

Safety, Productivity and Technology



► SAFETY LEVEL

Highest safety level on the market

► ERGONOMICS

Improved ergonomics

► SERVICE

Smart commissioning and preventive maintenance
On-board diagnostics tool

► PERFORMANCE

Optimized performance



Agenda

1. Elevators for crane operators
2. Control command (CCS) and P+ systems
3. Wireless crane technology
4. Other improvement in crane technology and changes to EN14439

Elevators for crane operators

Where there are rules for operator lifts



Country	Regulation type	Max climbing height
Sweden	Recommendation Obligation	20m 25m
Denmark		30m
Norway	Under project	25m or 30m
The Netherlands		30m
Belgium		30m
France	Recommendation	30m



Why requesting crane operator lift

- For North European countries, the main reason is to reduce the risk of accident when climbing the crane during winter (ice on ladder and platforms).
- For France is to reduce the risk of accidents and also it is to lower the pain to climb and then to open crane operator job to more people and aging population.

Elevators for crane operators

External solution



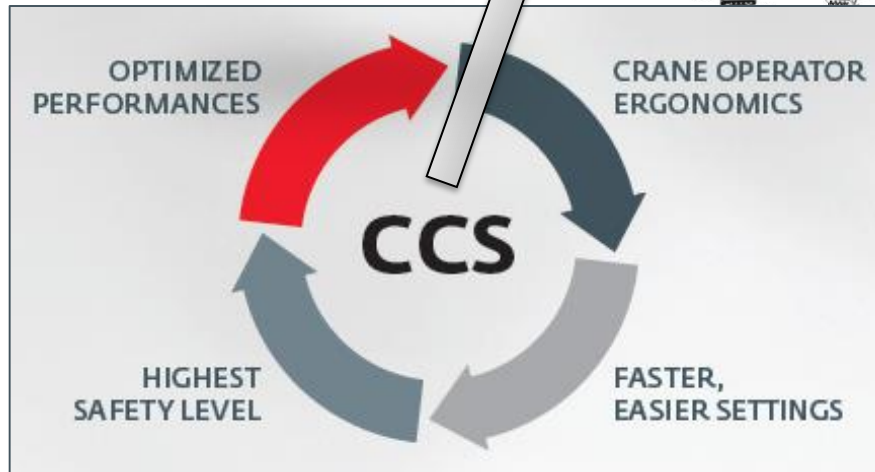
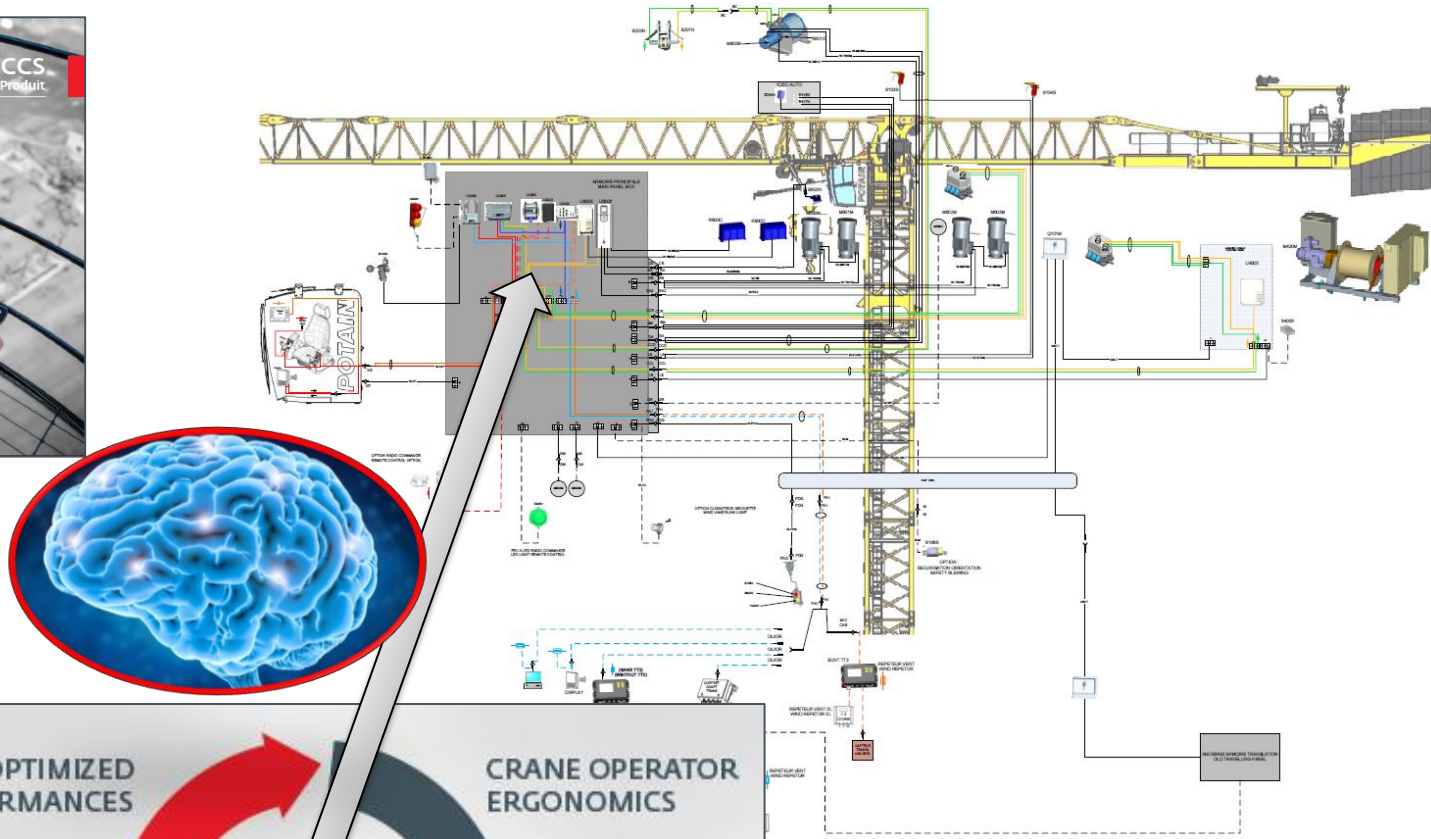
- Offered by different suppliers and adaptable on different tower crane brands to offer flexibility.
- Need access between masts and operator lift and adequation have been made between crane manufacturers and lift manufacturers to ensure safety.
- Will be assembled after the tower crane erection as it comes on different trucks and are stored separately.

Internal solution

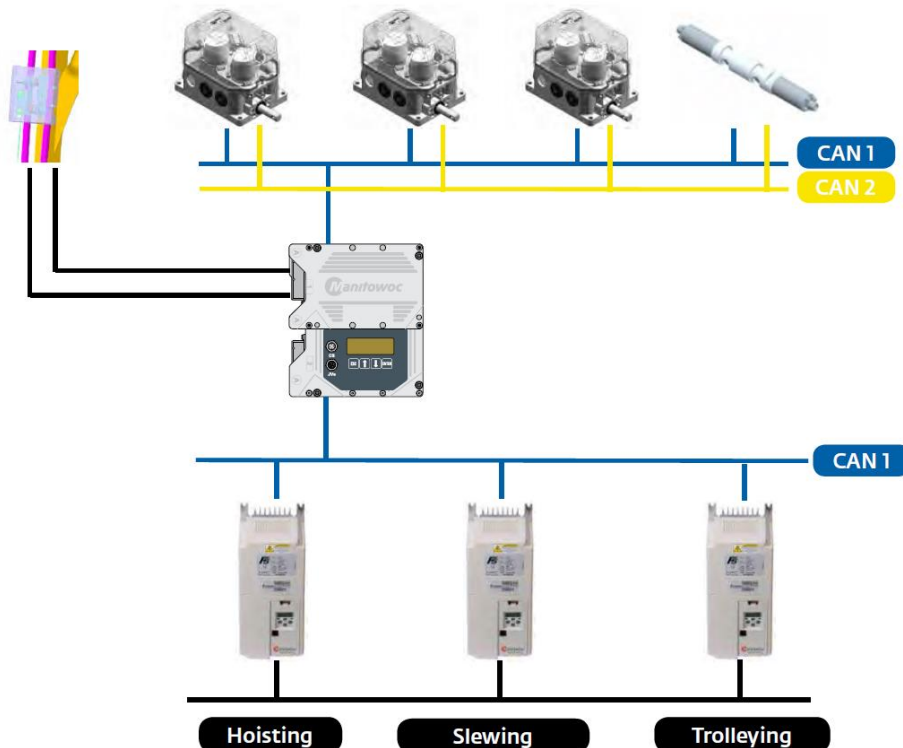


- Offered only by crane manufacturers as it needs to be fully integrated.
- Will be erected in the same time as the tower cranes as it comes assembled in the masts (no additional transportation and storage place).
- It offers a good protection for the lift as everything is inside the masts and maintenance schedule is linked with the tower cranes.

CCS = Crane Control System



CCS - Safety



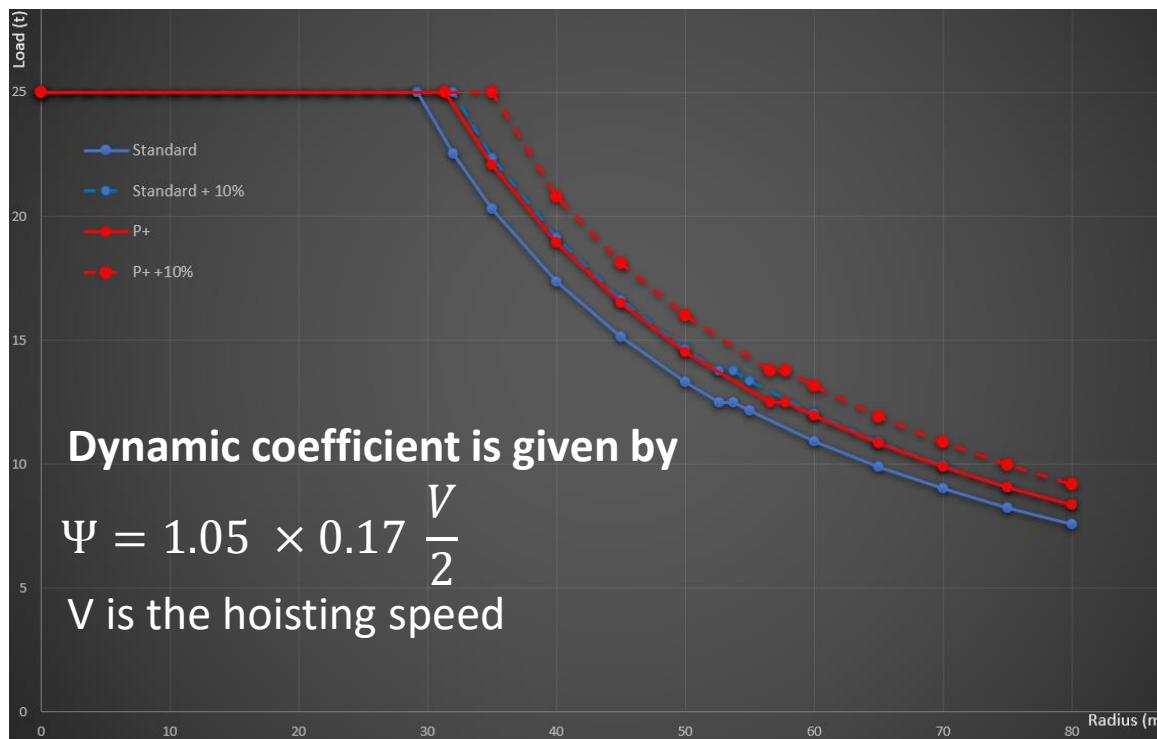
CCS safety management description

- All the safety sensors are redundant as well as the CanBUS
- All safety sensors are certified with a low failure rate ($pl=c$)
- Load safety stop are managed by load pin
- Moment safety stop are managed by the calculated moment (load x radius)
- Orders and move consistency control in real time
- Moment bar are here to control the number of fall given by the crane operator
- Commissioning is made under safety and recorded as the moment limit is set at 130%
- Each technician has his own password to record what is done on the crane.

Why offering 2 load charts

- Offering 2 load charts with one with higher capacities with “lower speeds” is mainly to avoid for few lifts to use a bigger tower cranes.
- This opportunity is just for few lifts as the productivity is really reduced. This “bonus load chart” could not be used as a standard one.

How to offer 2 load charts



P+ is considering a reduce speed and a reduced acceleration ramp, so another dynamic coefficient is considered.

This is bringing and additional load chart with 10% dynamic effect during the operation.

The P+ load chart is not using the 10% of the dynamic effect of the standard load chart.

Wireless crane technology

1. Remote control

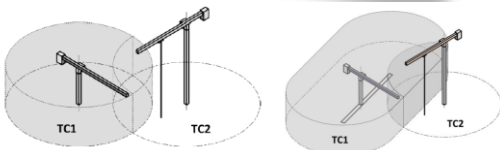


- Remote control is mainly use for self erecting crane or in south of Europe for smallest top slewing crane and thanks to new technology it improves self erection ergonomics and safety.
- While with new Potain top slewing cranes the use of remote control is easier, more and more cranes are used with remote control for job site phase where there is no need of productivity.
- Remote control connection are now “anti-hacking” with latest crane generation

2. Driving aids (anti-collision devices)



- New EN standard will be released in 2020 for anti-collision device – it becomes a **safety system** and no more a driving aids system (pl=c minimum).
- Remote communication are done with radio (new standard defines the actions required if there is a lost of communication)
- Mainly one radio suppliers for the different brands
- Additional way of communications for non safety functions like Wi-Fi.



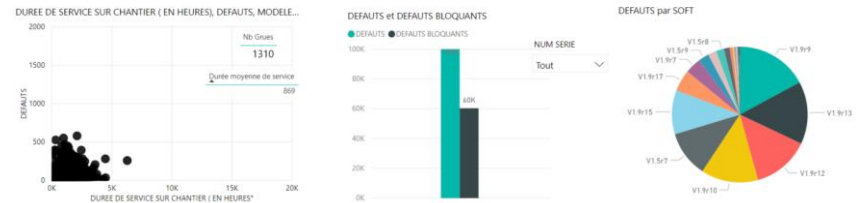
Wireless crane technology

3. Remote maintenance and telematics



All CCS cranes are connected via a 3G/4G modem for:

- remote diagnostics (speed up troubleshooting) already implemented and used all over the world.
- Developing populating “big data” for analysis (working hours, working cycle,...).



4. The future...



- Job site modeling (BIM) provides more and more detailed lifting planification that could lead to automatization.
- Advanced driving aids (target points,...) – already implemented for automotive industry like line detectors
- Driving crane remotely – already implemented for military purpose with drones
- Self driving crane – strong interest in the automotive industry...

How standards bring safety

The standards that are managing the “tower cranes world” are the EN14439 (CE standard) and the FEM rules (historical rules)

The current EN14439 was release in 2009 and a new version is under preparation (release plan in 2022/2023). This new version will bring major changes (to be confirmed as still under discussion)

- Revise structural calculation by including fatigue calculation
- Revise stability and reactions calculation by including new in service and out of service cases.
- Revise safety functions for the control command (16 safety functions should be pl=c)
- Revise the mechanisms calculation (including wire rope) by including lifting cycle as defined for the structural fatigue calculation.
- More detailed definition of the tower crane accesses.
- New standard for anti-collision devices will be applied early 2020 and will be in the next standards. With this standard, the anti-collision devices are now not driving aids but safety system that should be pl=c with the cranes.

➔ All these will lead to safer tower cranes.

