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塑造智慧变革

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How Machine Control is revolutionizing the Heavy Construction Industry

Johan Arnberg, President, Leica Machine Control Division

September 12, 2018

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Agenda 1

1. The Challenge
2. What is Machine Control
3. Digital Revolution

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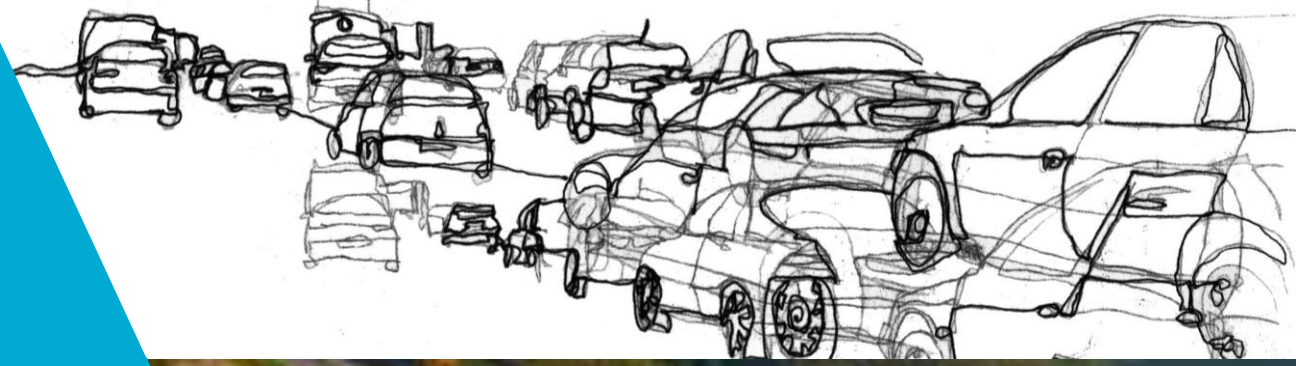
THE CHALLENGE.

The Challenge



❑ Increased Demand in Infrastructure

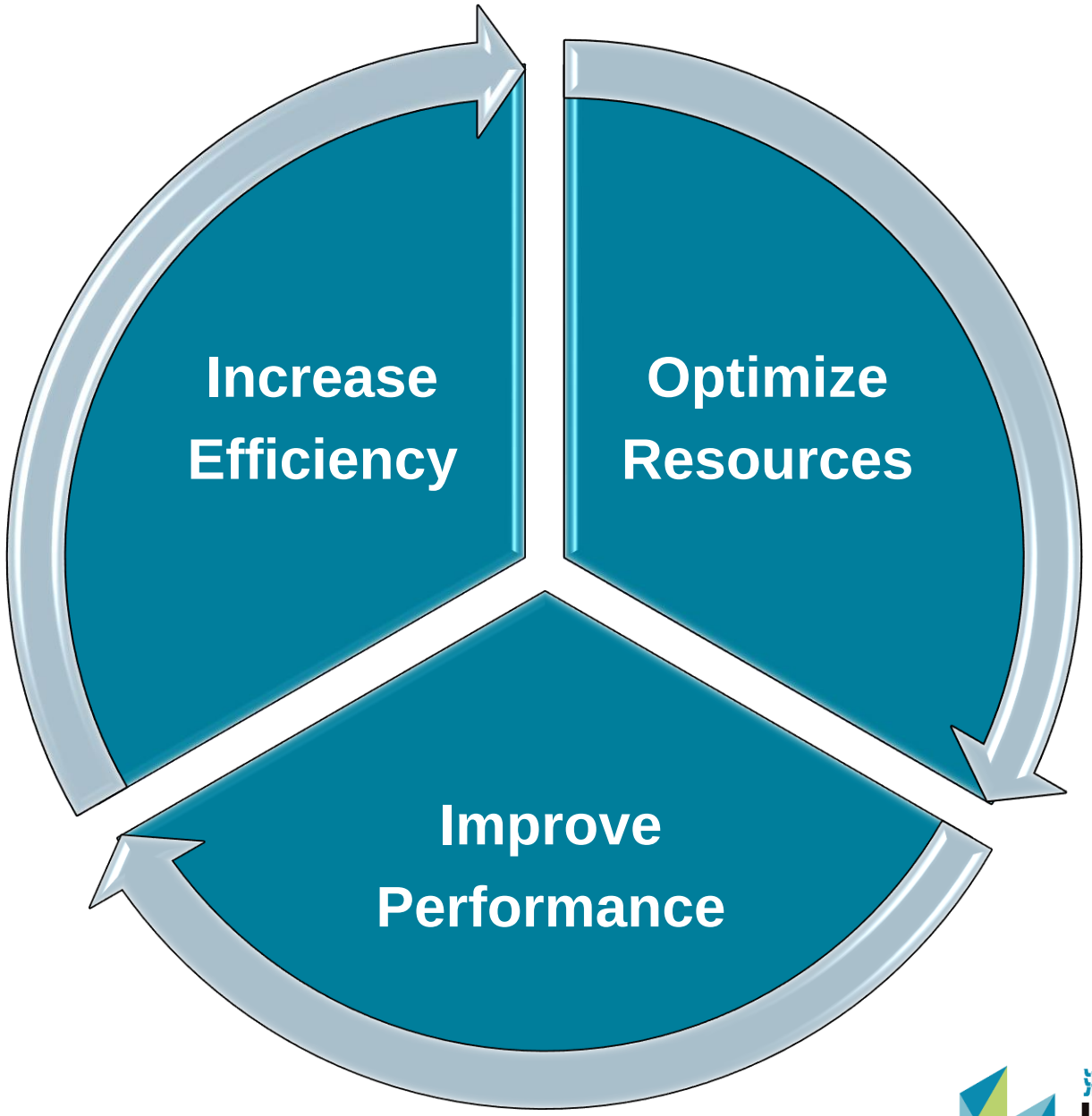
- New development in emerging markets
- Increased repair & maintenance in developed markets
- Population growth
- Traffic is increasing
- Freight traffic to increase by 50% within the next 10 years
- Not only more roads – also more “robust”
- Projects are getting larger and more complex

❑ Less Spending for Future Infrastructure

- 2030 expected spending needs exceed 40 Trillion €
- But the governments will have 50% less money to spend

The Challenge

- Demand goes Up
- Increasing Funding Gap
- Lack of Control
- Increased Pressure



Construction
A large Part of the World Economy

Annual productivity growth has only increased

1% over the past 25 years

Construction-related spendings accounts for

13% of the world GDP

$ 1.6 trillion of additional value added could be created through higher productivity

meeting half the world‘s infrastructure need

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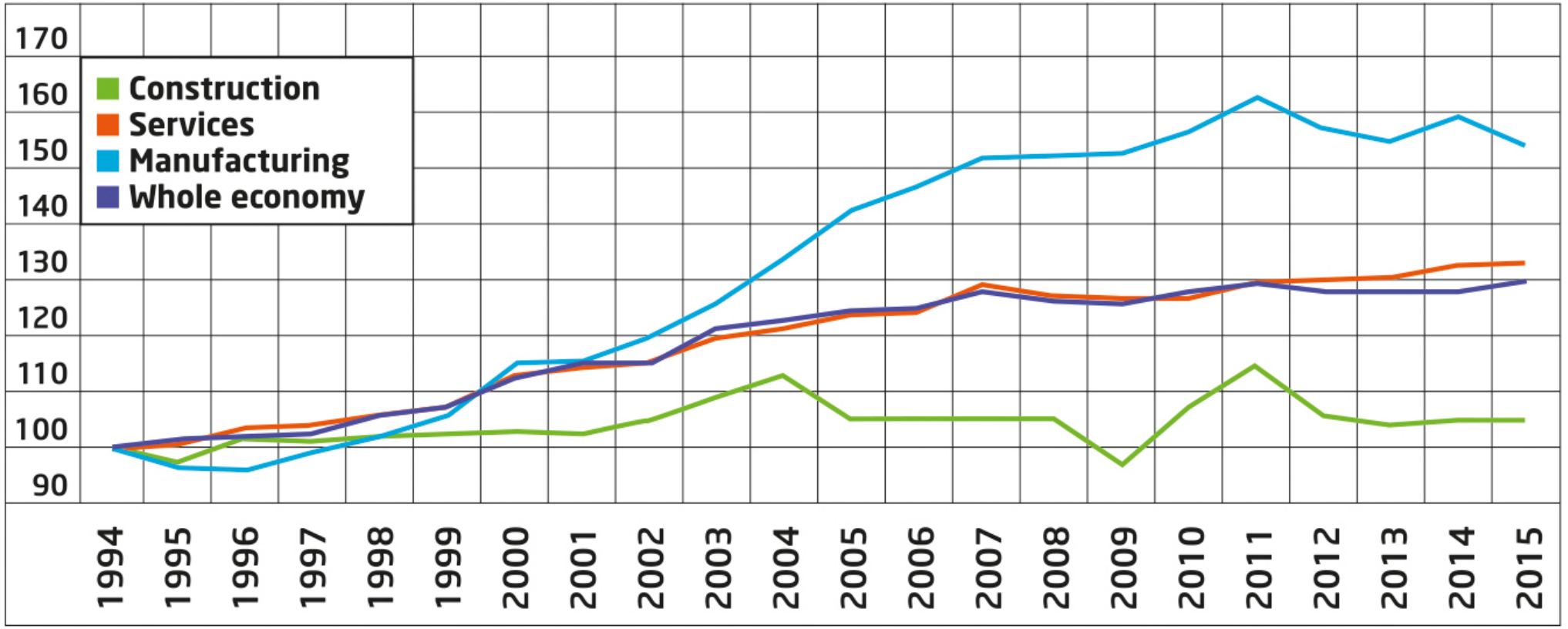
The Construction Industry is still in the Stone Age



Source: ONS. Index adjusted to 1994 = 100

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And this?

80%

Over Budget

20%

Over Schedule

Major Capital Projects

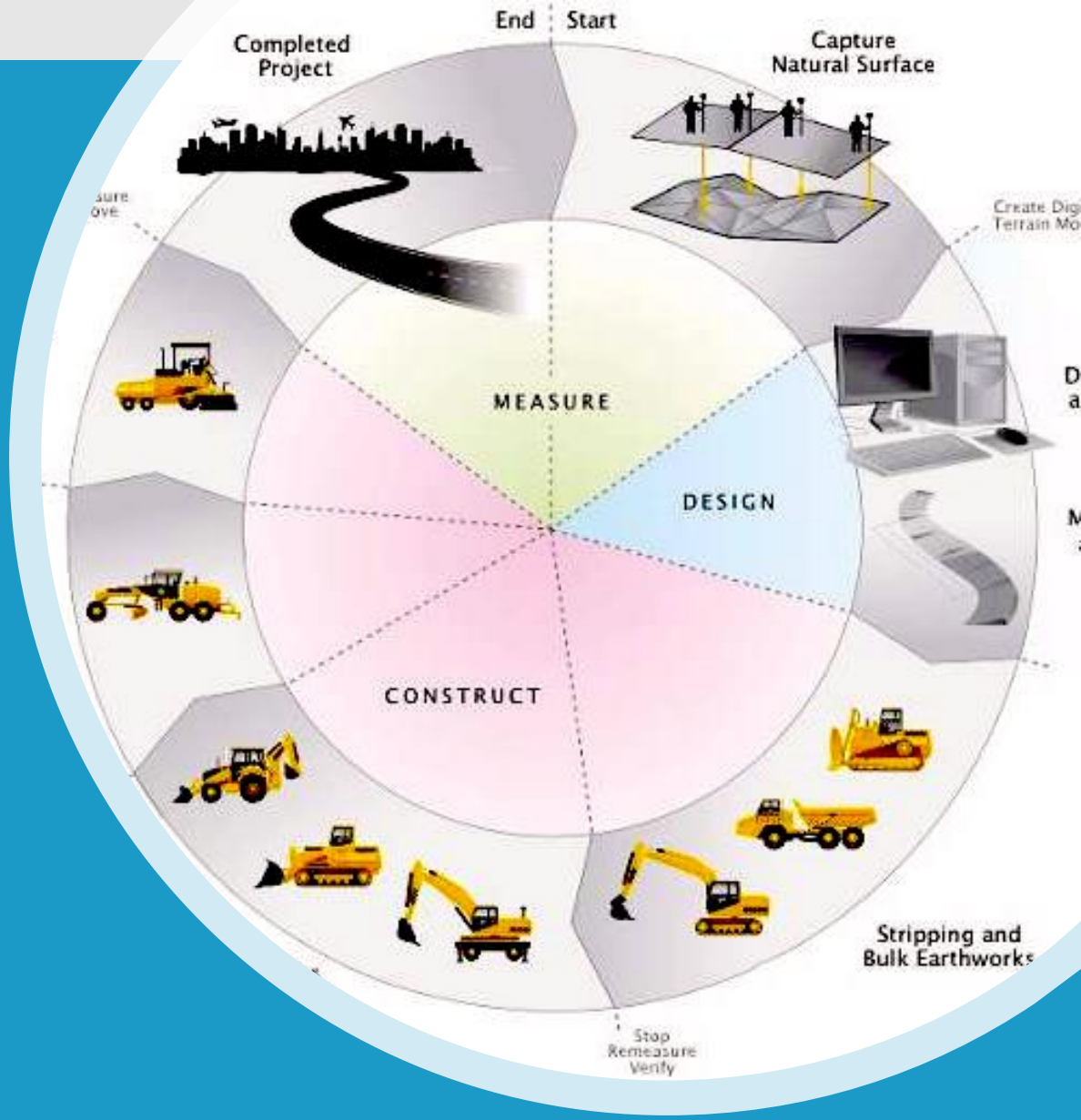
Lack of Control

- Every project is a prototype
- No KPI‘s
- How a project is executed is up to the local site management

Smart Decisions made in Real-Time

By Connecting:

- ❑ *Equipment*
- ❑ *People*
- ❑ *Processes*
- ❑ *Data*



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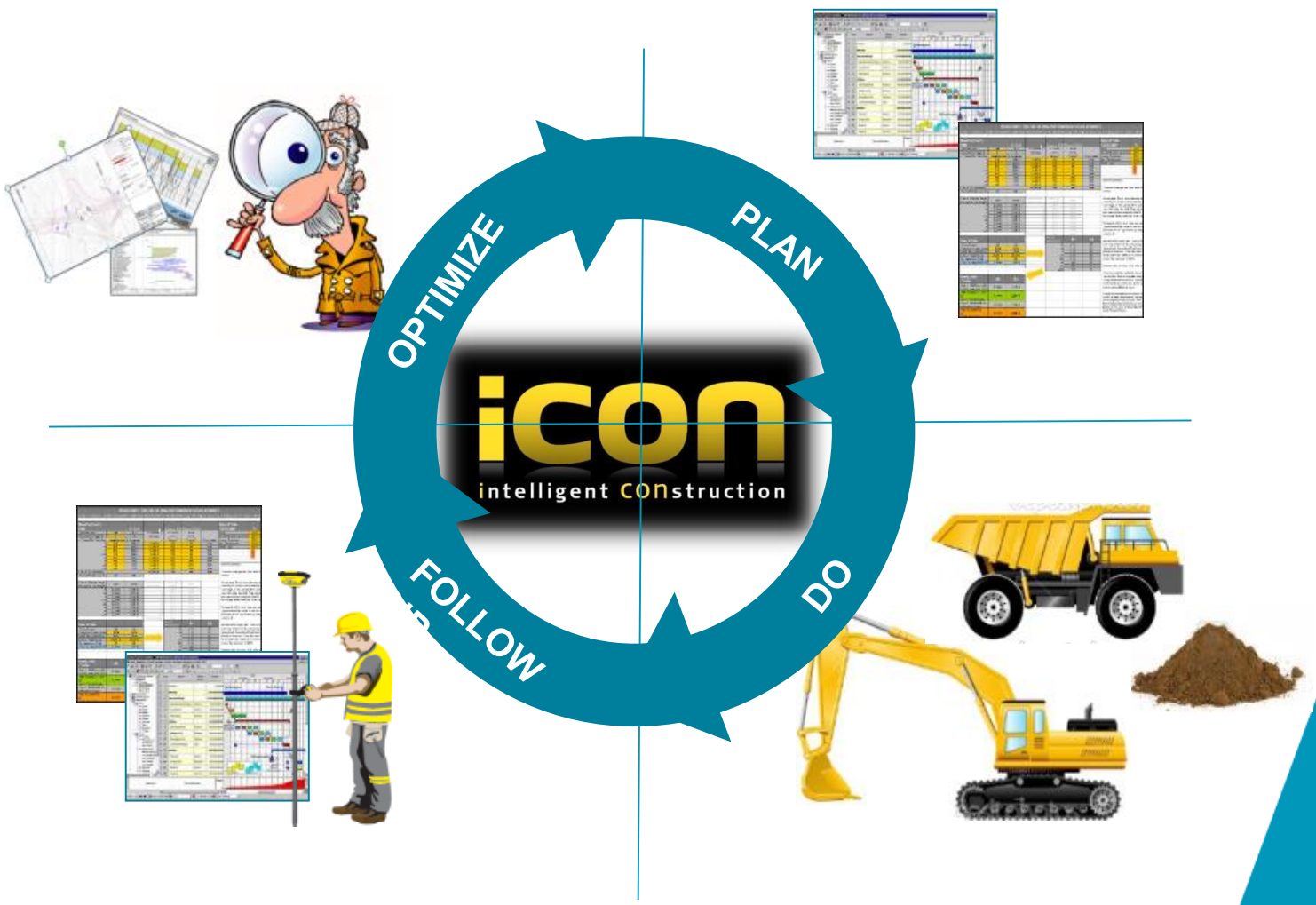
What a Contractor need to know within his Project are:

Time

Budget

Specification

Smart Decisions made in real time



Connectivity

Digitilization

BIM

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Machine Control Transforms the Way the World Works

Making the markets we serve significantly more productive by sensing & automating systems, optimizing workflows and connecting the field to office, from site to site.

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Why invest in Machine Control?

- Machine Control is changing the construction industry and construction processes

- Machine Control makes it possible to finish Projects;
  - Faster, with Lower Costs
  - Higher Accuracy
  - Fewer Accidents.

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The Benefits using Machine Control…

- ❑ Job site preparation / stake out
  - Less people on site needed
  - < 75% reduction in time
- ❑ Earthwork using machine control
  - < 30% fewer man hours
  - < 35% fewer equipment hours
  - < 45% fewer project hours
  - < 40% less fuel consumption
- ❑ So a 10-30% price increase of the machine gives you 50-60% productivity increase
- ❑ Payback depending on the project is 6-12 months

Or in other Words it will allow you to...

❑ Be able to build Safely

- Have fewer people working around the machines and in dangerous areas
- Give the operator a digital view of what they cant see above and below ground
- Remove trip hazard from stringlines and batter boards
- Train operators faster
- Make sure everyone gets home safely

❑ Be able to build on Time

- Build it right the first Time = Less Re-work
- Less stops to verify Level (Grade). Reduces also the dependency on Surveyors on Site
- Greater machine productivity
- Improve logistic and rework

❑ Be able to build on Specification

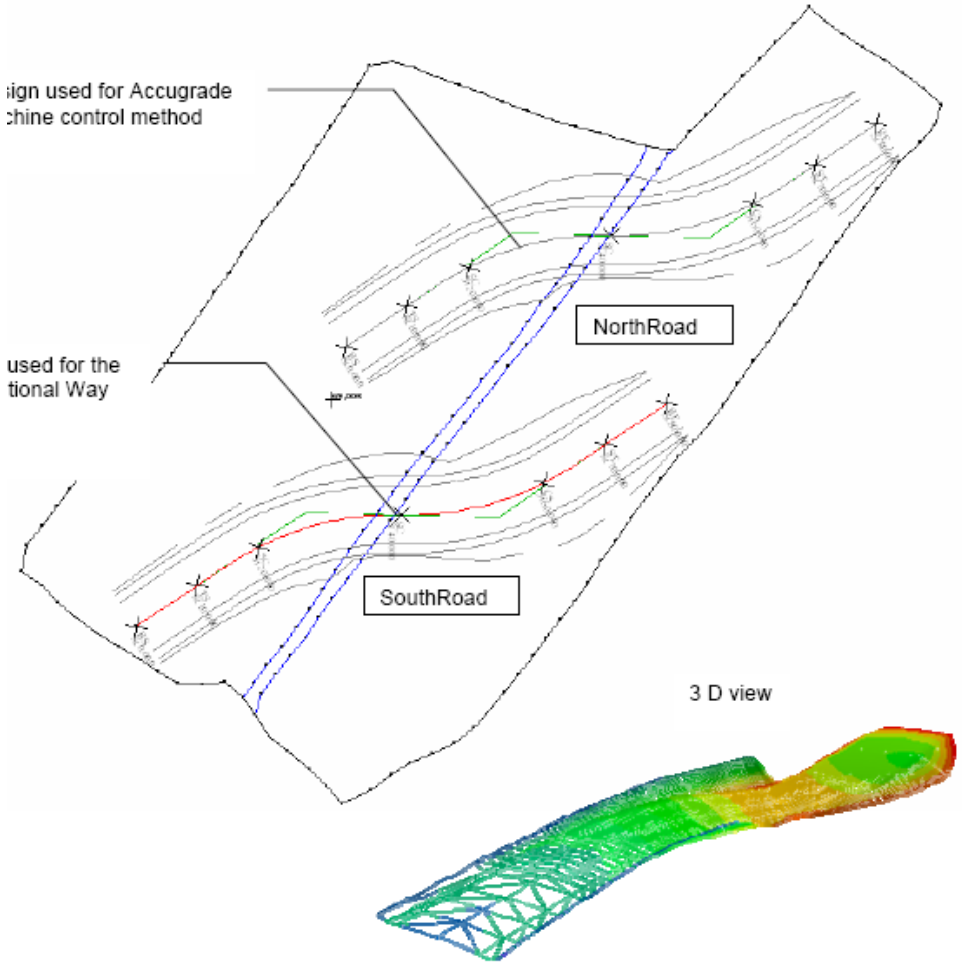
- Higher Accuracy
- Better Material Usage and Movement
- Higher Quality
- Less Maintenance later on

❑ Be able to build on Budget

- Increase the Performance and Speed of the Machine
  - Less Machine Maintenance
  - Greater machine productivity
- Less Fuel Consumption
- Less Staff on Site
- Complete the Job faster and get the Bonus

Analysis of Machine Control Savings

- **Two identical 80m road alignments where constructed**
  - Stakeout alignment
  - Excavating & Grading of Subgrade
  - Import & spreading Base Course material
  - Fine-grading of Base Course
  - Compaction
  - As-built checks
- **Conventional vs 3D Machine Control**
- **Time, fuel, materials & personnel savings were measured**



Analysis of Machine Control Savings

Task	Equipment	Conventional Method	Machine Control Method	Efficiency Gain
Survey & Stakeout		07:31	00:54	6:37 saved
Bulk Earthworks		04:40 02:23	04:18 01:53	+9% +27%
Subgrade Layer Rough Grading		03:48 02:56	01:28 02:43	+159% +8%
Base Course Layer Rough Grading		02:24	00:53	+172%
Base Course Layer Fine Grading		01:49	00:32	+241%
Total		**24:32**	**11:50**	**+101%**

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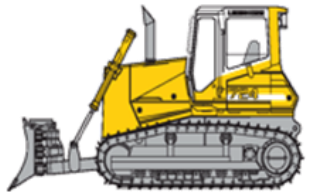
Analysis of Machine Control Savings

Machine	Equipment	Conventional Construction	Machine Control Construction	Efficiency Gain
	Passes	632	306	+107%
	Fuel	**210 litres**	**136 litres**	**35% saving**
	Passes/ Trucks	308/ 40	245/ 31	+26% (29% fewer truck movements)
	Fuel	**231 litres**	**123 litres**	**47% saving**
	Passes	62	17	+265%
	Fuel	**22 litres**	**7 litres**	**68% saving**

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Another example – MC versus non MC

CAT D8R with MC			2 CAT D8R without MC		
Effective working time	23.0	Hours	Effective working time	46.7	Hours
Fuel Burned	206.7	Gallons	Fuel Burned	413.5	Gallons
Area Prepared	9000	M^2	Area Prepared	6571	M^2
Labor Used	1.5	Working Hours	Labor Used	45	Working Hours
Survey Works	1.5	Working Hours	Survey Works	5	Working Hours
Accuracy Results	+/- 1.5 cm	Maximum in cm	Accuracy Results	+/- 16 cm	Maximum in cm
Cost per sqare meter	0.52	Dhirhams	Cost per sqare meter	1.45	Dhirhams
Operator feedback about the system	9	(1 to 10, 10 stands for very easy & 1 for difficult)	Operator feedback about System	3	Operator feedback about the system

The single GNSS dozer had an increased productivity of 27% over TWO conventionally equipped dozers

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What it really comes down to …..

- Machine control and construction technology really comes down to helping in a few key areas

- Completing projects
  - **ON TIME**
  - **ON BUDGET**
  - **WITHIN SPECIFICATION**
  - **SAFELY**

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