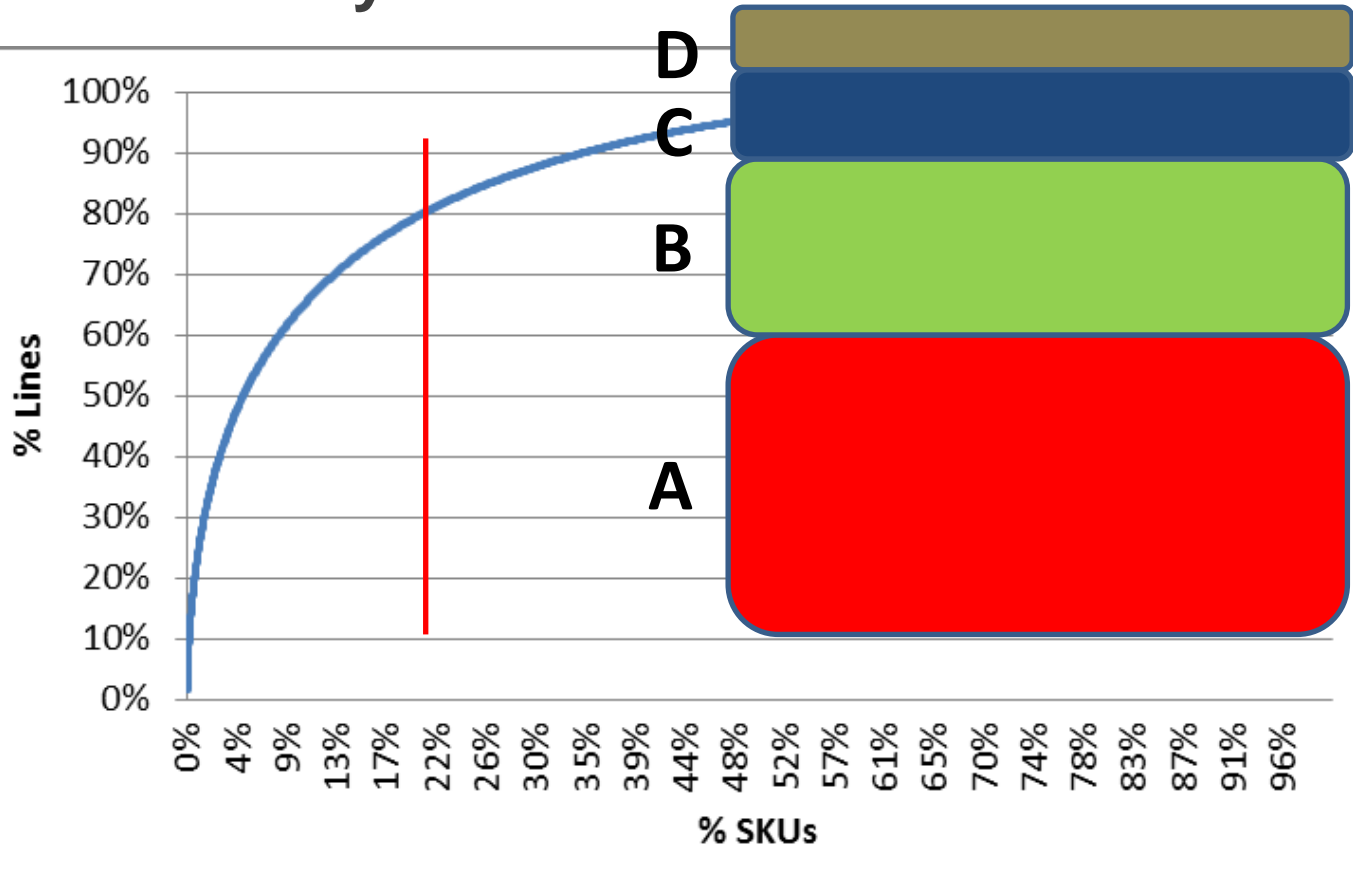


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Pareto Analysis in 2-dimensions



D=Last 5% Lines

C=Next 15% Lines

B=Next 30% Lines

A=Top 50% Lines

80% of the Line Volume Comes From 20% of the SKUs

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Pareto Analysis in 3-dimensions

Current state

A = Red

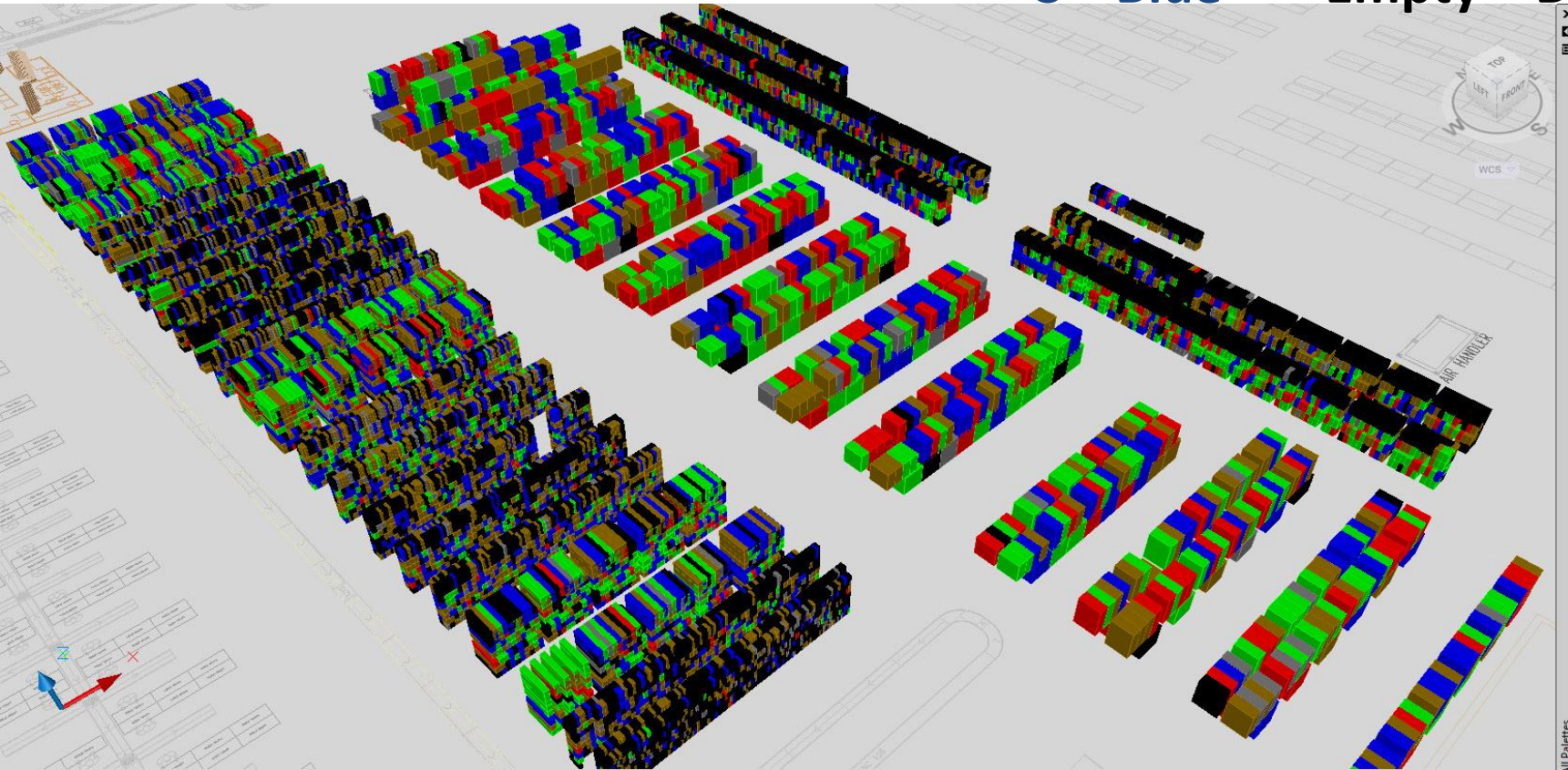
D = Brown

B = Green

Dead = Grey

C = Blue

Empty = Black



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Slotting Forward Pick Area After Re- Slotting

A = Red

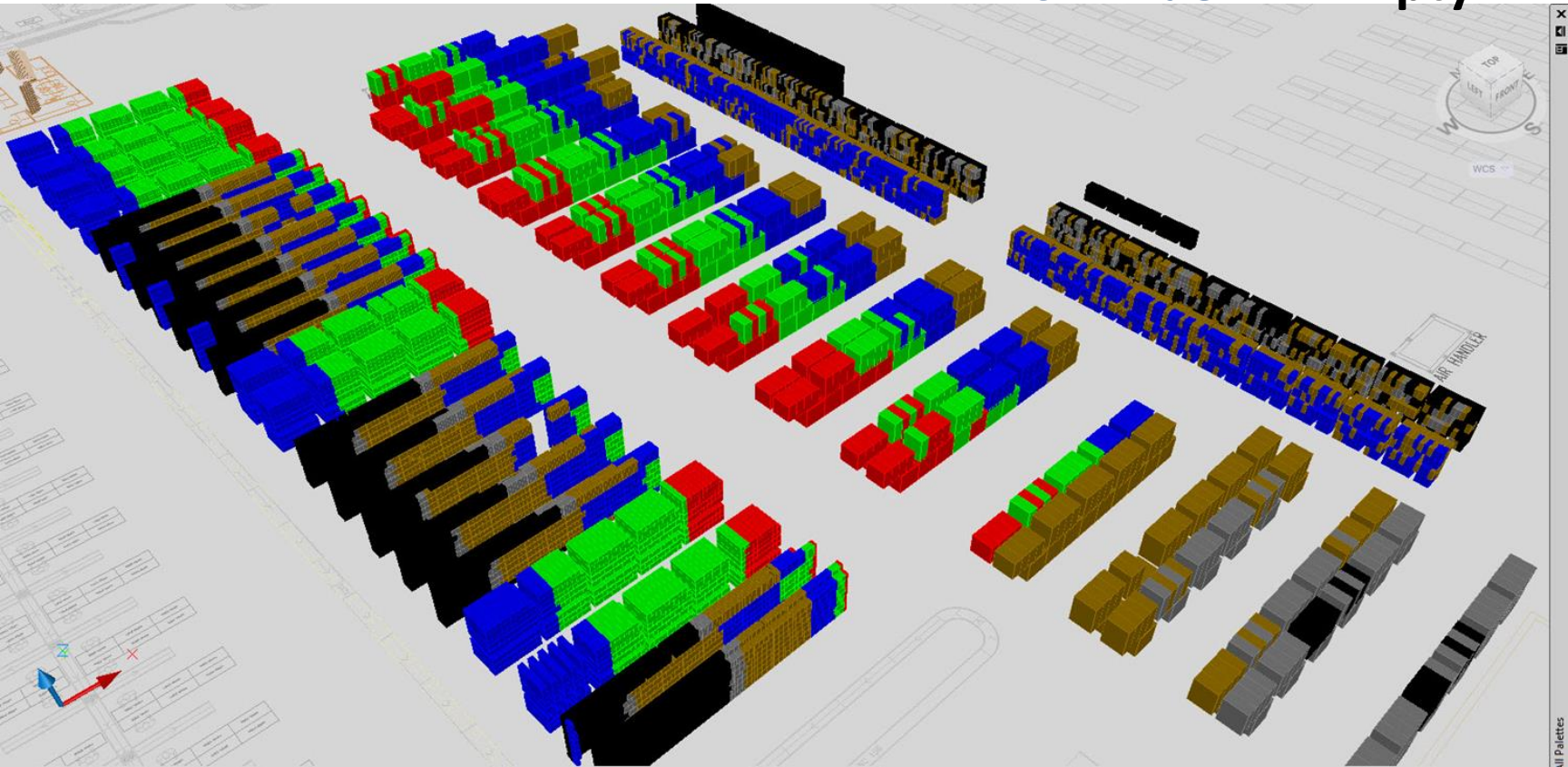
D = Brown

B = Green

Dead = Grey

C = Blue

Empty = Black



FIND WHAT'S NEXT.

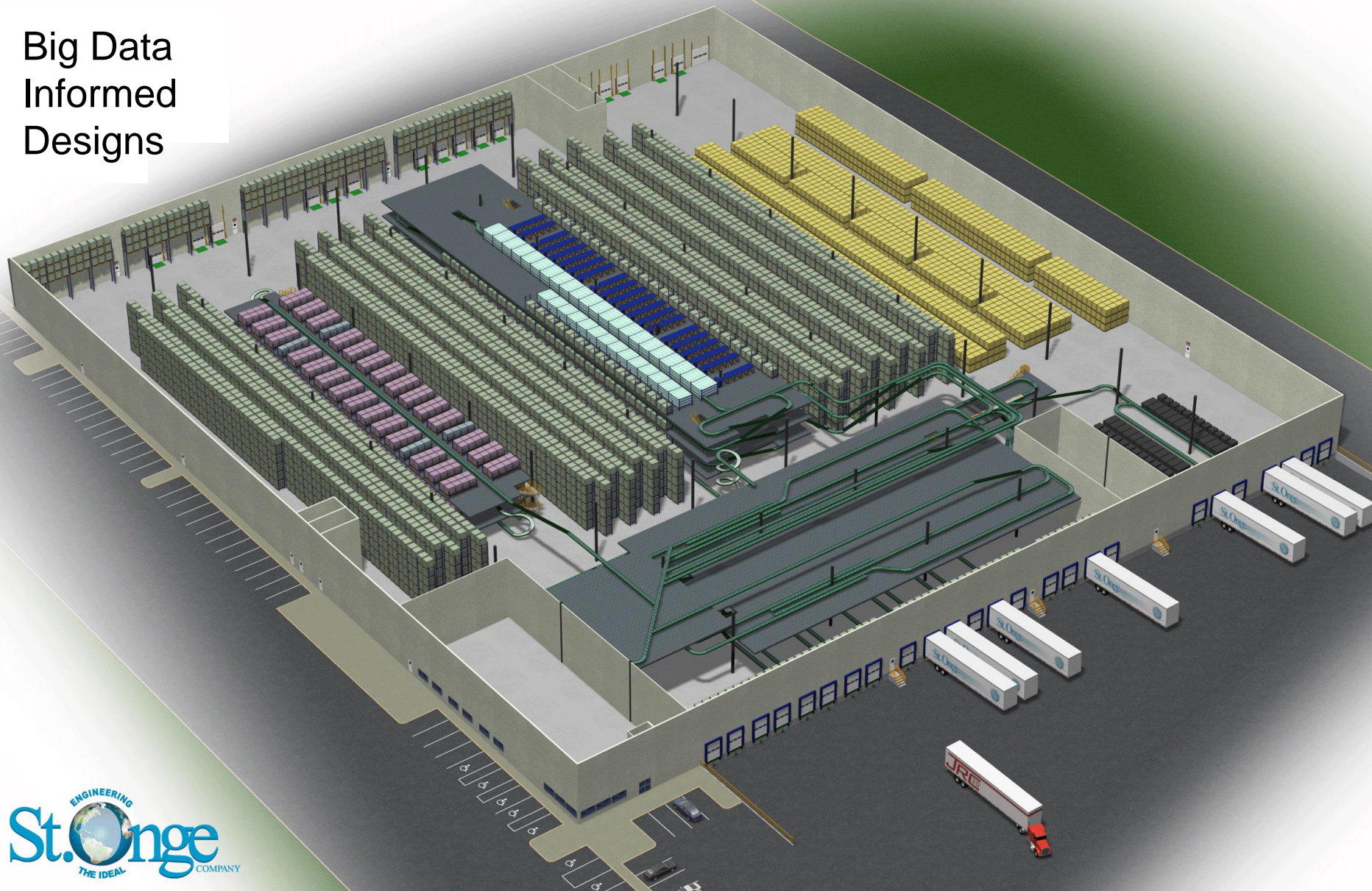


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Big Data Informed Designs



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OPERATION INSIGHT AND DECISION MAKING – HOW DO YOU GET THERE?

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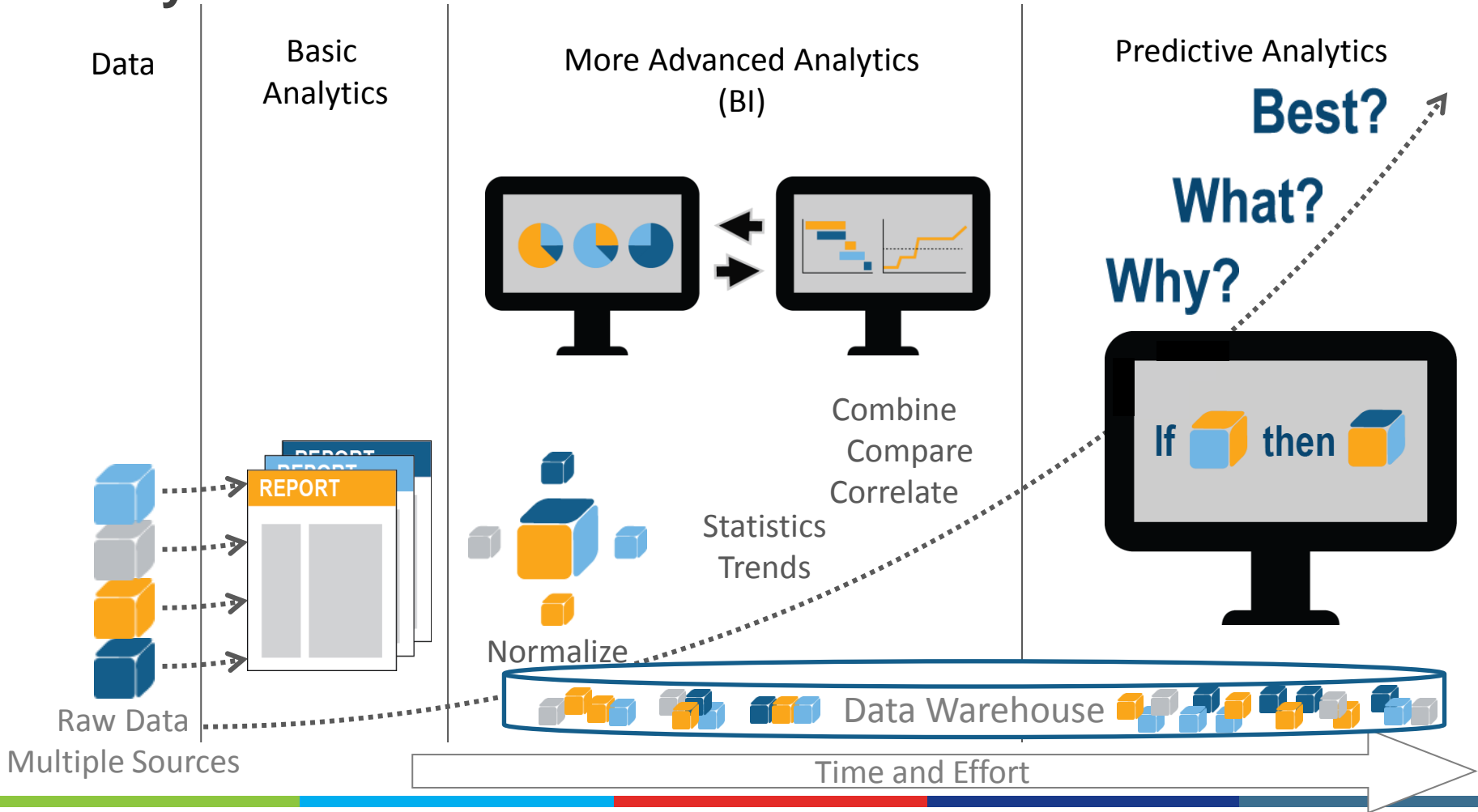
Now we need to operate...

WHAT is happening?
WHY is it happening
WILL it happen again?

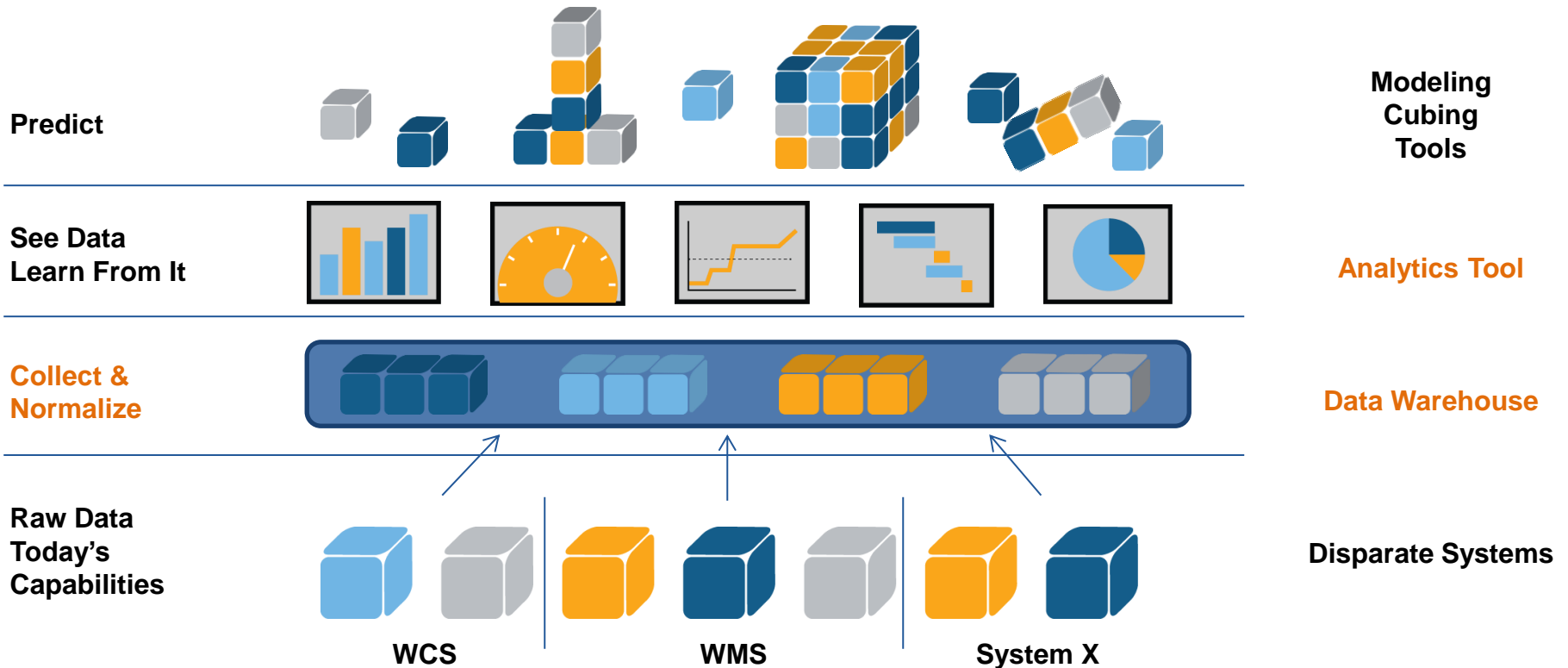


FIND WHAT'S NEXT.

Analytics Value Path

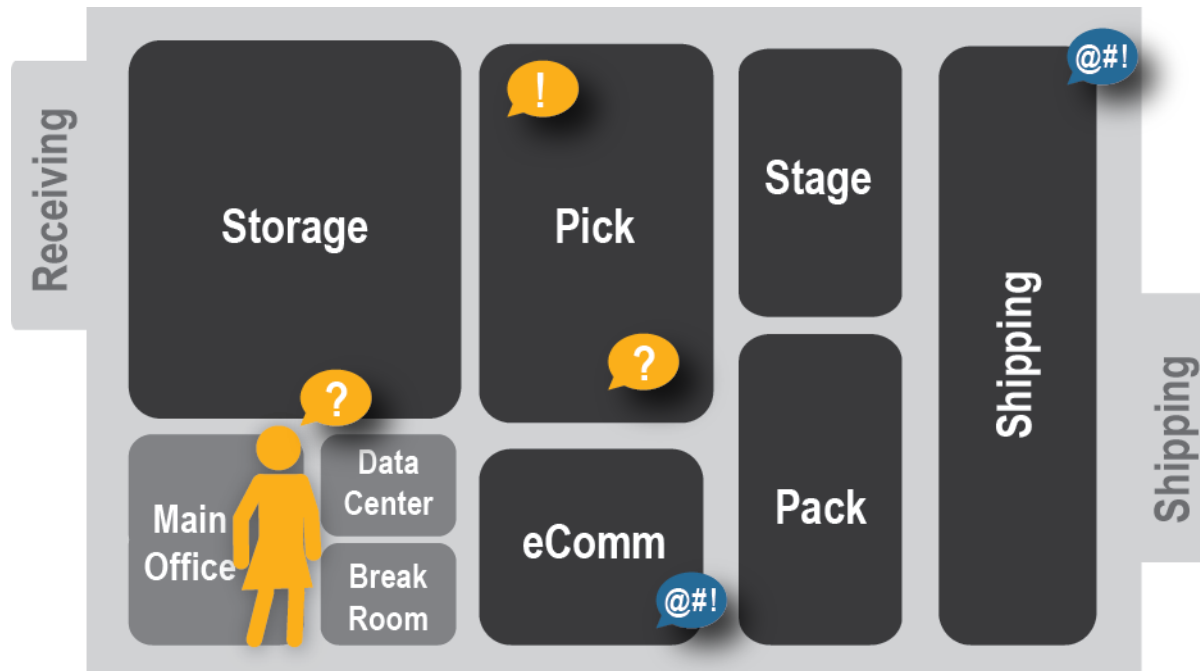


Analytics Building Blocks



Real-World Example

- No Visibility to Wave or Batch Better
- Leveraging Instinct and “that’s how we’ve always done it mentality”

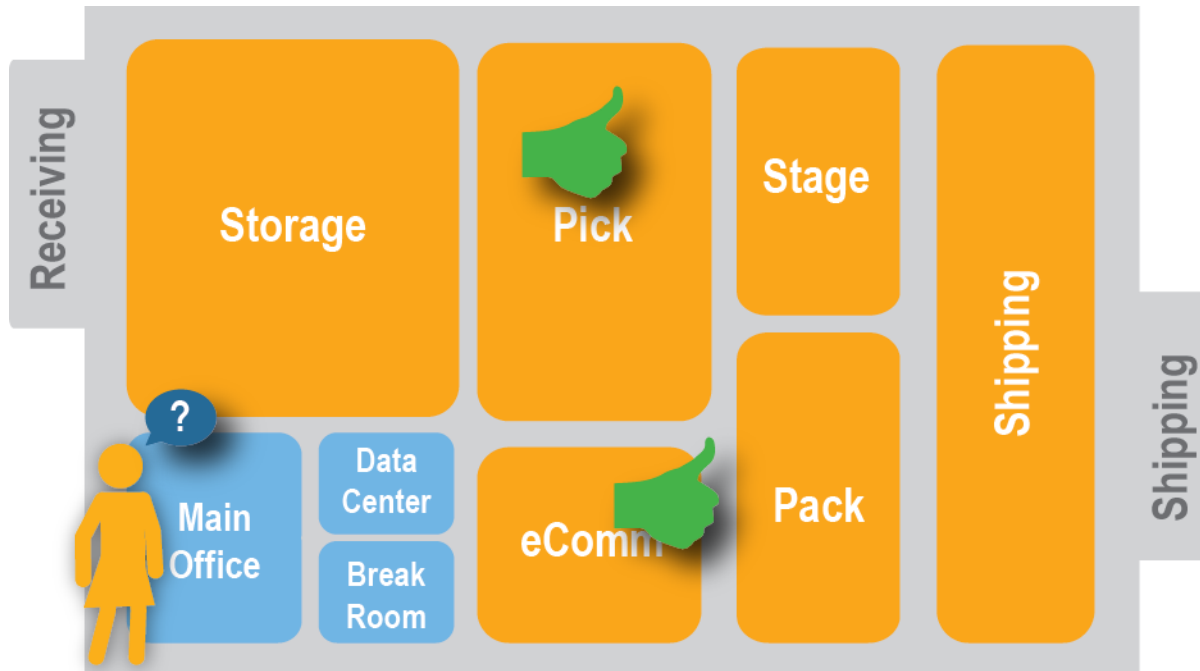


Decisions affect downstream operations



The Office CAN See the Warehouse

- **Better Visibility Results in Better Decisions**
- **What if Decisions can be Tested Before They are Made?**
 - Confusion and Guessing Turn into Confident Business Decisions



What?

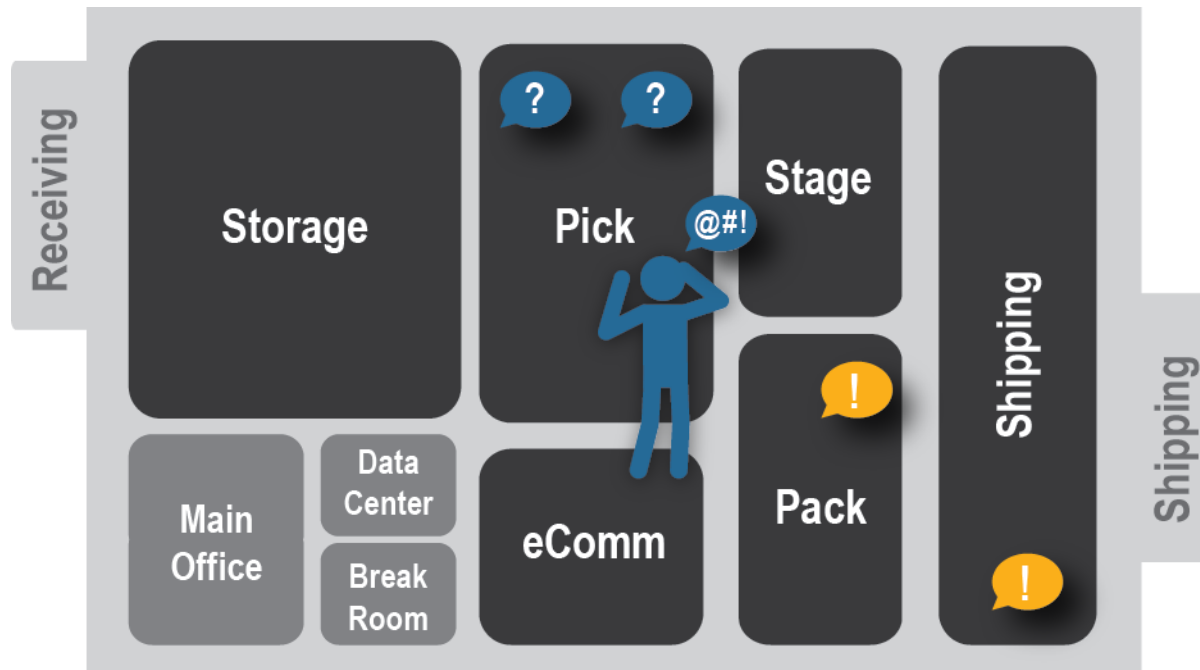
When?

Why?

Best?

Operators Operating Blindly

- Do Operators (i.e., Pickers) Have the Right Information?
- Are they motivated correctly?

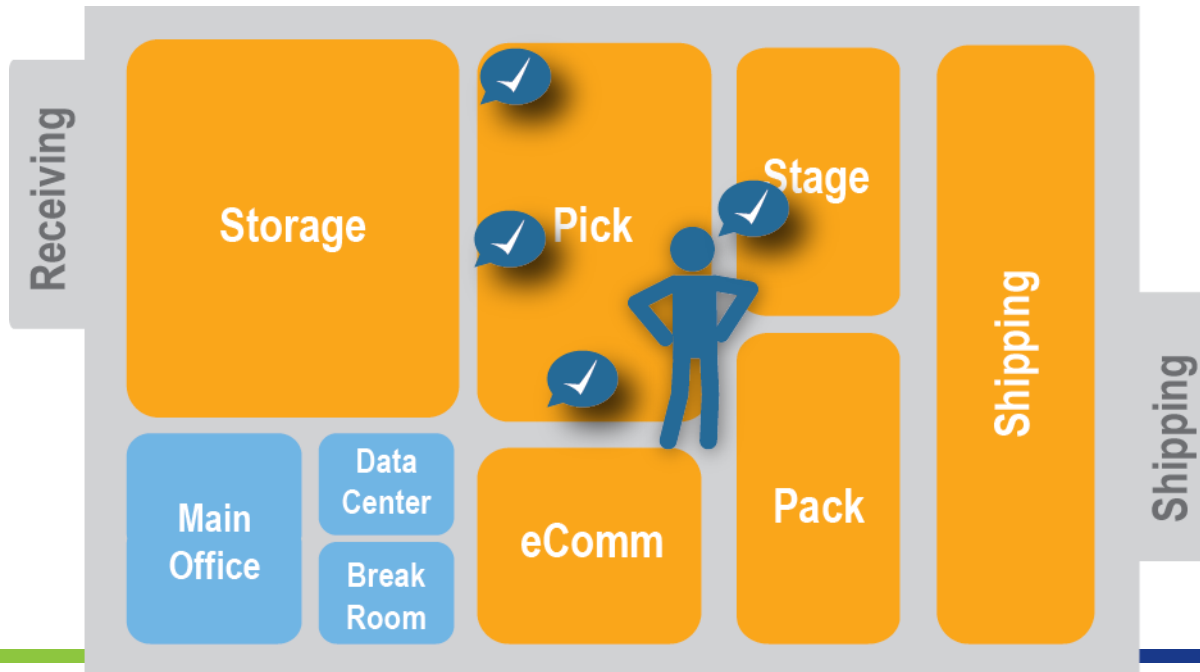


Isolated Decisions and Motivations Are Not Always Positive



Operators Operating ~~Blindly~~

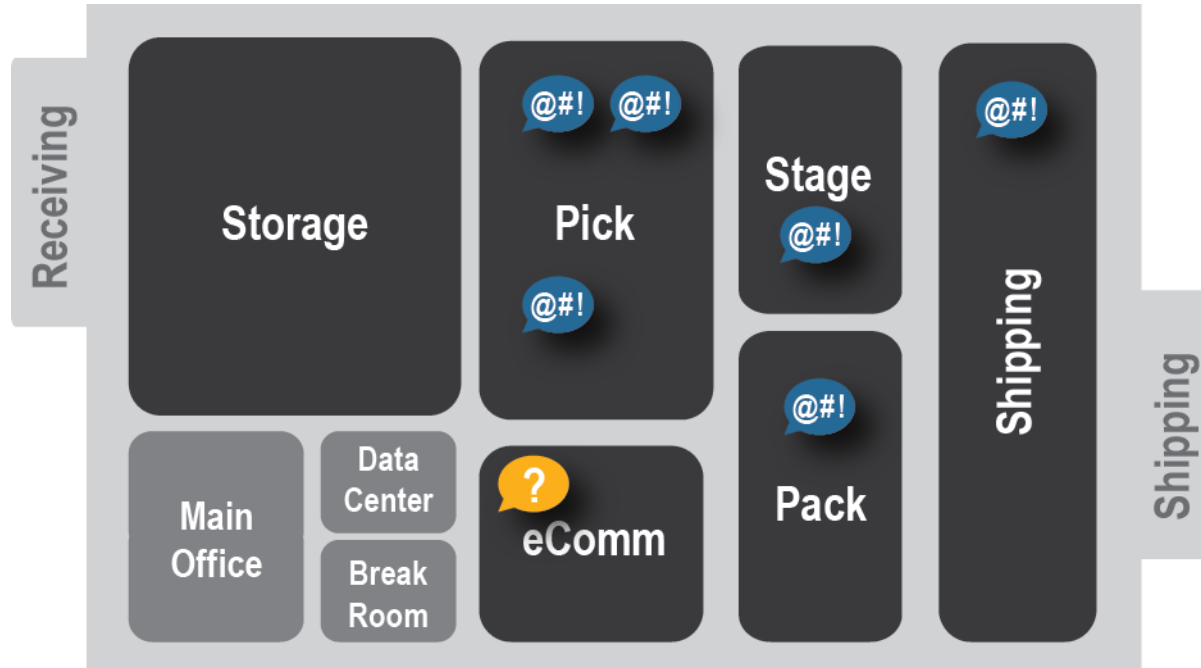
- **Real-Time Information for Real-Time Direction**
 - Direct to Different Pick Zones
 - Adjust Motivators
- **Replace the “Clipboard” and Printed Reports**





eComm is Different

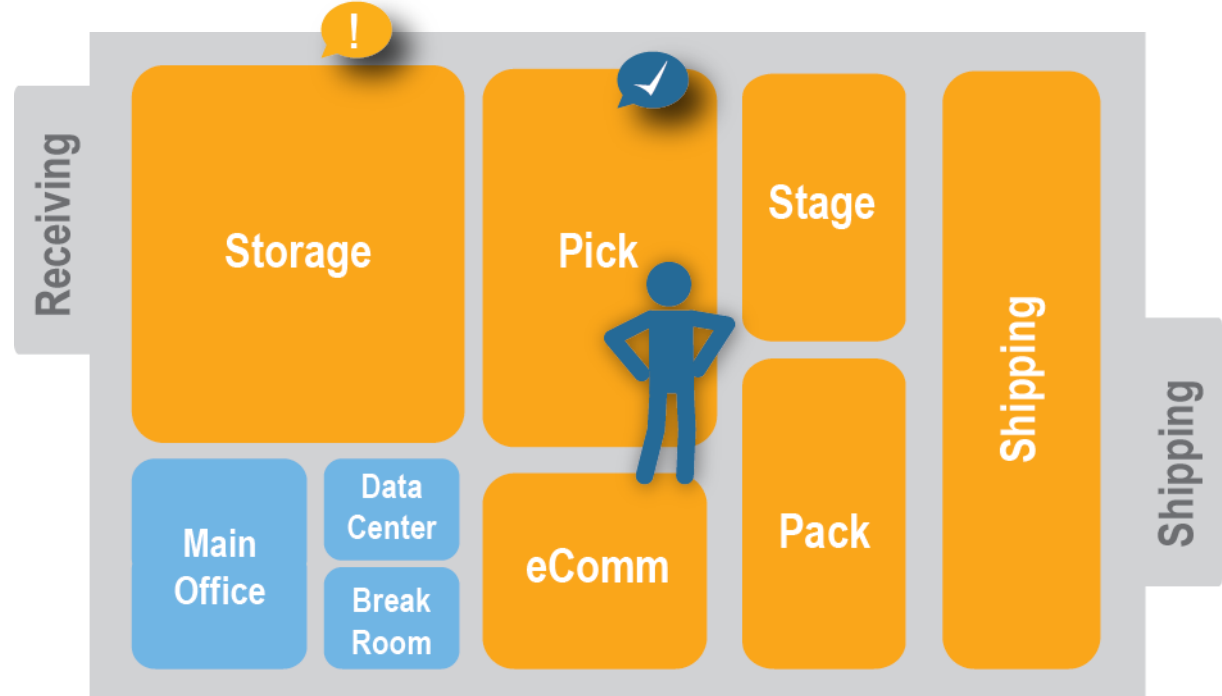
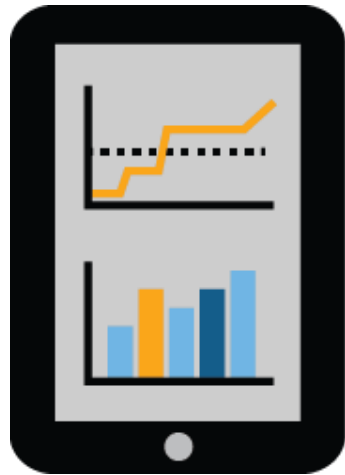
- eComm Variability Can Cause Major Fire-Drills
- Multiple Departments are Disrupted



Large Disruptions for Low Volumes

eComm is ~~Different~~

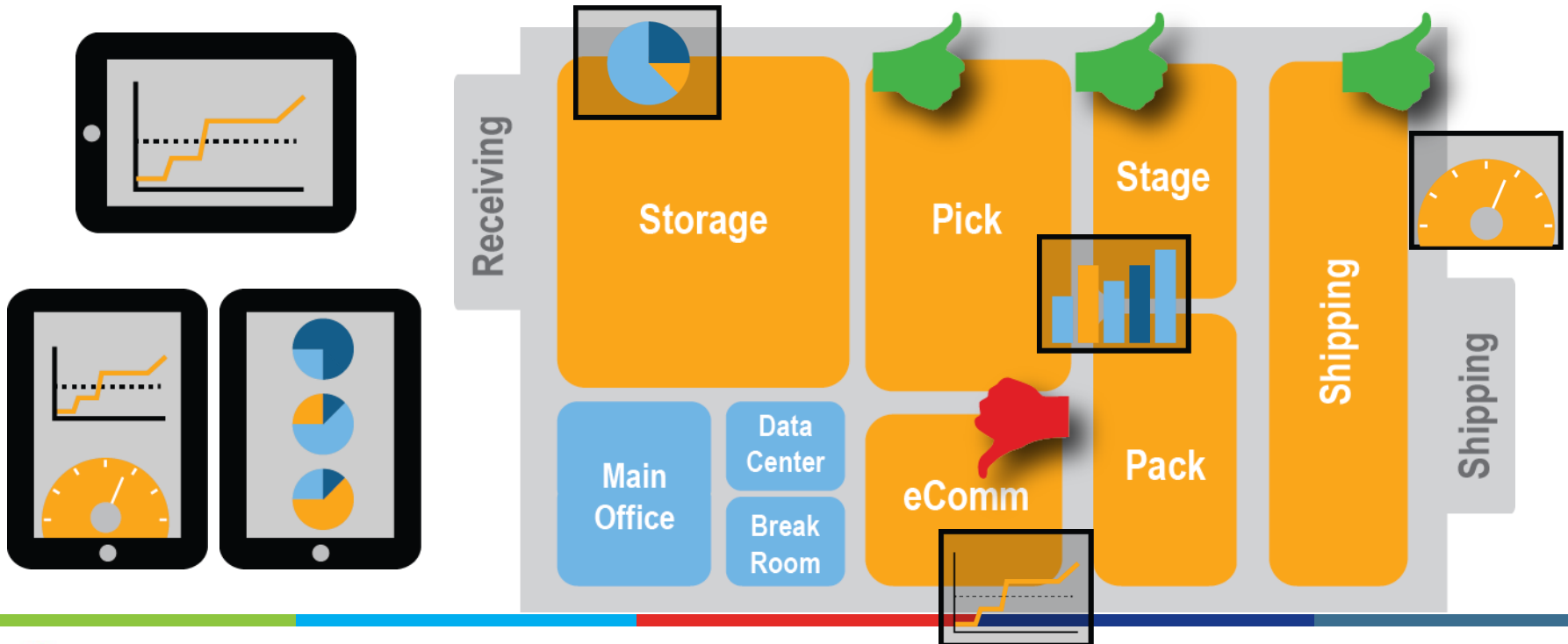
- Mobility and Analytics Combine for Quick Access to Information
- A Common Need to Answer: “Where is it?”



Immediate Action as a Result of Analytics on a Mobile Platform

How is the Operation Performing....NOW?

- Executive Level and DC Managers Need Summary Level Information
- “Where Do I Look Next?” – Trends, Alerts, Changes
- “What is Coming at Me?” – See It Before It Happens



**FIND WHAT'S
NEXT.**



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Analytics Demo...



You Need a Strong Team and/or Partner

- Multiple Skillsets Required
 - IT Support
 - Database Development and Management
 - Data Scientist and Statistician
 - Industry SMEs (Subject Matter Experts)
 - Project Management
 - Business Owners
 - Business Champion
- A Vendor Partner May be Necessary
 - Partners Generally Scale Better Than Internal Teams
 - Leverage Their Experience and Knowledge
 - Make Sure Partners Understand Your Business, Not Just Data
 - A Partner Should Feel Like They are Part of YOUR Team



The Secret Sauce to Making BI Work

- UX / UI
 - User Experience / User Interfaces are Key
 - Drives Efficient Use
 - Make it Intuitive
 - Consider the Device
- It's About the "Persona"
 - Who Needs the Data and Why
 - How do THEY Need it Displayed
 - Executive, Manager, Supervisor, Operator, Maintenance
- Journey Maps Can Show You the Way
- Do You Need a Data Scientist?



Key Takeaways

- Understand the Layers of Analytics
- Develop a Plan to Leverage Data
 - It Starts With a Problem Statement and Ends With the Data
- Own the Iterative Process
 - Get Multiple Layers of Your Company Involved
- Build a Team and Leverage a Strong Partner
- Consider the end-user and Their Needs

Good luck with your analytics journey...questions?

**FIND WHAT'S
NEXT.**



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