

# Improving Weight Engineering through the Widespread Use of Databases

Database > Data

# Introduction

- Is it possible to give the Navy more value in the weight data while saving money?
  - A database gives the opportunity to access more information faster and in more ways than a report
  - A database gives possibilities to analyze and check data more effectively than with a report
- What discussion are we proposing to start?
  - Should a database be delivered in addition to (or instead of) a report as an RP requirement?
- Why?
  - Most shipyards and design agents are using a relational database
  - Some of the value of the data is lost when it is reduced to an 80-column report or spreadsheet listing
  - Transferring a database will save time and money, and provide many benefits to the Navy compared to a report

# Benefits for the US Navy

- During Construction
  - Potential time/cost savings
  - Improved weight and CG monitoring
- During Lifecycle
  - Updating weight data on existing vessels
  - “What if” scenarios
  - Inclining test improvement tools under development
  - Salvage
- During Early Stage Design
  - Reusing historical data
  - Ratiocination

# What is a database?

- A database is a collection of electronic information that is organized so that it can easily be accessed, queried, managed, and updated.
- Data is defined so that it can be reorganized and accessed in a number of different ways

# Database versus Excel

- Relational Database
  - Maintaining relations between different types of data
  - Simultaneous access (multiple users)
  - Separating functionality and data storage
  - Security features
  - Reporting capabilities

# Accessing and Querying Data

- Sorting & Filtering
- Grouping
- Comparing
- Analyzing
- Visualization
- Reports (beyond standard reports)
- Combination of the above

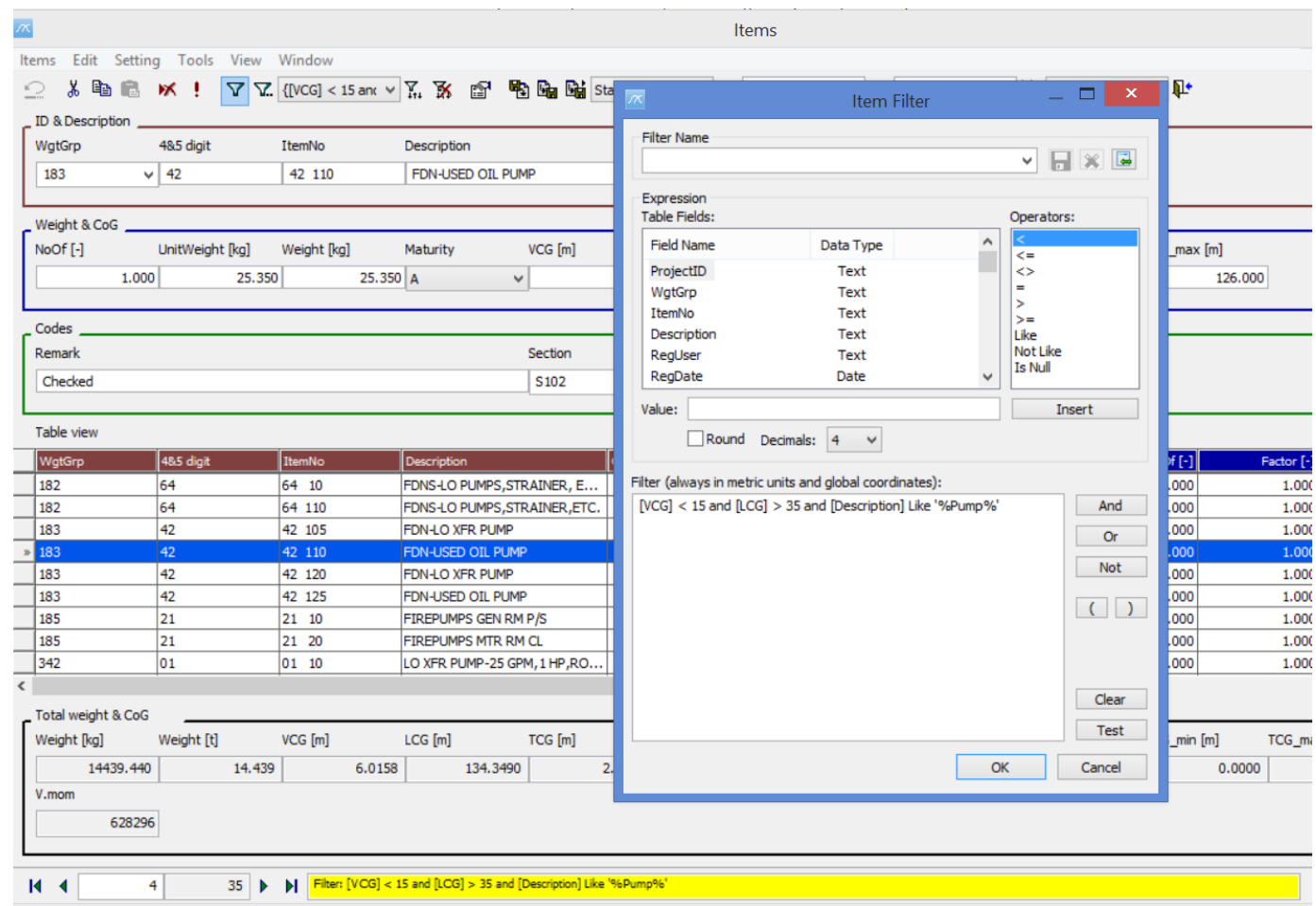
# Sorting & Filtering

- Sort data to check min/max values for QA purposes
  - Extreme values will emerge
- Filter data to find weight and CG of data collections with a specific
  - Geometric area
  - Discipline
  - Size
  - Combinations of several filters



# Example

- Finding all pump equipment within a CG boundary



The screenshot shows the ShipWeight software interface. A table of items is displayed, with the following data:

WgtGrp	485 digit	ItemNo	Description
182	64	64 10	FDNS-LO PUMPS, STRAINER, E...
182	64	64 110	FDNS-LO PUMPS, STRAINER, ETC.
183	42	42 105	FDN-LO XFR PUMP
183	42	42 110	FDN-USED OIL PUMP
183	42	42 120	FDN-LO XFR PUMP
183	42	42 125	FDN-USED OIL PUMP
185	21	21 10	FIREPUMPS GEN RM P/S
185	21	21 20	FIREPUMPS MTR RM CL
342	01	01 10	LO XFR PUMP-25 GPM, 1 HP, RO...

An 'Item Filter' dialog box is open, showing the following configuration:

- Filter Name: (empty)
- Expression: `[VCG] < 15 and [LCG] > 35 and [Description] Like '%Pump%'`
- Table Fields: ProjectID (Text), WgtGrp (Text), ItemNo (Text), Description (Text), RegUser (Text), RegDate (Date)
- Operators: <=, <>, =, >, >=, Like, Not Like, Is Null
- Value: (empty)
- Round:  Decimals: 4
- Buttons: OK, Cancel

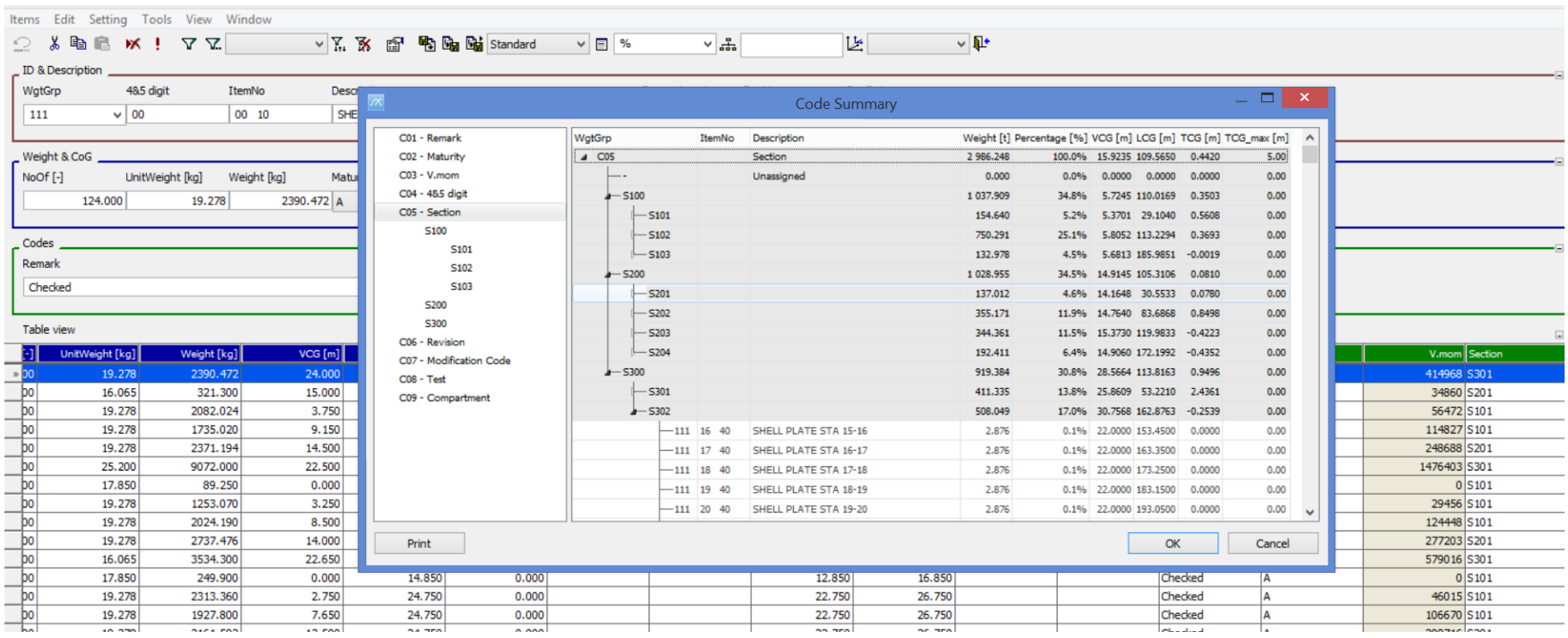
The status bar at the bottom shows the active filter: `Filter: [VCG] < 15 and [LCG] > 35 and [Description] Like '%Pump%'`

# Grouping

- Get weight and CG data and summary for cross-SWBS properties like
  - Systems Weight Distribution
  - Assemblies
  - Materials

# Example

- Hierarchical module summary



The screenshot displays the ShipWeight software interface. A 'Code Summary' dialog box is open, showing a hierarchical tree of codes on the left and a detailed data table on the right. The background shows a main data table with columns for UnitWeight [kg], Weight [kg], and VCG [m].

**Code Summary Dialog - Hierarchical Tree (Left):**

- C01 - Remark
- C02 - Maturity
- C03 - V.mom
- C04 - 485 digit
- C05 - Section
  - S100
    - S101
    - S102
    - S103
  - S200
    - S201
    - S202
    - S203
    - S204
  - S300
    - S301
    - S302
- C06 - Revision
- C07 - Modification Code
- C08 - Test
- C09 - Compartment

**Code Summary Dialog - Data Table (Right):**

WgtGrp	ItemNo	Description	Weight [t]	Percentage [%]	VCG [m]	LCG [m]	TCG [m]	TCG_max [m]
C05		Section	2 986.248	100.0%	15.9235	109.5650	0.4420	5.00
-		Unassigned	0.000	0.0%	0.0000	0.0000	0.0000	0.00
S100			1 037.909	34.8%	5.7245	110.0169	0.3503	0.00
S101			154.640	5.2%	5.3701	29.1040	0.5608	0.00
S102			750.291	25.1%	5.8052	113.2294	0.3693	0.00
S103			132.978	4.5%	5.6813	185.9851	-0.0019	0.00
S200			1 028.955	34.5%	14.9145	105.3106	0.0810	0.00
S201			137.012	4.6%	14.1648	30.5533	0.0780	0.00
S202			355.171	11.9%	14.7640	83.6868	0.8498	0.00
S203			344.361	11.5%	15.3730	119.9833	-0.4223	0.00
S204			192.411	6.4%	14.9060	172.1992	-0.4352	0.00
S300			919.384	30.8%	28.5664	113.8163	0.9496	0.00
S301			411.335	13.8%	25.8609	53.2210	2.4361	0.00
S302			508.049	17.0%	30.7568	162.8763	-0.2539	0.00
-111	16	40 SHELL PLATE STA 15-16	2.876	0.1%	22.0000	153.4500	0.0000	0.00
-111	17	40 SHELL PLATE STA 16-17	2.876	0.1%	22.0000	163.3500	0.0000	0.00
-111	18	40 SHELL PLATE STA 17-18	2.876	0.1%	22.0000	173.2500	0.0000	0.00
-111	19	40 SHELL PLATE STA 18-19	2.876	0.1%	22.0000	183.1500	0.0000	0.00
-111	20	40 SHELL PLATE STA 19-20	2.876	0.1%	22.0000	193.0500	0.0000	0.00

**Main Data Table (Background):**

UnitWeight [kg]	Weight [kg]	VCG [m]
19.278	2390.472	24.000
16.065	321.300	15.000
19.278	2082.024	3.750
19.278	1735.020	9.150
19.278	2371.194	14.500
25.200	9072.000	22.500
17.850	89.250	0.000
19.278	1253.070	3.250
19.278	2024.190	8.500
19.278	2737.476	14.000
16.065	3534.300	22.650
17.850	249.900	0.000
19.278	2313.360	2.750
19.278	1927.800	7.650

# Comparing

- Compare weight and CG data with previous revisions or projects
  - SWBS groups
  - Assemblies
  - Etc.
- Run regression on past ship data for estimation of new ships
  - Ratiocination of weight/ship parameters
  - Ratiocination of CG/ship parameters

# Example

- Checking Maturity (Class) Status between revisions

Compare
\_ □ ×

Code type: C02 - Maturity ▼

List

Defined

All

Input

Sort

Hierarchy

Deviation

Show CoG

VCG

LCG

TCG

Deviation

Show

Absolute

Relative

CoG impact

Show

Absolute

Relative

View

Grid

Tree

Project

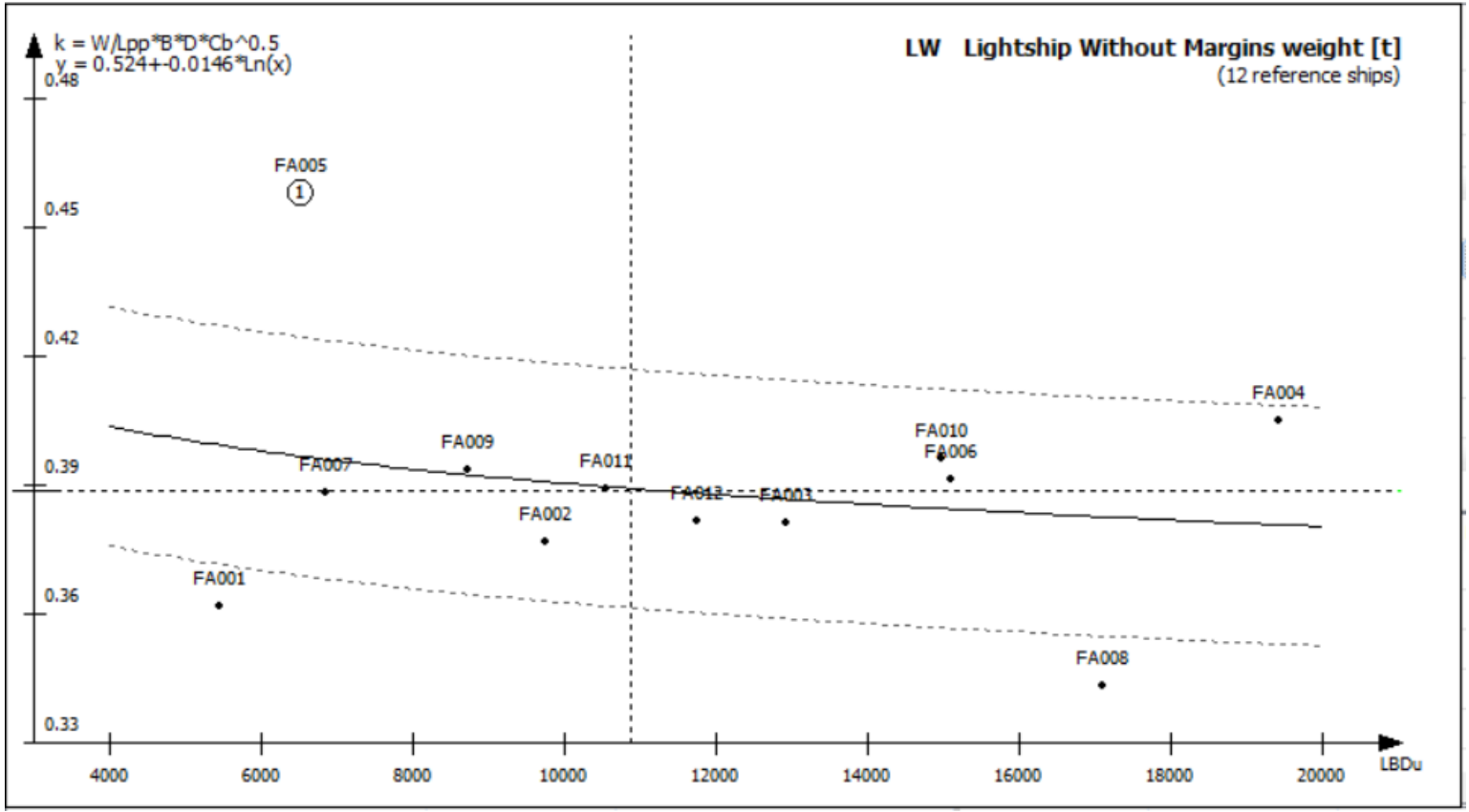
RAA-PC - SW04\_SAWE2015(P-X Rev 2)

Code & Description	Weight [t]			VCG [m]			LCG [m]		
	P-X Rev 1	Rev 2	Dev.[t]	P-X Rev 1	Rev 2	Dev.[m]	P-X Rev 1	Rev 2	Dev.[m]
-	3 086.248	3 300.484	-214.236	16.477	16.691	-0.214	109.255	110.953	-1.698
A - Asbuilt	2 014.321	2 241.537	-227.215	15.584	16.284	-0.700	114.459	115.159	-0.700
C - Calculated	698.348	777.122	-78.774	18.222	18.922	-0.700	108.216	108.916	-0.700
E - Estimated	243.097	270.518	-27.421	13.364	14.064	-0.700	85.483	86.183	-0.700

Print
Close

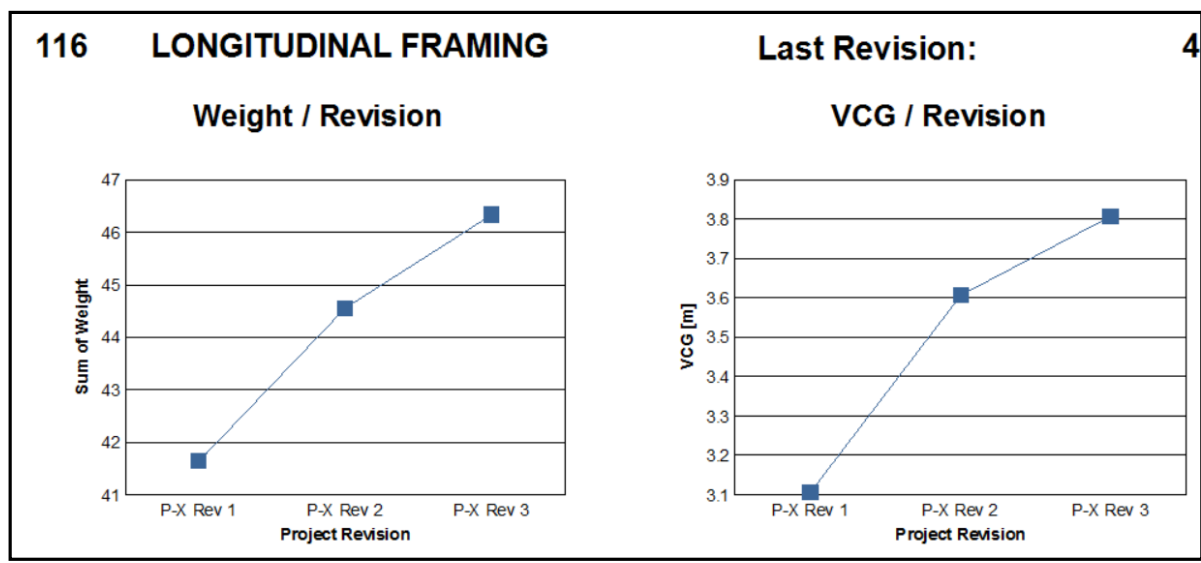
# Example

- Ratio between Weight and LBD



# Analyzing

- Weight Distribution Curve
- Gyradius calculations
- Find duplicates
- Trend lines
- What-if/modification studies?



# Example

- QA of duplicate items

Find Items
\_ □ ×

Compare Field	Filter Field	Tolerance	Cnt	Weight	VCG	LCG	TCG
<input type="checkbox"/> Factor	<input type="checkbox"/>	<input type="checkbox"/>	2	-2120.580	42.250	148.000	0.000
<input type="checkbox"/> Length	<input type="checkbox"/>	<input type="checkbox"/>	2	-196.350	40.250	182.000	-4.000
<input type="checkbox"/> Width	<input type="checkbox"/>	<input type="checkbox"/>	2	3.000	22.000	91.000	16.000
<input type="checkbox"/> UnitWeight	<input type="checkbox"/>	<input type="checkbox"/>	2	4.000	12.000	36.000	-3.000
<input checked="" type="checkbox"/> Weight	<input type="checkbox"/>	<input type="checkbox"/>	3	4.000	17.000	174.000	-12.000
<input checked="" type="checkbox"/> VCG	<input type="checkbox"/>	<input type="checkbox"/>	3	4.000	17.000	174.000	12.000
<input checked="" type="checkbox"/> LCG	<input type="checkbox"/>	<input type="checkbox"/>					
<input checked="" type="checkbox"/> TCG	<input type="checkbox"/>	<input type="checkbox"/>					
<input type="checkbox"/> VCG_min	<input type="checkbox"/>	<input type="checkbox"/>					
<input type="checkbox"/> VCG_max	<input type="checkbox"/>	<input type="checkbox"/>					
<input type="checkbox"/> LCG_min	<input type="checkbox"/>	<input type="checkbox"/>					

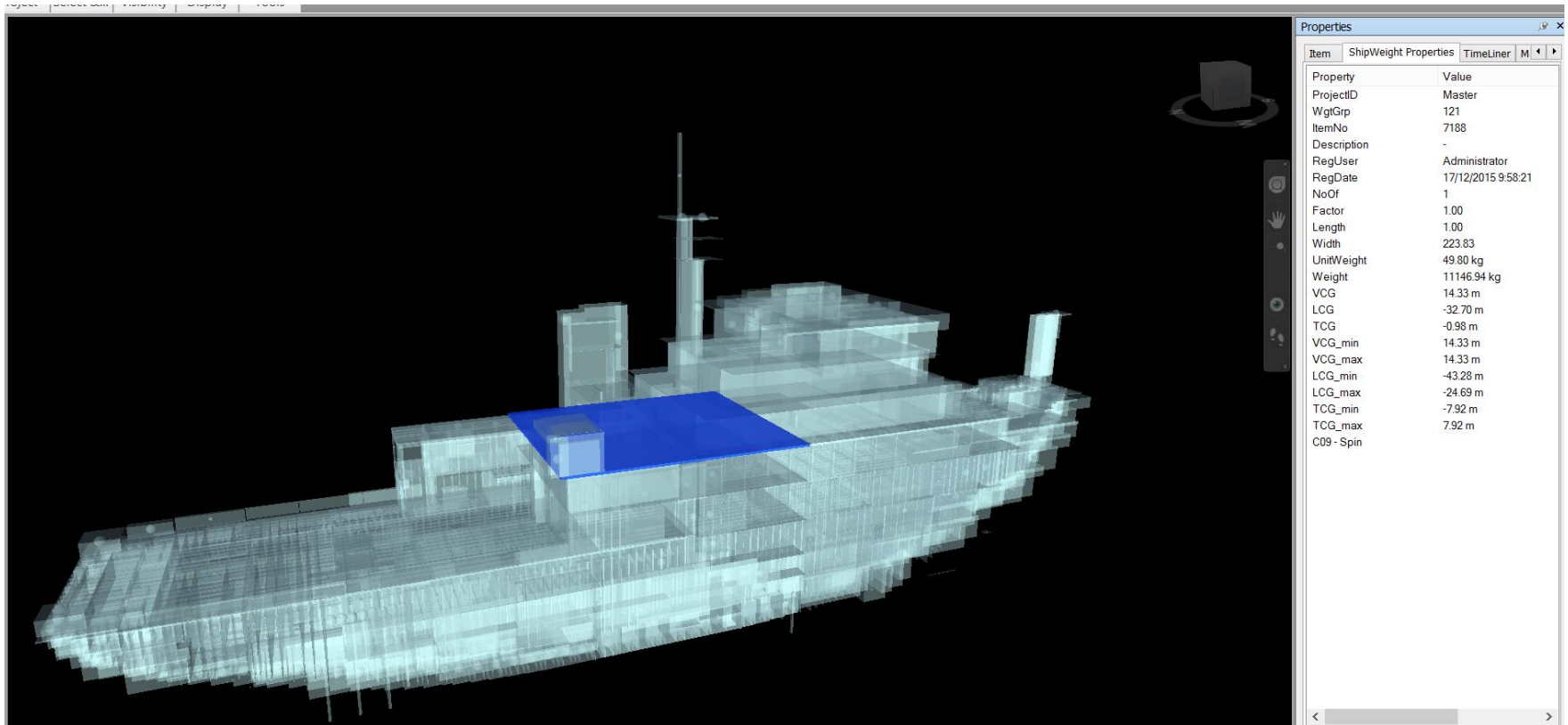
ProjectID	WgtGrp	ItemNo	Description	NoOff	UnitWeight	Weight	VCG	LCG	TCG	VCG_r
P-X Rev 1	522	06 20	FTGS-MISC 20 PCT	1.000	4.000	4.000	17.000	174.000	-12.000	0.0
P-X Rev 1	522	06 25	SPRINKLER HEADS	4.000	1.000	4.000	17.000	174.000	-12.000	0.0
P-X Rev 1	522	06 30	HANGERS 20 PCT	1.000	4.000	4.000	17.000	174.000	-12.000	0.0

Print
Query ->
Close



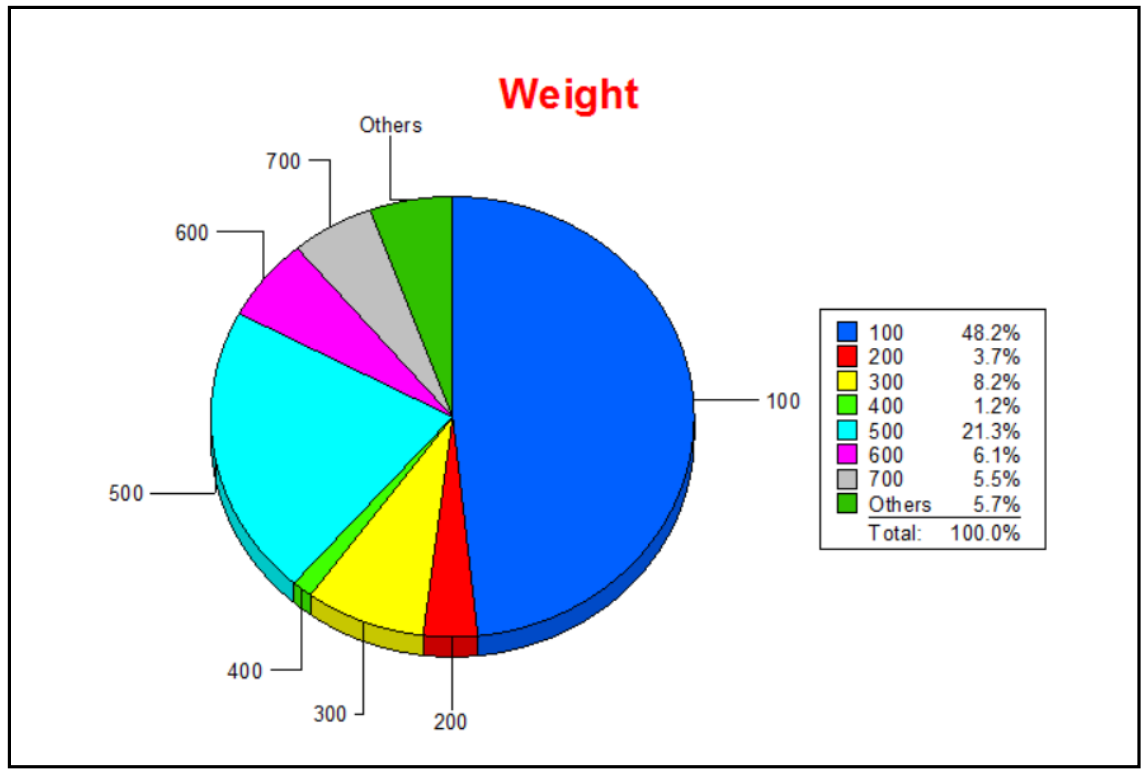
# Visualization

- QA the model visually



# Reports

- Graphs, Pie charts
- Trend lines
- Matrix
- Assemblies
- Etc.



# Transferring of Data

- An XML file could be defined for easy transfer of weight data
- Why XML and transfer the entire database, not just an Excel listing of all of the items?
  - Parameters
  - History
  - Code relationships and calculation methods
  - Preserves relational information

# Benefits

- Significantly more capabilities than traditional reports
- Less time and money spent on formatting
- Data can be re-used for parametric estimation of new designs
- Historical data can be exported to a LEAPS concept for use within ASSET
- Inclining efforts may be reduced through new tools
- Benefits during construction, life-cycle, and new designs