

Excavator



**Boom Truck
Crane**



**Backhoe
Loader**



**Aerial Utility
vehicles**



**Balance
Cranes**

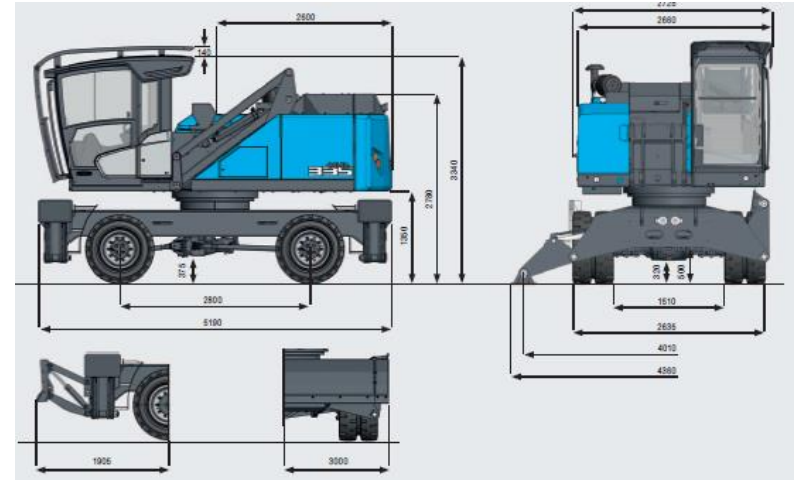


**Material
Handler**



Methodology:

- Understanding the detailed requirements from the site, (wish list, nearest competitors)
- Preliminary Collection of data from various sources like competitor websites, internet search for the related specifications
- Detailed information gathering by visiting the actual work sites, exhibitions / Expo shows, service stations etc.
- Categorization of data into various buckets.
- Detailed Excel based report starting with co-relation study of various competitors and arriving at the best specifications.
- For components a detailed comparison is made by capturing details like no of bends, weld areas, castings, ease of manufacturability.
- Highlighting the best path for component design to be followed for NPPD



Project Plan

Input Study & Planning

- Gather all technical documents of machines to compare.
- Comparison of specification documents of all machines.
- Identify the sub-systems & parameters to be considered .
- Prepare benchmark execution plan.
- Prepare performance check plan.

Benchmark activity - In Germany

- TIRC Engineers visit to Exhibition / customer site / Fuchs facility.
- Overview of competitor machines / Fuchs machines
- Observation & sub-systems study
- Conduct performance check activities & capture data.

Data analysis & Report generation

- Analysis of all data captured during benchmarking activity.
- Compile the data into measurable outputs.
- Report generation
- Industry trend report
- Best practices
- Unique selling points
- Voice of customer – VOC
- Best machine spec.
- SWOT analysis
- Specification comparison
- Performance check results

Data capturing for Material Handler

- Data Collection from Competitor Machines
- Comparison on Lifting Load, Various Boom & Stick combinations, Attachments and Machine Dimensions.
- Various Operating parameters taken Operating weight, working range, Lifting load, engine and emission, Travel drive, Swing drive, brake system, structure and Cab.
- Functional Aspects for Hydraulic & Electrical system, Equipment features.
- For Transport condition, Shipping Height with Falling Object Guard, Shipping Length.
- Various Attachments, like Sorting Grapple, Hydraulic Hammer, Pulverizer, Dedicated Quick Coupler, Pin Grabber Coupler etc.

Product Benchmarking

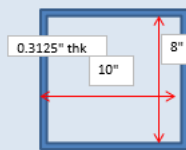
Utilities Transmission TL series Benchmarking.

Observation on TL series Machines	Terex	Versalift		
	TL 60	VST 6000 I03	VST 7500 E108 With elevator lift	VST 9500I
Basket Capacity (lbs)	600	650	800	600
Platform Height (ft)(with 33 ft elevator)	60.1	60	108	95
Hydraulic system pressure (psi)	3000	2250	3000	3000
Dielectric Category	C	B	B	B
Rated line voltage (kV)	46	69	69	70
Travel height (ft)	12.1	12.9	13.5	13.4
Flow rate (gpm)	8.0	7.5	10	10.0
Hydraulic Pump Power (Hp)	14.0	9.8	17.5	17.5
GVWR,Weight Comparison(lbs)	33000	33000	58000	58000
GAWR-Front (lbs)	14000	12000	18000	18000
GAWR-Intermediate1 (lbs)			20000	20000
GAWR-Rear (lbs)	19000	21000	20000	20000
Cycle time				
Rotation (CW or CCW) (seconds)	66-76	55-70	90-105	90-105
Lower boom (Raise)	25-35	35-50	40-50	50-60
Lower boom (lower)	25-30	25-35	30-40	35-45
Upper boom (Raise)	27-37	30-45	40-50	40-50
Upper boom (lower)	24-34	25-35	30-40	30-40
Inner boom (extend)	12-24	18-28	25-30	50-60
Inner boom (retract)	18-28	18-28	20-30	25-35
Outrigger Type	A frame type outrigger on front and back	A frame type at front and different type of outrigger at rear end as shown	Radial type outrigger	Radial type outrigger

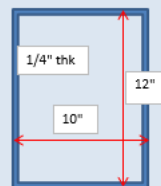


Lower Boom-Moment of Inertia

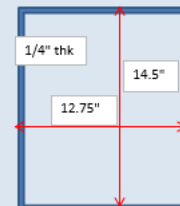
l_{yy} (inch 4) 160.3
l_{xx} (inch 4) 113.3



236.0
178.3



438.0
359.8



438.0
359.8

Product Benchmarking



Direction of Improvement (▲ = Increase, ▼ = Decrease, X = No Change)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18
Performance of 800 TPH	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
500 hrs / 2 million cycles	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
emissioning	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○	○
Utilization	○	○	▲	▲	▲	○	○	○	○	○	○	○	○	○	○	○	○	○
get ratio 1.2 - 1.3 kWh/MT	○	○	○	▲	○	○	○	○	○	○	○	○	○	○	○	○	○	○

Balance Crane Market Research

- Study & Researching of Major Manufacturers of Balance cranes on:
 - Market Share
 - Sales Based on Geographies
 - Statistics
- SWOT Analysis of competitor products.
- Feature Comparison for Application Type, Size of Balance Crane, Type of Mount, Input Drive, Balancing Mechanism, Counterweight, Type of End Attachment, Cycle Times.
- Provided Design Observations on the components & subsystems.
- Arriving at Preferred New Product Spec & features – Options & Pricing.
- Quality Function Deployment- House of Quality to arrive at most critical parameters.

Sales Mate – Based on Operating Weight

	30 MT	75 MT	90 MT	110 MT	160 MT	200 MT	225 MT	250 MT	450 MT	600 MT
Seramgroup	#1502(3.0) #1513(3.9)	#160(1.2)	#1202(0.12) #1225(0.15)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)
E Crane	#1502(3.0) #1513(3.9)	#160(1.2)	#1202(0.12) #1225(0.15)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)
Sennebogen	#1502(3.0) #1513(3.9)	#160(1.2)	#1202(0.12) #1225(0.15)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)
Euromec	#1502(3.0) #1513(3.9)	#160(1.2)	#1202(0.12) #1225(0.15)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)
Metso	#1502(3.0) #1513(3.9)	#160(1.2)	#1202(0.12) #1225(0.15)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)	#1502(0.15) #1525(0.18)



Model	Photos	Boom Type	No. of pins used	Boom end(E) being	Boom end(D) Dipper	Structural design	BOOM OBSERVATION												
							Hose routing	Pin locking	Reinforcement	Welding	Coating	Other	Other	Other	Other	Other	Other		
CASE		Straight Boom Fully fabricated	4															15 Faces minimum	Very good geometry. No bulging seen
CASE2		Straight Boom Fully casted	4			Not linear from picture. May be a bit better	Not Visible	Not Visible	Not visible	Since complete boom is casted-reinforcement is not possible	Since complete boom is casted-Welding is not possible								Leakage seen in more
CAT		Barrel Boom Fully fabricated (Two halves are welded together. can be seen from picture in column 07)	3				Not Visible	Not Visible										12-14 plates minimum	Very good geometry. No bulging seen. Pin pins behind with a washer from the outside
CAT2		Barrel boom-Full fabricated	4															8 plates welding minimum	Leakage seen
DEERE		Barrel boom-Full fabricated	3																
JCB		Straight Boom-Fully fabricated	4															Minimum 12 welding seen	
KOMATSU		Barrel boom-Fully fabricated	3															8 plates welding minimum	No double dipper end
NEW-HOLLAND		Full fabricated	3															Minimum 12 welding seen	Not visible
TEREX		Barrel boom-Fully fabricated	4															8 plates welding minimum	Not visible
VOLVO		Barrel Boom-Fully fabricated	3																

Product: Backhoe Loader

Benchmarking with market leaders, arrive at best kinematic features, compare the structural, electrical and hydraulics

Key parameters for Benchmarking:

- Structural details
- Kinematic parameters like Dumping height , Vertical wall reach, Digging depth etc.
- Productivity trials of Excavator and Loader group
- Driveline arrangement

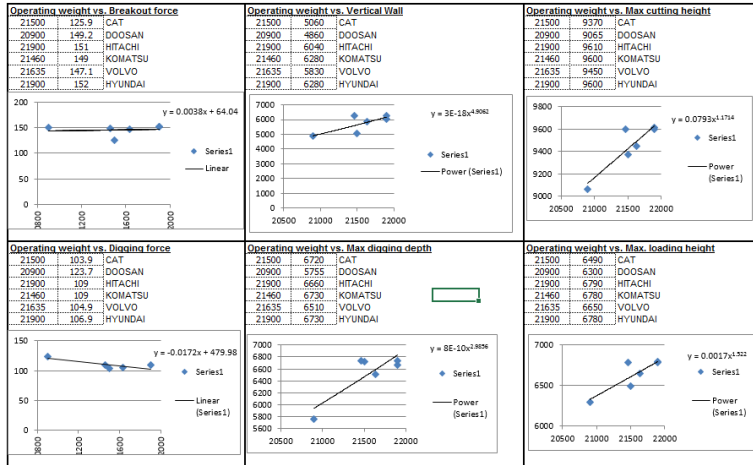


CAT 424B

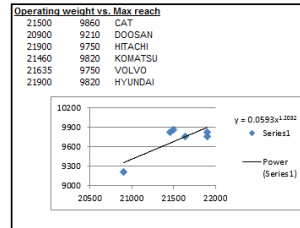
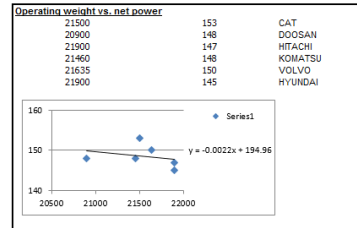
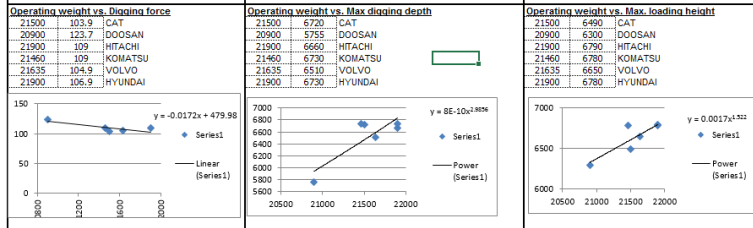
CASE 770

JCB 3DX

Product Benchmarking



Parameter	Collected Governing Equations	Recommended TVER Specification	UNIT	Machine Operating weight
Breakout Force	$y = 0.0038x + 64.04$	144 kN		21000
Digging Force	$y = -0.0168x + 479.88$	109 kN		
Max. Digging reach @ground	$y = 0.0585x^{0.992}$	9750 mm		
Max. Digging depth	$y = 8E-10x^{2.998}$	6608 mm		
Max. Cutting height	$y = 0.0793x^{1.1714}$	9400 mm		
Max. Loading height	$y = 0.0017x^{1.998}$	6440 mm		
Max. Vertical wall	$y = 3E-10x^{1.998}$	5008 mm		
Net power	$y = -0.0022x + 194.96$	148 HP		



Product: Excavator 20T

Benchmarking of 20T & 30T class work group excavators

Key parameters for Benchmarking:

- Structural details
- Kinematic parameters like Dumping height, Vertical wall reach, Digging depth etc.
- Correlation study done based on weight, and the best parameters were specified in the result
- Proposed parameters for new machine being worked out for the next generation machines and kinematic parameters were worked out to realize the proposed parameters.

Component	Beam Fast End	Beam Fast Welding	Beam Fast Pin/Inlet/locking	Beam Fast Bush/Lubrication	Beam Cylinder	Beam Cylinder Pin/Locking on Main frame	Beam Cylinder Lubrication on Main frame	Beam Top Plate	Beam Side Plate	Beam Center Part	Beam Cylinder Center mtg Locking	Lubrication	Beam Bottom Plate	Beam Fast part	Beam 5 Arm Pin Locking	Arm Cylinder Mtg Bracket	Arm Cylinder Pin/Locking	Lubrication	Hydraulic Piping & Clamping
Hyundai R210-7V																			
Komatsu																			
Hitachi EX200LC																			
Kobelco SK210LC																			
JOE210LC																			