WÄRTSILÄ IN ITALY

COMPANY PRESENTATION

2015

Did you know?

- Wärtsilä has more than 180 years of experience in power generation on land and at sea
- We employ close to 18,000 people across the globe/132 nationalities
- Every third ship sailing the oceans is powered by Wärtsilä
- Our power plants produce 1% of the world’s energy
- Services 24/7 globally, close to 200 locations in 70 countries

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Financial highlights

MEUR	**2014**	**2013**	2012	2011
Order intake	**5084**	**4 872**	4 940	4 516
Order book at the end of the period	**4530**	**4 426**	4 492	4 007
Net sales	**4779**	**4 654**	4 725	4 209
Operating result[1)]	**569**	**520**	517	469
% of net sales[1)]	**11.9**	**11.2**	10.9	11.1
Earnings/share, euro	**1.76**	**1.98**	1.72	1.44

[1)] Figures exclude non-recurring restructuring items and selling profits .

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Wärtsilä Italia Management Team

Energy Solutions Italy
Marco Golinelli
Director

Services Unit Italy
Patrick Borstner
Director

Marine Solutions
Andrea Bochicchio
Director Delivery Centre Trieste

Wärtsilä Italia S.p.A.
Sergio Razeto
President & C.E.O.

Human Resources Italy
Raffaele Ferrio
Director

Finance & Control Italy
Ferruccio Canzi
Vice President

Marine Solutions
Paolo Pierdomenico
Director Manufacturing Engineering

Legal Affair- Services
Gianluigi Morselli
Senior Legal Counsel

Marine Solutions
Stefan Wiik
Vice President Product Company Large Bore

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Trieste Factory (2015)

1. Headquarters and Offices
2. Human Resources
3. Canteen
4. Goods Reception and Logistics for production
5. Services Logistics
6. Module Factory
7. Services Workshops & Training Centre
8. Big Module Factory
9. Assembly and Test Factory
10. R&D Laboratories
11. CPP & Gear Boxes
12. Finishing Area
13. Cooling Tower
14. Chemical Storage
15. Transforming Station
16. Heating Plant
17. Water Treatment Point
18. Auditorium & Technical Offices
19. LMT Thrusters area

Total area 550,000 sq.m
Covered area 155,000 sq.m

Wärtsilä Italia Key Figures Year 2014

Deliveries
More than 3400 MW
- 168 Engines
- 91 Thursters
- 56 Gear Boxes
- 16 CPP

Personnel
1260 Employees

Wärtsilä Product Portfolio
26, 38, 46, 46F, 46DF, 50DF, 50SG, LMTs, CPP, GB

Spare Parts
Wärtsilä, Sulzer and GMT

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Wärtsilä Italia 4-s Engine Product Portfolio

	From	To	
W26	1,950	5,440	kW
W38B	4,350	11,600	kW
W46	5,850	17,750	kW
W46F	7,500	23,000	kW
W46DF	6,870	18,320	kW
W50DF	5,700	17,100	kW
W50SG	-	18,810	kW

Wärtsilä Italia LMT - CPP - GEAR BOXES

Wärtsilä Steerable Thruster:

- L-drive and Z-drive
- Fixed or Controllable Pitch Propellers
- Customized arrangements and CFD design
- Diesel or electric drive ≤ 5,5 MW
- Underwater Demountable
- Ice Class available

Wärtsilä Retractable Thrusters

- L-drive and Z-drive
- Retraction system with cylinders or spindles
- Electric driven ≤ 4,5 MW
- Ice Class available

Gear Boxes:

- Single or Double Input Gears ≤ 25 MW
- Horizontal and/or Vertical Offset
- 2-speed Gears* ≤ 13 MW
- PTI / PTO / clutches options

Propellers:

- Wärtsilä customized CFD design (4/5 blades) > 1 MW
- Bronze and Stainless Steel Controllable Pitch Propellers
- Stainless Steel Built-up Fixed Pitch Propellers
- Ice Class available

* *2-Speed Gears provide two selectable propeller speeds at 100% engine speed to allow multiple operational modes or reduced transit speed at high efficiency*

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THIS IS WÄRTSILÄ

ENERGY SOLUTIONS

MARINE SOLUTIONS

SERVICES

Wärtsilä Marine Solutions Italy

SHIP POWER

- Sales & Sales support to owners and shipyards for marine solutions in Italy, Malta, Monaco and the Balkan area.
- Project Management for marine solutions.
- Solution Engineering for all Wärtsilä Italy products portfolio (2T excluded)
- Sales and project engineering of gas fuel systems
- Engineering support for propulsion products
- Delivery Management for Trieste products

Merchant

Offshore

Cruise and Ferry

Navy

Special Vessels

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Wärtsilä Energy Solutions Italy

- Wärtsilä power generation solutions in ITALY for land based power plants
- Energy Solutions markets and sells:
  - Power generation equipment
  - Power generation systems
  - Turnkey power plants
  - Power generation operation and services
- Solutions are based on Wärtsilä prime movers for power plants from 1 MW up to 300 MW

Flexible base-load power generation

Grid stability and peaking

Industrial self-generation

Solutions for the oil and gas industry

Oil, dual-fuel and gas fired power plants

Liquid biofuel power plants

Flexible grid stability power plants

Combined heat & power plants (CHP)

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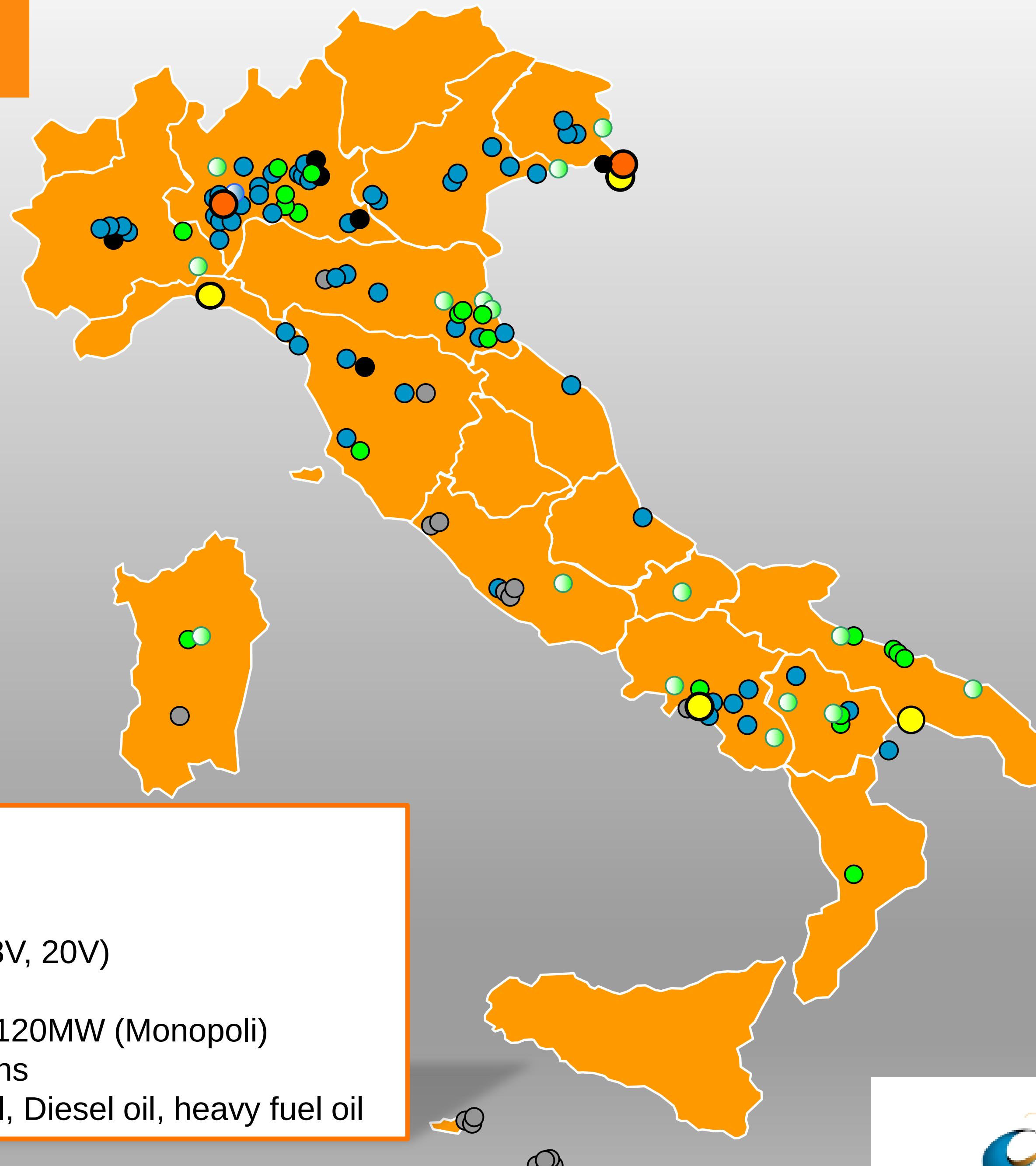
POWER IN ITALY

WIT Energy Solutions Offices
WIT Service Centers

Power Plants

NG
LFO
HFO
LBF



181 power plants
1400 MW

Wärtsilä Italia power plants Mix

Engines: W34 (9L, 16V, 18V, 20V)
W20 (6L, 9L)
W32 (6L, 9L, 12V, 16V, 18V, 20V)
W46 (18V)

Power: from 1 MW (Treviglio) to 120MW (Monopoli)

Scope: ED,EEQ and EPC solutions

Fuels: Natural Gas, Vegetable oil, Diesel oil, heavy fuel oil

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Crude Palm Oil World's Largest plant

Italgreen Energy - Monopoli	
Prime movers	6x 18V46
Electrical output	102.457 kWe
Thermal Output	41.796 kWth
Steam turbine combined cycle	12.653 kWe
Total Efficiency	50%

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Wärtsilä’s CHP solutions – Linate Airport Tri-generation

Prime movers	3 x 20V34SG
Electrical output	24.129 kWe
Thermal Output	19.082 kWth
Electrical Efficiency	46,2%
Total Efficiency	82,7%
CO2 saved	35000 ton/yr
NOx Emission	40 mg/Nm^3 (5% 0_2)

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Wärtsilä's CHP solutions – ENI Headquarters S. Donato-MI

Prime movers	2 x 20V34SG
Electrical output	18.146 kWe
Thermal Output	9.186 kWth
Electrical Efficiency	46,5 %

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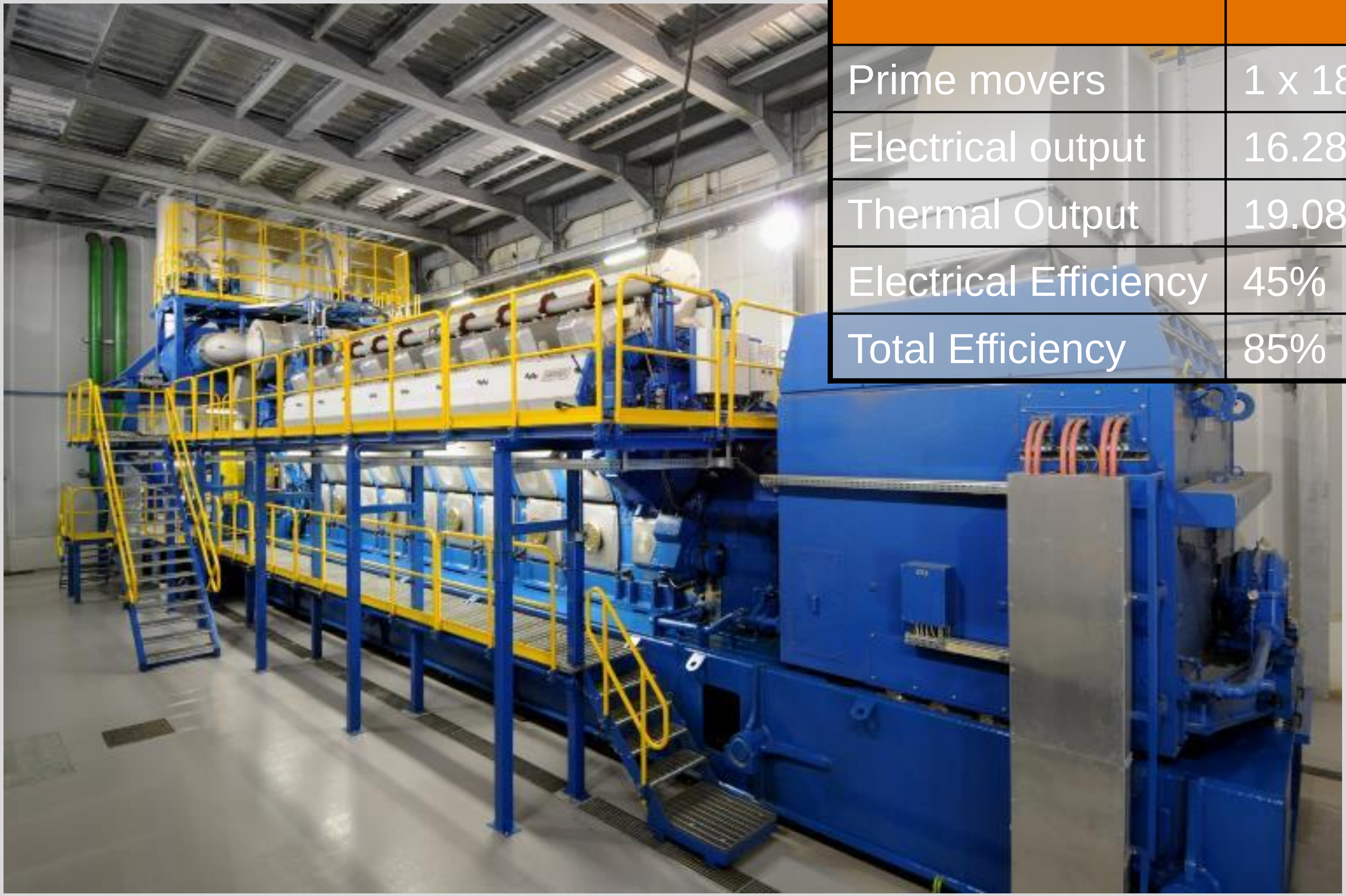
FANTONI POWER PLANT (3rd) 18V50DF

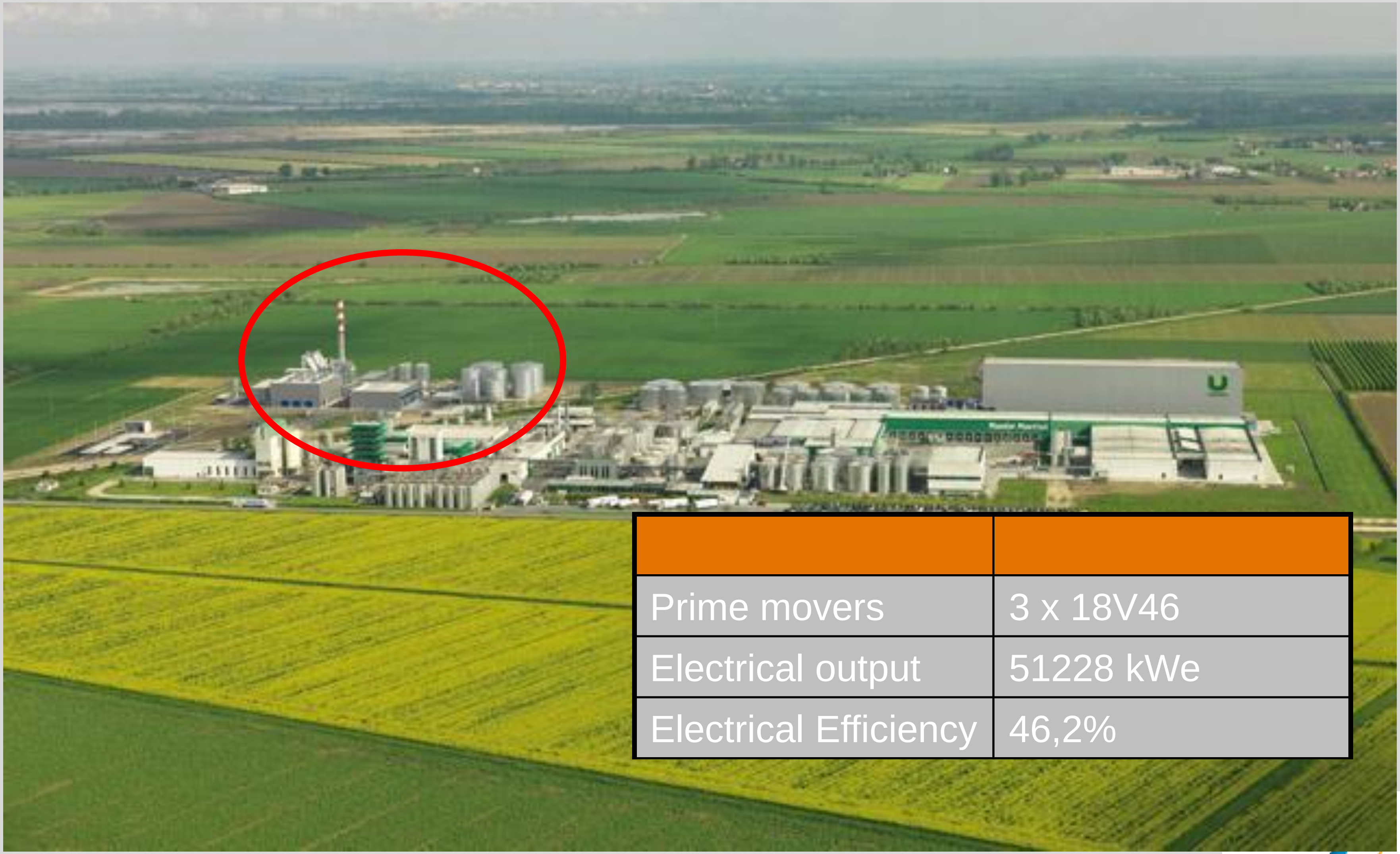


Prime movers	1 x 18V50DF
Electrical output	16.285 kWe
Thermal Output	19.082 kWth
Electrical Efficiency	45%
Total Efficiency	85%

AGAM MONZA 2 x 9L34SG

Prime movers	2 x 9L34SG
Electrical output	8.686 kWe
Thermal Output	5.914 kWth
Electrical Efficiency	45,9%
Total Efficiency	87%

UNIGRA' Power plant



Prime movers	3 x 18V46
Electrical output	51228 kWe
Electrical Efficiency	46,2%

FRIEL ACERRA EPC CC

Prime movers	4 x 18V46 + ST
Net Plant Output	72.200 kWe
Total plant electrical efficiency	50,4 %

Wärtsilä Services Italy

In the marine and energy markets, Wärtsilä services supports its customers throughout the lifecycle of their installations by enhancing their business, optimizing efficiency and performance. We offer high quality expertise as a **Total Solution Provider**

- supplying components/spare parts (not only for Wärtsilä applications)
- long-term maintenance contracts
- reconditioning
- modernization solutions for propulsion systems
- environmental solution in compliance with the latest legislation

Wärtsilä Land and Sea Academy, Trieste Training Centre

Extensive training offering for ship and power plant operators and Wärtsilä's own personnel

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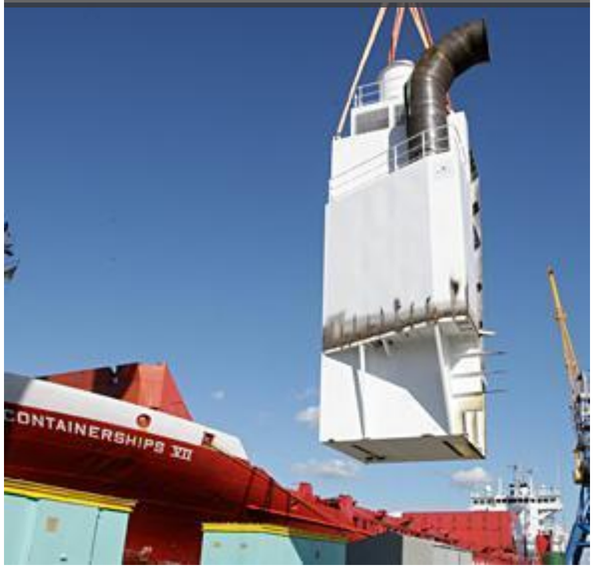
Profitable growth by focusing on three areas

Smart Power Generation	Gas as a fuel	Environmental Solutions
		
The transition to sustainable and modern energy systems drives the demand for smart power generation.	Economic and environmental reasons increase the growth potential for gas solutions in both end markets.	Environmental regulation and increased focus on optimised lifecycle efficiency create demand in the marine industry.

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USE OF DYNAMIC SIMULATION IN ENERGY INDUSTRY: SOME REAL CASES IN WARTSILA ITALY

Paolo Pierdomenico
Wartsila Italia S.p.A

Summary

- I will **show a catalogue of simulation in Energy industry**, developed through real case experience and various types of simulation models.
- With the aid of simulation our Company has been able to:
  - design efficient production and business systems
  - validate and trade off proposed design solution alternatives
  - troubleshoot potential problems
  - improve systems performance metrics and consequently, cut cost, meet targets and boost profits.

- As important as simulation results, we got additional benefit through building up the model:

we develop the **capacity to capture the functionality and the relevant characteristics of real systems** and facilitates system knowledge, analyses, improvement, and optimization.

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Why simulation of existing systems

- Is **cheaper** and **more safe** to test out scenarios on a computer than to do them in the real-life system:
  - Modify an existing plant is a fast, one shoot, expensive project
  - fix the design in the planning phase is cheaper than fixing a finished under-performing plant

Why simulation of new system

- In some cases, it is not even feasible to observe the real-life system (i.e. when we simulate something that doesn't exist yet):
  - Planning a new 100 M€ production facility, would you rather just design, commission and see how it performs, or better simulate it to see how well your design works?

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Accuracy of simulation

- In normal industry no simulation is (economically) 100% accurate:
  – simulation **model** is (considerably) simpler than the associated system
  – simulation **model** contain a number of assumptions
  – simulation **model** very often is based upon incomplete or uncertain data (garbage in, garbage out)
  – simulation **model** may even contain bugs or logic errors
  – the effort to obtain a higher accuracy is not economically useful

Which tool for simulation

- There are many tools you can use to simulate
- My recommendation is to use a simple tool
  - **Easy** to built the model
  - **Easy** to use and program
  - **Easy** to analyse the output
- In our case we use WITNESS Software (© 2014 Lanner Group)

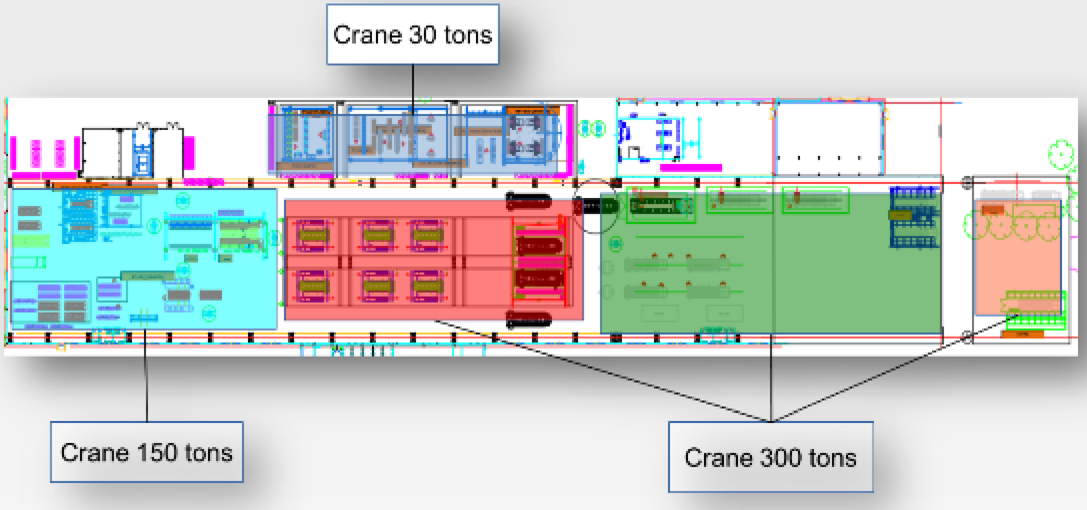
Some example of simulation

- Simulate to design a new factory to produce Diesel engines
- Simulate to innovate or improve an existing maching workshop for large components
- Simulate to support the production flow improvement in Wartsila Italy (from 3 to 1 building project)

Simulation of a new factory for diesel engines

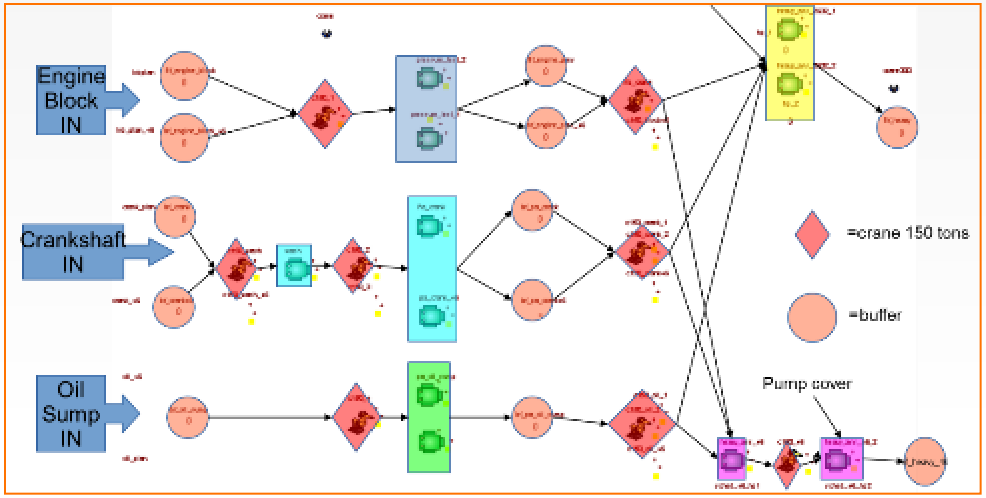
- Scope was:
  - to evaluate if the number of overhead crane and production cell was sufficient
  - to evaluate the overall utilization rate of cranes and assembly stations

Factory Model



Factory layout

Factory model



Results

Report: W46 heavy assembly & main assembly busy percentage

	3+2	3,5+1,5	4+1	4+1,5
HP_46_1	79,1%	60,5%	39,3%	55,4%
HP_46_2	56,2%	40,2%	28,4%	40,1%
main_ass_46_1	94,9%	89,6%	63,1%	87,2%
main_ass_46_2	94,8%	86,6%	55,4%	83,5%
finished_W46	69	66	45	65

- In 3+2, 3,5+1,5 and 4+1,5 simulations we can see there is a bottle neck in W46 main assembly due to the input rate of W46 engine.
- In the 3+2 simulation the bottle neck is stronger than the other cases, in fact we can see in buffers slide that the buffer located upstrem of W46 main assembly called bf_heavy_46 has a large store rate.

- In the 4+1 simulation the busy percentage of W46 main assembly is low so we could think to increase the W46 input rate

Report: testing, inspection, Painting &preparation busy percentage

	3+2	3,5+1,5	4+1	4+1,5
test_run_1	36,2%	41,9%	54,6%	43,1%
test_run_2	21,8%	35,2%	41,8%	31,1%
test_run_46	69,7%	69,4%	43,5%	67,4%
Ins_1	59,7%	69,2%	59,6%	70,6%
Ins_2	58,6%	57,1%	50,5%	63,3%
painting	70,7%	77,3%	74,5%	83,1%
preparation	80,4%	82,2%	76,4%	88,5%

- In 3,5+1,5 and 4+1,5 simulations, the preparation station and to a lesser exten painting station has a high busy level due to the input rate of engines.
Furthermore, if we observ the preparation working time of engines we can perceive that W46 working time in preparation station is greater than W26/W32 working time, (3,75-12,5)hours against (30-36)hours so when W46 arrives in preparation station, it employs the activityfor a long time
- These are the reason of storing in bf_prep, especially in 4+1,5 simulation.

Report: cranes 150/300 tons busy percentage and day utilization

		Busy	Busy	Busy	Busy			Busy	Busy	Busy	Busy
Crane 150		32,7%	33,8%	34,2%	36,9%	Crane 300		57,3%	62,7%	63,8%	68,4%
		3+2	3,5+1,5	4+1	4+1,5			3+2	3,5+1,5	4+1	4+1,5
mean_utilization	[lifts/day]	6,35	7,04	7,06	7,71	mean_utilization	[lifts/day]	6,37	7,11	7,38	7,73
st_dev	[lifts/day]	4,41	4,81	3,98	4,50	st_dev	[lifts/day]	4,52	4,82	4,99	5,38

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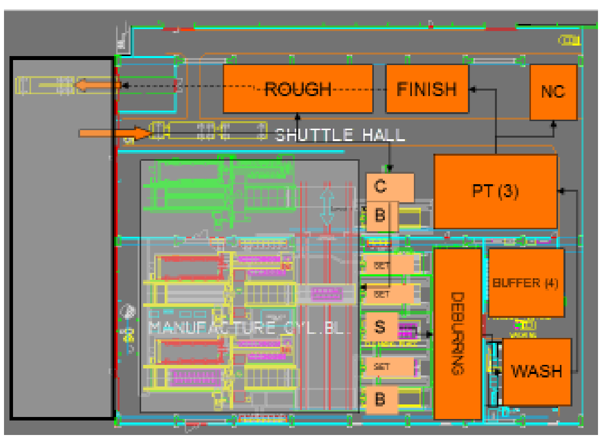
Simulation to improve an existing plant

- how improve the production level in machining of large components

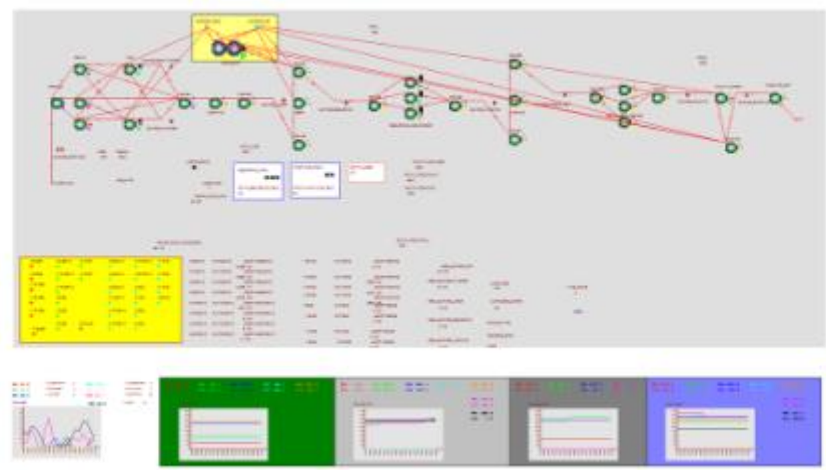
Reference data

- **MODEL SETTINGS**
  - 14 working cells: according to AS IS layout
  - 2008 production plan + warm up period: 1 year of production
  - Arrival date: 6 weeks before due date date



Factory layout

Production model



Factory model

  Doc.ID: Revision: Status:

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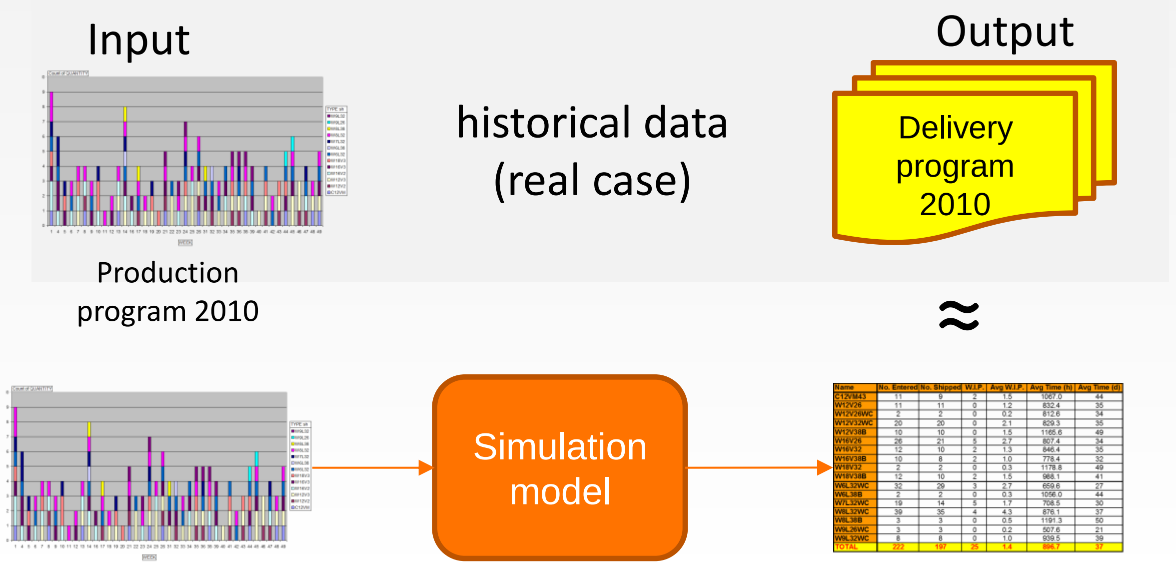
Hystorical data to increase reliability

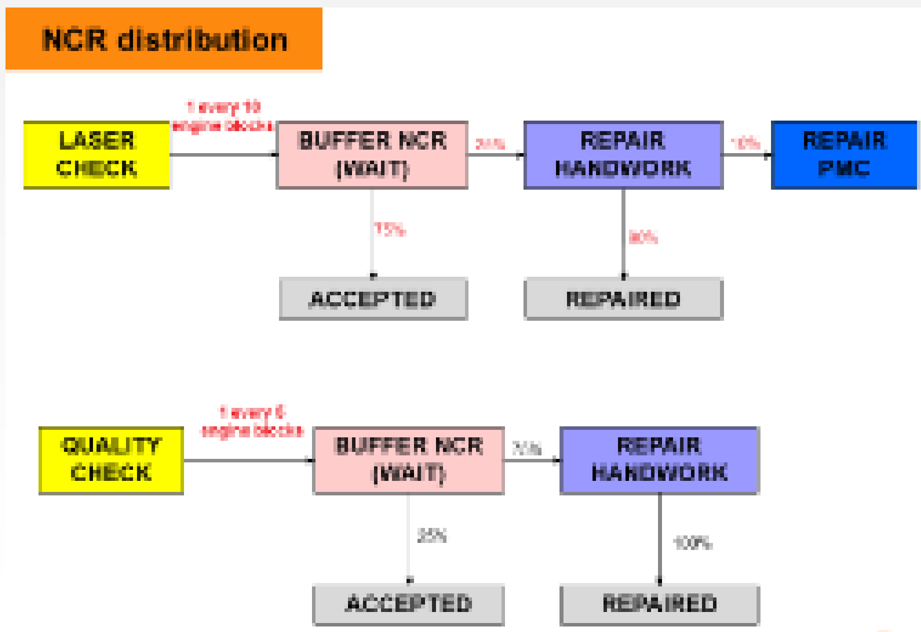
- In this case was possible to improve the accuracy of the model by using historical data



Name	No. Entered	No. Shipped	W.I.P.	Avg W.I.P.	Avg Time (h)	Avg Time (d)
C12VM43	11	9	2	1.5	1067.0	44
W12V26	11	11	0	1.2	832.4	35
W12V26WC	2	2	0	0.2	812.6	34
W12V32WC	20	20	0	2.1	829.3	35
W12V38B	10	10	0	1.5	1165.6	49
W16V26	26	21	5	2.7	807.4	34
W16V32	12	10	2	1.3	846.4	35
W16V38B	10	8	2	1.0	778.4	32
W18V32	2	2	0	0.3	1178.8	49
W18V38B	12	10	2	1.5	988.1	41
W6L32WC	32	29	3	2.7	659.6	27
W6L38B	2	2	0	0.3	1056.0	44
W7L32WC	19	14	5	1.7	708.5	30
W8L32WC	39	35	4	4.3	876.1	37
W8L38B	3	3	0	0.5	1191.3	50
W9L26WC	3	3	0	0.2	507.6	21
W9L32WC	8	8	0	1.0	939.5	39
TOTAL	222	197	25	1.4	896.7	37

Incident simulation

- Because of good reliability of the model we decide to introduce also ‘incidents’ in the model for the main machines:
  - utilization rate with triangular distribution for MTBF and MTTR of main machines
  - Non conformity in production: distribution according to historical data



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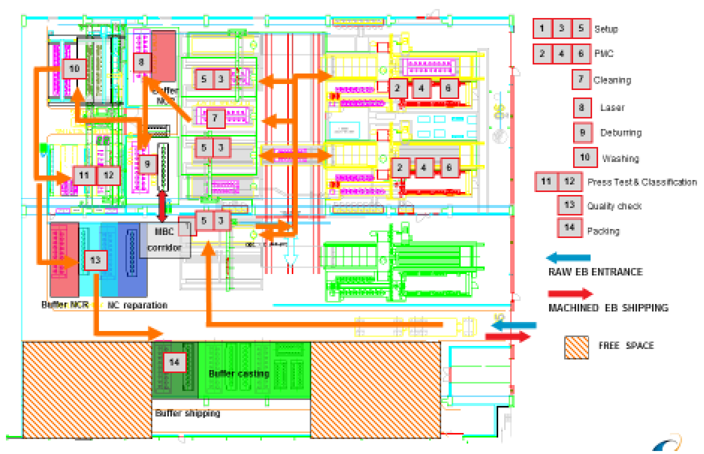
Suggestion from simulation

- We simulate 5 different options (Case 1-5) with different CAPEX, different efficiency and resources
- we selected the ‘low CAPEX’ case and
  - increase resources in manual activity an
  - reduce waiting time
  - use few (selected) machine in 2 shifts
  - advance and detail planning of and all ac
  - reduce NCR: invest in higher quality leve

Output results

		CASE 1	CASE 2	CASE 3	CASE 4	CASE 5
PROD. PLAN	2010	259 EB - 13214 hours machining				
NCR	STATION	na	2	na	na	2
	Utilization (% on shift)	-	28%	-	-	32%
PMC	STATION	2	2	3	3	3
	Utilization (% on 8760 h)	70%	69%	53%	53%	57%
LASER	STATION	1	1	1	1	1
	Utilization (% on shift)	13%	14%	15%	15%	16%
DEBURRING	STATION	3	3	3	3	3
	Utilization (% on shift)	23%	23%	27%	27%	26%
PRESS TEST	STATION	2	3	2	3	3
	Utilization (% on shift)	47%	39%	54%	45%	46%
BUFFERS (pcs)	AVG CASTINGS (pcs)	20	25	0	0	1
	AVG SEMIFINISHED (pcs)	3	0	0	1	0
	AVG FINISHED (pcs)	0	0	0	0	0
	AVG NCR (pcs)	-	2	-	-	2
	AVG SHIPPING (pcs)	1	1	2	2	2
CLASS WT	distribution (hours)	1-36	4-60	1-36	4-60	4-60
RESOURCES	MACHINING TEAM	4	4	4	4	4
	Utilization (% on shift)	46%	46%	52%	52%	57%
	DEBURRING TEAM	9	9	9	9	9
	Utilization (% on shift)	35%	36%	41%	41%	41%
	NCR TEAM	na	2	na	na	2
	Utilization (% on shift)	-	43%	-	-	47%
SHIPPED	(pcs)	234	231	267	266	268
WIP	(pcs)	42	50	7	7	11
LEAD TIME	MEAN (days)	54	63	17	16	20
	MAX (days)	64	81	42	42	43

Layout proposal low impact



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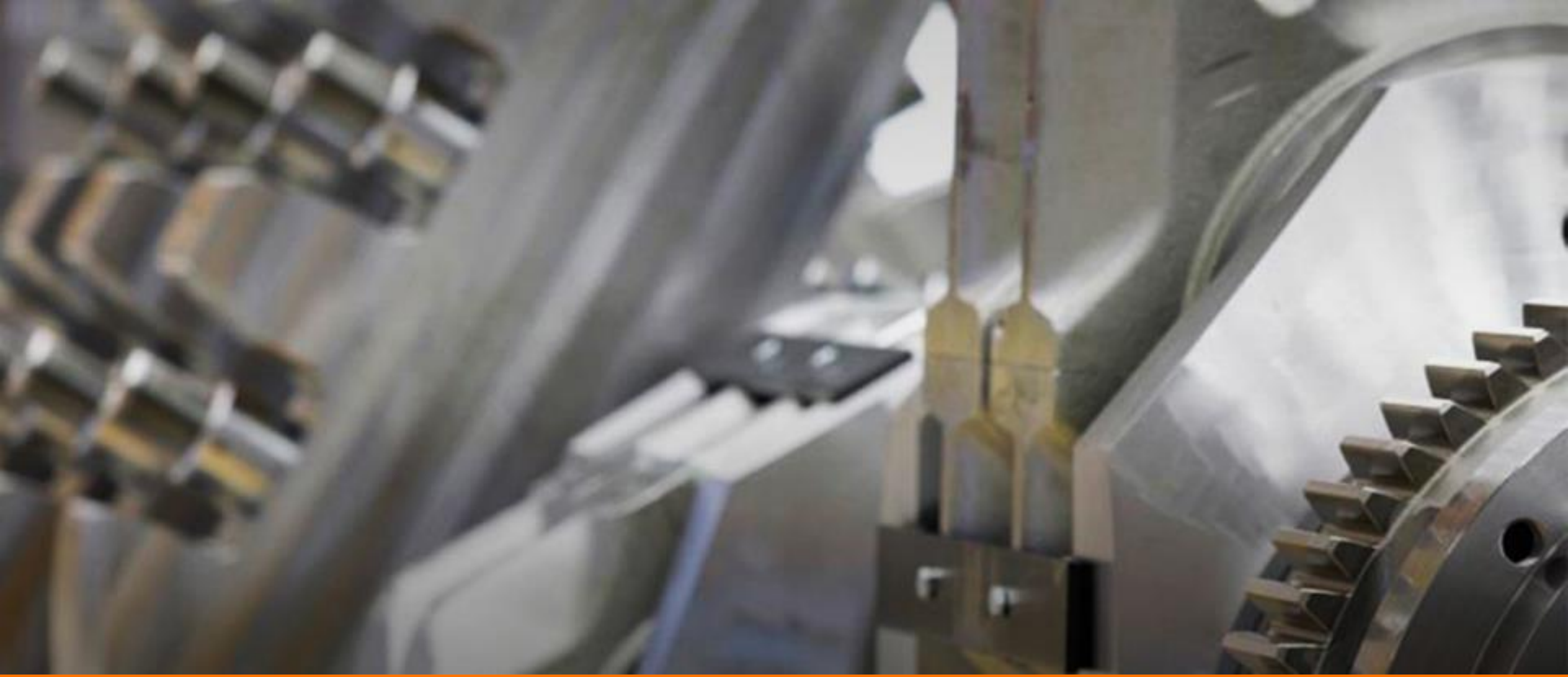

2016 WARTSILA ITALY

'FROM 3 TO 1 BUILDING PROJECT'

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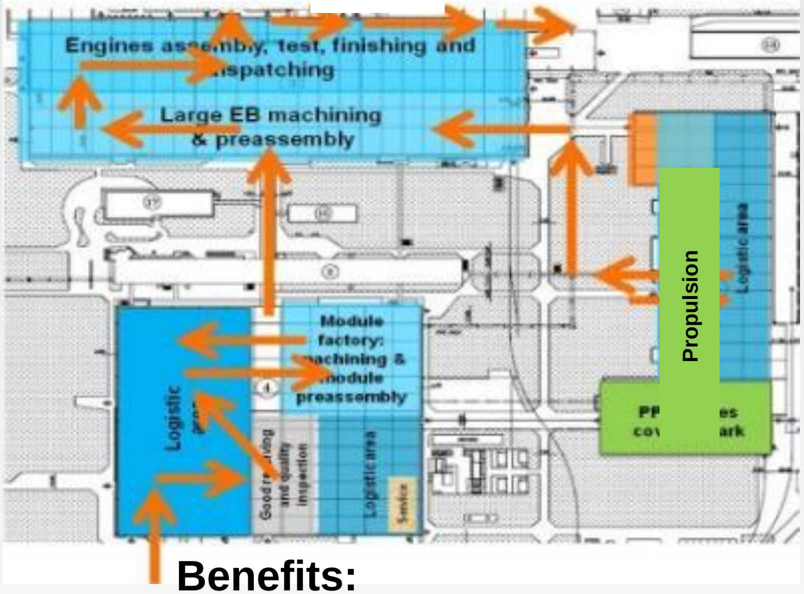
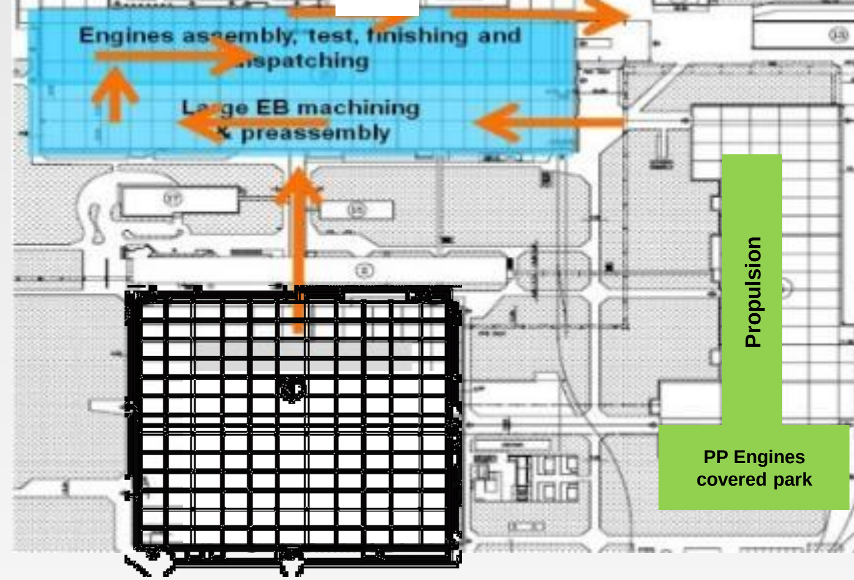
DCT production flow improvement

FROM



TO

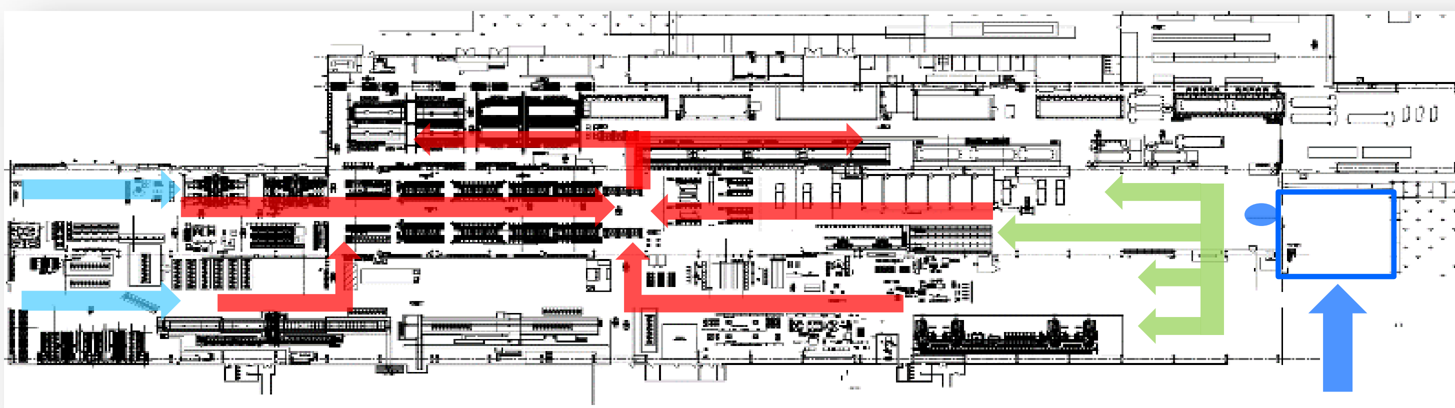


Benefits:

- - 53 % ➢material movements per engine
- - 55 % ➢factory area in 4s production use
- - 9 % ➢capacity cost
- - 30 % ➢inventory & WIP

New production flow:

- Incoming goods
- Heavy parts in
- Materials to warehouse
- Materials to machining or assembly



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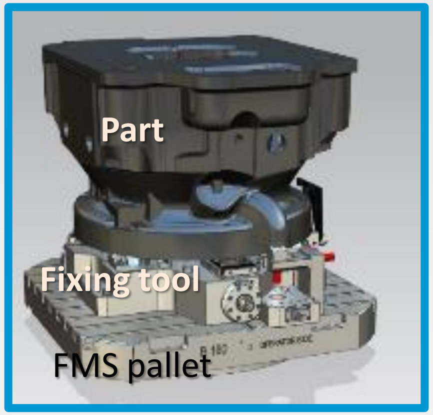
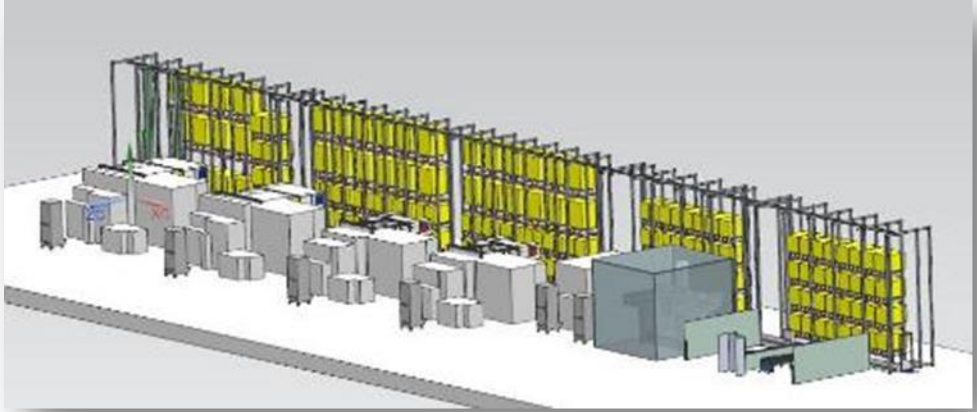
Simulate to support: 3 to 1 building project

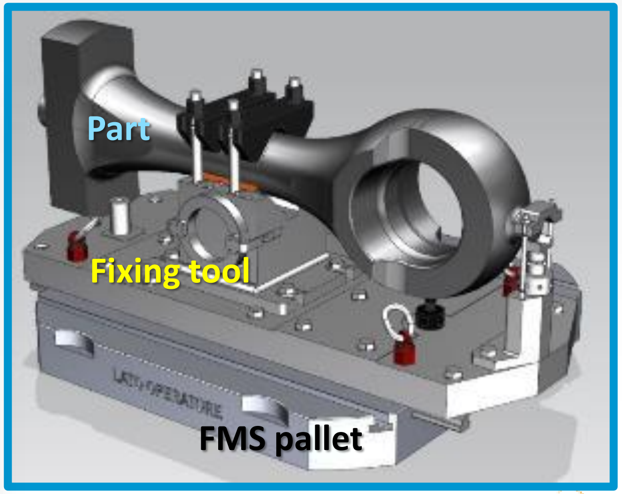
- FMS system
- Phase Array Ultrasonic system SIMULATION
- Internal logistic flow Simulation_1B

FMS optimization supported by simulation model



- Objective: evaluate different scenarios **of number of tools/pallet and storage locations in the system**, in order to define the most effective one
- In scope: define production output and machine efficiency, by optimizing resources
- Basic assumptions: max output condition only considered (no disruption taken in consideration, such as breakdown, failure, absenteeism)





Simulation description

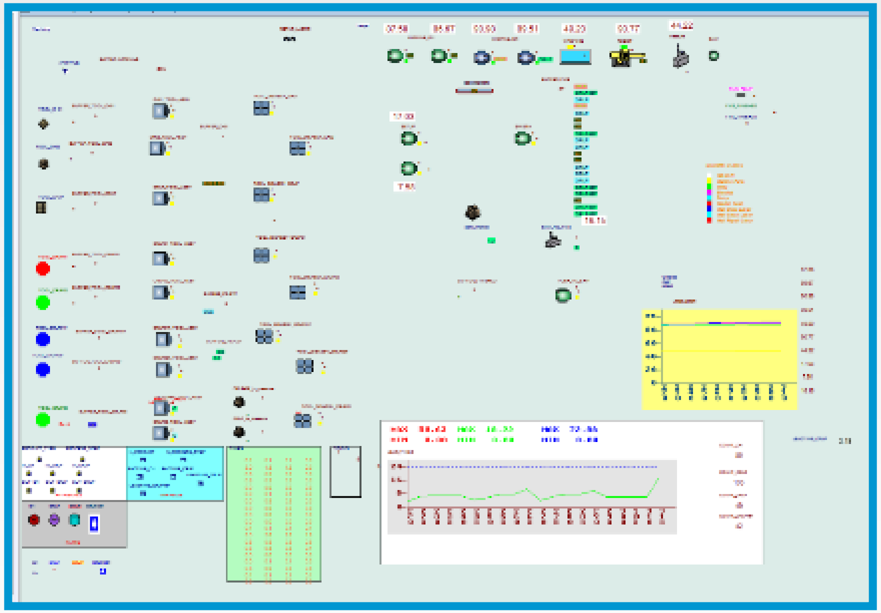
SINGLE RUN INPUT:
(= variables)

Tools number

	Attrezzi (TOOL)								
Prova	Totale TOOL	Tools PART11	tools PART12	Tools PART21	tools PART22	Tools PART4 1	tools PART4 2	tools PART2 3 (measu	Tools PART3
Prova 53	41	7	5	7	4	7	4	4	3
Prova 54	39	6	4	7	4	7	4	4	3
Prova 55	36	4	3	7	4	7	4	4	3
Prova 56	26	4	3	4	3	4	3	3	2
Prova 57	21	3	3	3	2	3	2	3	2
Prova 58	28	6	4	3	2	4	3	3	3
Prova 59	28	6	4	3	2	4	3	3	3
Prova 60	28	6	4	3	3	3	3	3	3
Prova 61	28	5	5	3	3	3	3	3	3
Prova 62	28	6	5	3	3	3	3	2	3
Prova 63	28	6	3	5	2	5	2	2	3
Prova 64	28	6	3	5	2	5	2	2	3

Working shift

Prova	Risorse
Prova 53	5 gg 2t, 2 gg 1 t
Prova 54	5 gg 2t, 2 gg 1 t
Prova 55	5 gg 2t, 2 gg 1 t
Prova 56	5 gg 2t, 2 gg 1 t
Prova 57	5 gg 2t, 2 gg 1 t
Prova 58	5 gg 2t, 2 gg 1 t
Prova 59	5 gg 2t, 2 gg 2 t
Prova 60	5 gg 2t, 2 gg 2 t
Prova 61	5 gg 2t, 2 gg 2 t
Prova 62	5 gg 2t, 2 gg 2 t
Prova 63	5 gg 2t, 2 gg 2 t
Prova 64	5 gg 2t, 2 gg 1 t

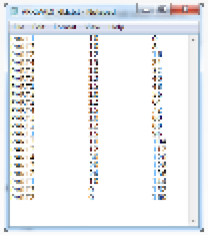


GENERAL INPUT:

Cycle time

		1	2	3	4
		PART1	PART2	PART3	PART4
Process Step	OPERATION	Times [h]	Times [h]	Times [h]	Times [h]
1	SETUP 1	0,15	0,10	0,10	
2	STAGE 1	3,00	1,25	1,25	
3	ROBOT 1	0,75	0,50	0,50	
4	WASHING 1	0,50	0,25	0,25	
5	SETUP 2	0,00	0,00	0,00	
6	SETUP 2b		0,10	0,10	
7	STAGE 2 (ssega)		0,50	0,50	
8	ROBOT 3				
9	WASHING 3				
10	SETUP 3		0,00	0,00	
11	SETUP 3b	0,15	0,10	0,10	0,05
12	STAGE 3	3,00	2,75	2,75	1,75
13	ROBOT 3	0,75	0,50	0,50	0,50
14	WASHING 3	0,50	0,25	0,25	0,15
15	SETUP 4		0,00	0,00	
16	SETUP 4b		0,10	0,10	
17	MEASURING	0,50	0,50	0,50	0,50
18	SETUP 4	0,15	0,10	0,10	0,05
19	DELIVERY	0,00	0,00	0,00	0,00
	TOTAL HOURS	9,45	7,00	7,00	3,00

Part arrivals sequence
(= production schedule)

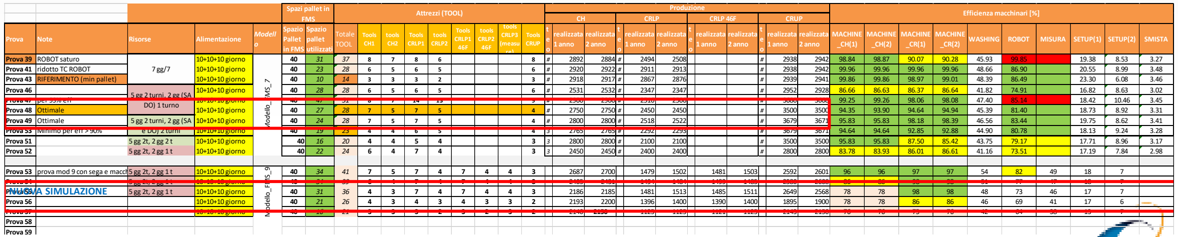


OUTPUT:

Production rate

Resources utilization

Storage space needs



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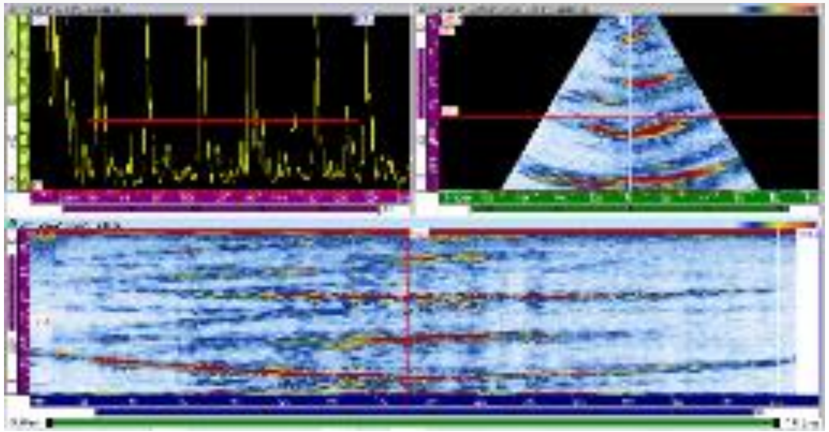
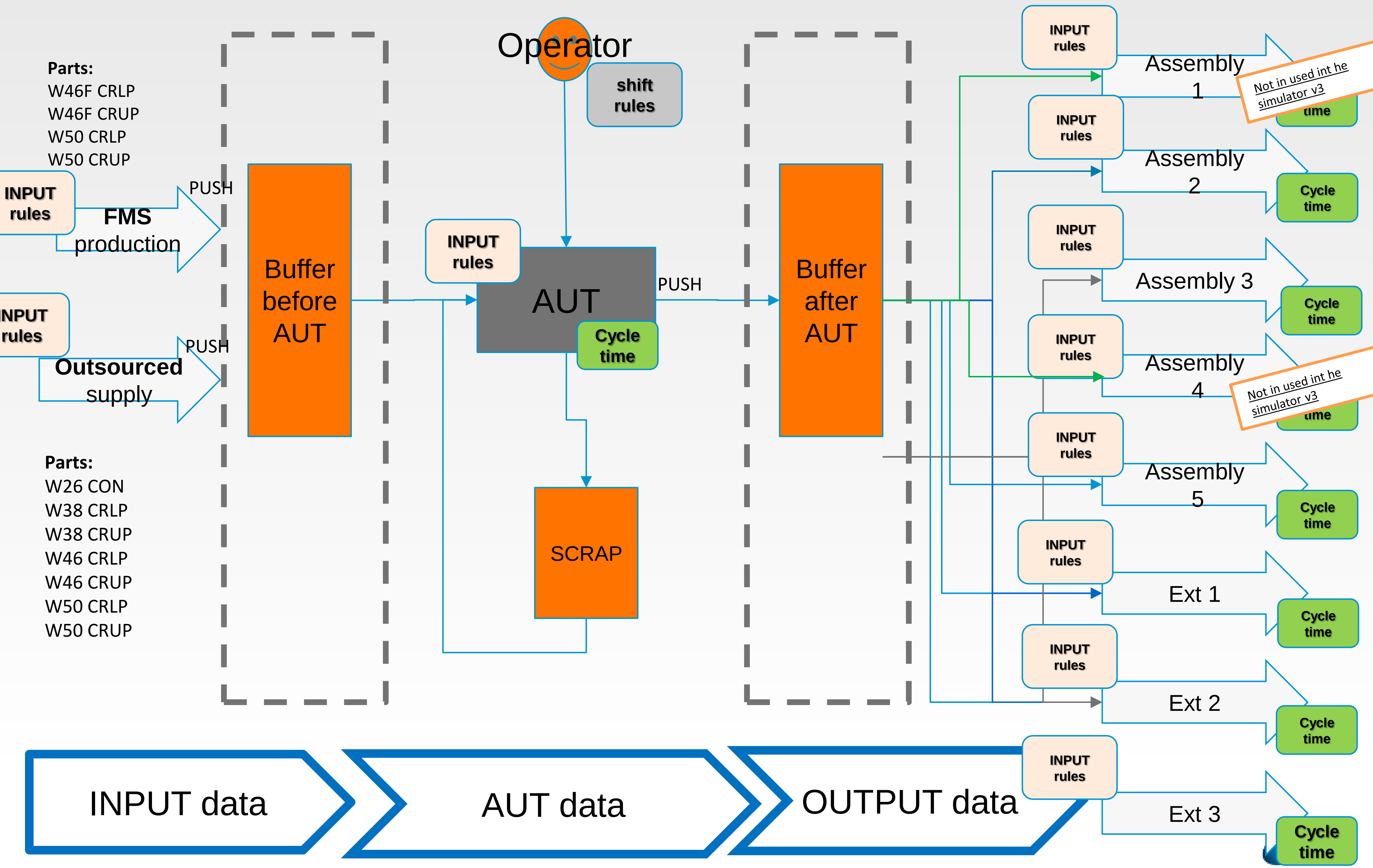
Phase Array AUT system SIMULATION

1. We will invest in automated phased array UT equipment for all steel parts to detect material defects (9 different parts)
2. Parts are produced in house and from subsupplier with different process:
   - Continuos flow
   - Batch production

Total volume: 16000 parts/year: How design WAREHOUSE before and BUFFER after?



Simulation Model (Version 4)



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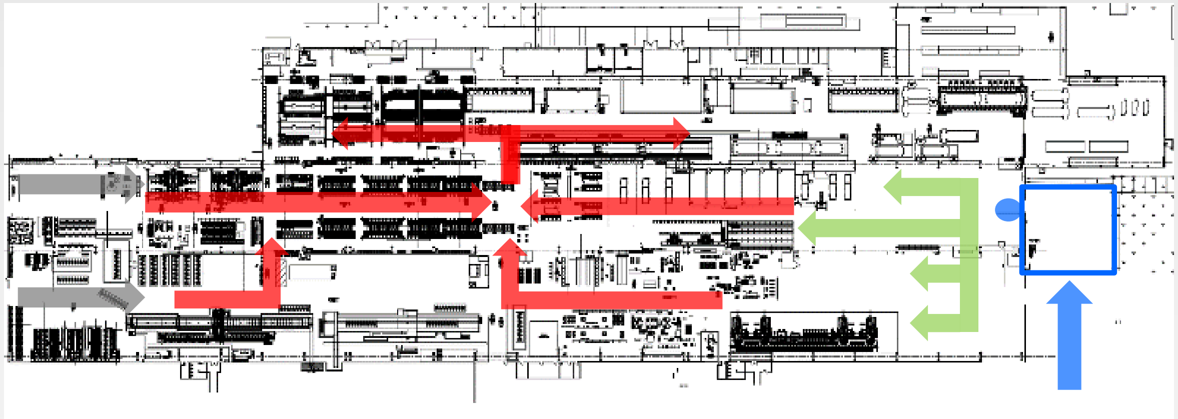
CONCLUSION

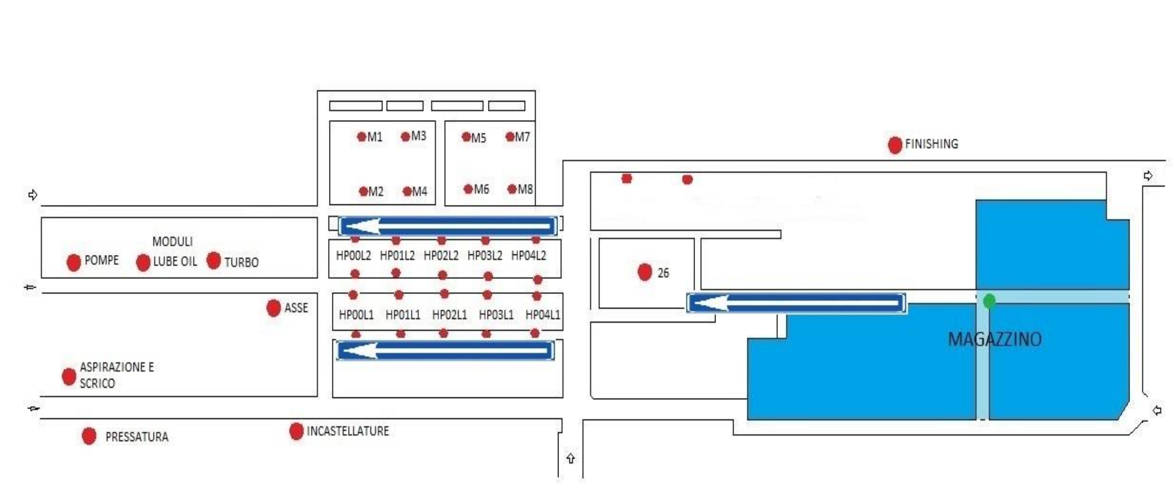
- Storage needs are highly impacted by low rotating parts (component) but those could be managed as special events
- AUT inspection batch dimension could be reduced from 50 to 20 pcs without impacts on the storage needs and machine performance
- Setup times and calibration time can impact on machines productivity and so increase storage space needs, in both the buffers of the machine.
- The more representative results to dimension the buffers are:
  - *Before AUT*: 49 pallets storage places (or 170 pcs)
  - *After AUT*: 95 pallets storage places (or 330 pcs)
  - No special needs for rejected parts if checked regularely

Internal logistic flow Simulation_1B

Simulate the traffic of forklift inside the factory in the new configuration (2016)

- Goals to be achieved:
  - Pallet stock in warehouse at the end of a working day -> 0
  - Average pallet delivery maximum delay = 1 day
  - % Forklifts loaded > 30%
  - % Streets filled and blocked (jamming roads evaluation)
  - Daily workload (balanced)
  - Explore different scenarios (time frame)





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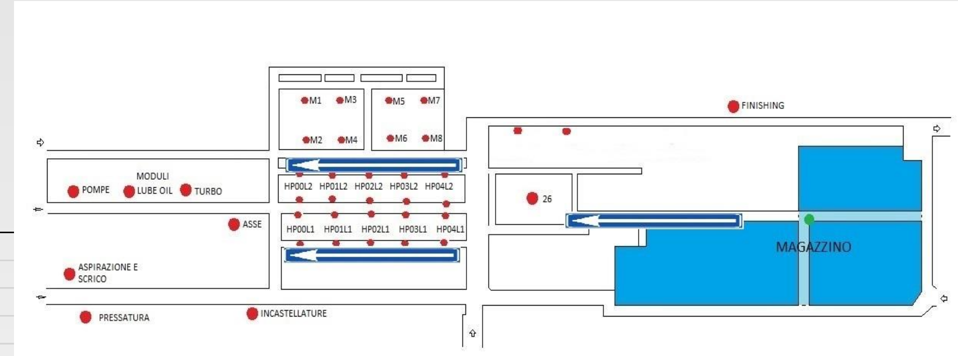
Results year 2016



Anno 2016

forklift	d_percorsa/anno	[]	%usage
forklifts (3)	11872874	m	60%
fork_help_1	3051660	m	27,87%
fork_help_2	1936541	m	12,24%
fork_help_3	901517	m	5,16%
tot	**17762,6**	km	

gg_lavorativi/anno =	222	-
nr°_motori/anno =	158	-
Km/gg=	**80,0**	km
Km/engine=	**112,4**	km

			forklifts					
			transfer	45,62%	->	1 fork	3fork	
0-1	25700	92,88%	Loading/Unloading	14,04%	->	187,01	561,0	h
1-2	1700	6,14%	not_used	40,34%	->	537,33	1612,0	h
2-3	270	0,98%				0,00	0,0	h
	27670							
			forklift_help_1					
			used =	27,87%	->		374,6	h
			forklift_help_2					
			used =	12,24%	->		164,6	h
			forklift_help_3					
			used =	5,16%	->		69,3	h
							2781,5	**h**

ore tot di diponibilità 1 fork= 6*222 1332 h

- Utilization rates forklift: 3 forklifts at 100% + 2 forklifts at 25% (for peak load)
- Only 1 road critical (one way mode)
- Delivery to workshop in 3 specific time frame (6-8, 12-14, 20-22)

Conclusion: simulation as tool

- Simulation is powerful tool to analyse performance of a plant and **analyse alternatives**
- Simulation bring additional benefit:
  - analyse and understand our real process (system)
  - understand parameters and elements that influence the system

Increase overall knowledge of the process under simulation

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Conclusion: effort for simulation

- To get better result in simulation we need to spend more time to :
  1. **analyse the system** to simulate
  2. **check the reliability of the model** vs the real system
  3. built the model
  4. analyse the result and fine tune the system

END

“Is very complicate to estimate, specially the future”

Niels Bohr

“Study the past if you want to predict the future”

Confucio

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