FURUNO NORGE

A structured process for **retrofitting the bridge**

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CHALLENGE the INVISIBLE.

For more than half a century FURUNO has developed cutting-edge, state-of-the-art, marine electronics. In our DNA you will find a dedication to push the boundaries for sensor technology, thus revealing what the human eye cannot see. Equally important is how we present data to create situational awareness, far exceeding the capabilities of the human mind.

This is how we *CHALLENGE the INVISIBLE.*

Retrofitting the bridge

Take advantage of our experience combined with our in-depth knowledge of each and every product, when planning your next retrofit project. Discuss with us what to keep and what to renew, to determine a cost optimized retrofit plan, specifically tailored to your vessel's operation.

Furuno offers an extensive range of navigation and communication products designed and manufactured with excellence in mind. The result is high performance and reliability even under the harshest of conditions.

Our service network is truly global consisting of the many dedicated local Teams, who we cooperate with to accommodate your retrofit project, at your preferred location. All over the world we have arranged retrofits. From single component replacements to full scale projects, including installation and commissioning of a complete and integrated navigation system.

The following pages presents key factors that we believe should form the base of any bridge retrofit project.

1. Define project scope

Use Furuno as your sparring partner to assist your fleet manager in assessing the retrofit plans for each ship. Based on our experience, we optimize the plan to address the specific needs, at the appropriate time.

When the decision for a specific retrofit project is made, the first step is to define the scope. By evaluating the state of the existing solutions; age, technology, availability of spares, changes in rules and regulations etc. one could optimize the life span of the existing installation.

Activities in this phase may include:

- Evaluate the planned lifecycle of the ship
- Define a retrofit concept that will meet future requirements for e.g. safety, reliability, maintenance and cost
- Identify key drivers for replacement of equipment
- Define criticality of systems subject to retrofit
- Identify interfaces to other systems
- Evaluate the need for familiarization and training
- Clarify the acceptable cost frame and timeline for the project

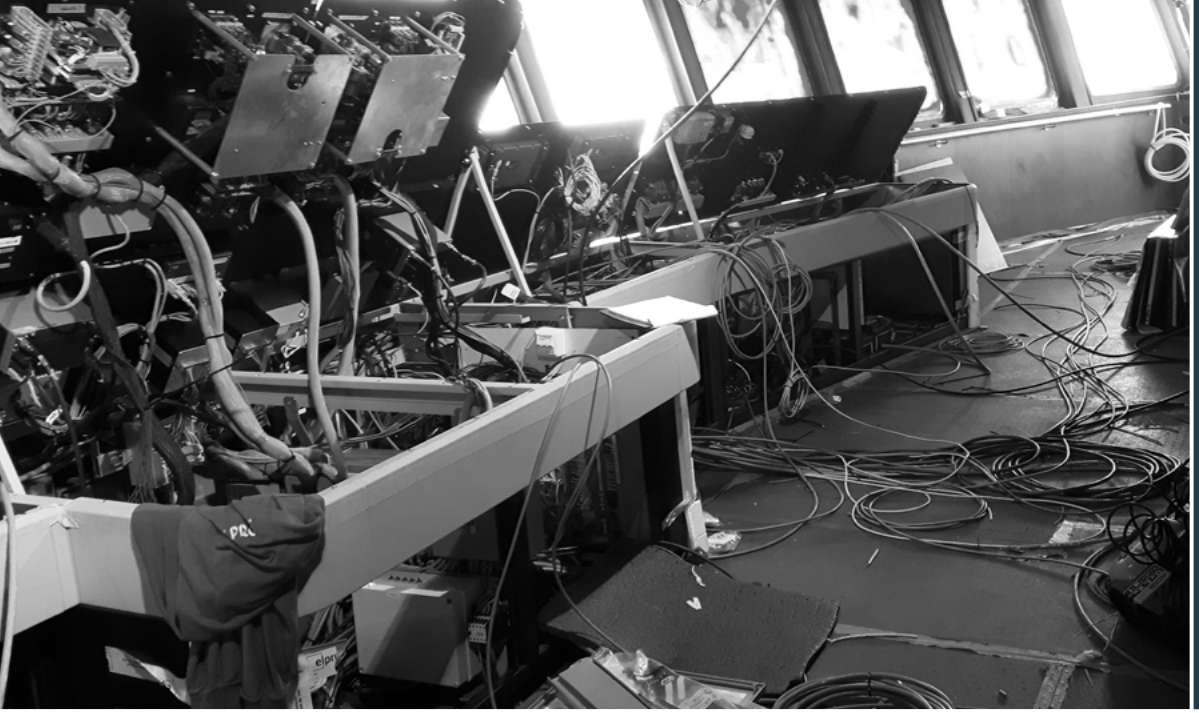
2. Project planning and engineering

When the project scope is settled it is time to prepare the next phases and outline a project plan. This phase is about the detailed planning which will significantly reduce the risk of additional costs and delays during installation, commissioning and sea trial.

Success heavily depends on the ability to stick to the plan during execution. Our experienced engineers will cooperate with your team to identify and avoid all the pitfalls and find the best way forward.

Activities in this phase may include:

- Verify ship's classification society and class notation
- Verify compatibility between existing and retrofit systems
- Evaluate existing bridge console layout and cabling
- Evaluate possibilities and limitations for mechanical work
- Determine the optimal location of equipment, hull units and external antennas, taken into consideration possibilities and limitations for cabling
- For more complex projects, evaluate the need for on-board survey
- Make installation drawings and other required documentation
- Make dry dock specifications in cooperation with vessel manager
- Complete the project plan with milestones for engineering, installation, commissioning, sea trial and documentation
- If the project is not implemented during yard stay, determine location(s) and work window for each job
- Allocate the necessary resources
- Order equipment in due time to obtain lowest possible freight costs



MS Spitsbergen. Bridge retrofit project.

"During installation one can be quite overwhelmed by the many activities going on, all over the place. The noise and the mess and the clock ticking away. You almost start regretting the whole thing..."

"But once again at sea, in due time, with new and modern systems at hand... Well, it was of course all worthwhile!"

3. Equipment delivery and installation

A well performed retrofit project is like a symphony where logistics, engineering and execution aligns with the ship's movement. Delivery of replacement products, port limitations, resource management, access to systems and the necessary work permits, are all subject for careful consideration to ensure completion in line with project milestone dates.

Both the Furuno installation team and our on-shore team will be instructed of the project's scope of work, well in advance. They will be guided by our on-site installation manager who will work closely with your on-site superintendent.

Activities in this phase may include:

- Equipment and accessories to be delivered well ahead of start-up date
- Installation team to arrive at installation site according to owner's instructions. Number of persons needed will depend on the scope of work and available time
- When possible, ship's crew may carry out mechanical work and other preparations ahead of arrival, to reduce time spent at installation site
- Installation team start their work according to agreed plans
- Installation manager reports progress daily to captain and superintendent

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4. Commissioning and sea trial

When installation of products, including hull units, antennas and cables, is completed the commissioning will start. All equipment will be powered up and the ship specific configuration for each system will be checked and verified.

System functionality will normally be verified during sea trial, as many functions need to be tested in a realistic environment and under normal operational conditions. Such tests may reveille the need for tuning or minor corrections. This is normal and the project plan should always allow sufficient time for this, to ensure operational excellency of each system.

Activities in this phase may include:

- Check and verify ship specific system configuration
- Perform harbour test as a pre-qualifier to the sea trial
- Verify system operation during sea trial
- Perform necessary tuning
- Sign acceptance papers

5. Documentation

When commissioning and sea trials are completed the final project documentation, including as-build drawings, are prepared for hand-over to ship owner for final acceptance. When relevant, owner will have to request acceptance by classification society.

In addition to solution and product documentation, retrofit installations may lead to the need for crew familiarization, training, and sometimes new type specific training certificates. This is normally not handled within the scope of the project, but by the relevant departments within the line organization.

When the project documentation is accepted the project is closed.

Activities in this phase may include:

- Complete the as-built drawings and documentation. Typical documentation is single line drawings, system block diagrams, cable termination diagrams, bridge arrangement drawings, outline drawings, equipment manuals, equipment certificates etc.
- Documentation file is handed over to the owner
- Owner request acceptance by classification society, when relevant