

# Modernized Magic

*Transforming a \$7 million project into a \$20 million asset wasn't witchcraft.*



BY PETE BEGLEY

**Foley Material Handling** is setting the new high vision cab in place. Inset photo shows finished crane with new 20-year life.

In medieval times, alchemists and wizards used metaphysical powers to try to change metals into gold. Today's magicians perform optical illusions to pull rabbits from hats and change scarves into white doves. In the lifting world, no amount of magic can transform a \$7 million project into a \$20 million asset. Instead, hard work, vision, planning, and teamwork helped aircraft carrier manufacturer Northrop Grumman Newport News, Newport News, Va., perform this feat.

*Pete Begley has more than 25 years experience in manufacturing and heavy fabrication. His involvement in material-handling engineering provides him with proven, practical expertise regarding productivity, overhead crane maintenance, modernization, and inspection issues.*

One of today's major business challenges is extracting maximum results out of tight capital budgets. Northrop Grumman Newport News is a prime example of how well-managed companies get the most value out of their capital investment. How did they make \$20 million from a modernization project? Let's start from the beginning.

About 27 years ago, the company invested in a 900-metric ton capacity Goliath gantry crane and 200-metric ton capacity Hammerhead crane. These cranes allowed them to handle large ship sections as they built aircraft carriers and other vessels.

The Hammerhead crane's unique design provides flexible, efficient, heavy lifting capacity. It has two trolleys, one with a single 200-metric ton hoist and a second with 120- and 20-metric ton hoists. This crane is 198'6" tall with a

173-foot maximum hook height. Both trolleys are top riding and travel on rails attached to the top of a horizontal, double-girder, counterbalanced boom with about 258 feet of load side length from centerline rotation to the tip. The machinery room and counterbalance extend 72 feet from center rotation on the opposite end of the boom to the trolley travel. The entire boom assembly sits on a rotation ring that permits 360° rotation. The rotation ring is mounted on a tower attached to the top of the gantry base with a 52-foot portal gauge. The majority of loads handled by the crane range from 30 to 120 metric tons.

Modernized a few years ago, the Goliath crane is a valuable asset to the company. Its heavy capacity, long span, and lifting height provides Northrop Grumman Newport News with exceptional capabilities.



View from high vision cab with state-of-the-art controls and overhead screen.

In spite of its unique design and handling ability, using the Hammerhead crane had become questionable. Faced with problematic 80 to 85 percent availability, obsolete technology, intrinsic design issues, and breakdown incidents occurring at critical times, Northrop Grumman management had to make some hard decisions regarding the future of the crane.

It had played a major role in building the Ronald Reagan aircraft carrier and could be extremely valuable in building the George H. Bush aircraft carrier, which is now under construction. Doing nothing wasn't an option: Downtime triggered huge consequential costs. If the crane could not be dependable, it would have to be decommissioned, but the estimated replacement cost was \$20 million to \$25 million.

### The process

Project Manager Brian Jones assembled a task force comprised of all the stakeholders to determine if modernization of the Hammerhead crane was a viable option. Operators, maintenance and engineering staff had equal input in creating a project specification and scope. The same lessons learned during the Goliath crane modernization still held true for the Hammerhead, so budgetary costs were assembled and a study was performed. The results clearly demonstrated modernizing the machine was a cost-effective and feasible option.

Funding submissions were approved, and in April 2002, inquiries were sent out to qualified vendors to initiate the competitive bidding process.

In June 2003, **Foley** Material Handling was selected based on a proposal offering best value. Its extensive track record of successfully modernizing several bridge and portal cranes at the Northrop Grumman Newport News facility, as well as other companies, was

heavily considered. **Foley's** knowledgeable engineering, fabrication, machining, in-house heat treating, and quality control capabilities were very beneficial. In addition, it was familiar with all of the project requirements, as well as Northrop Grumman Newport News operational, safety, and environmental policies and procedures. Once on board, **Foley** Material Handling was integrated into the team.

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**Modernized Magic**

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**Scope of the project**

Northrop Grumman Newport News took full advantage of its in-house capabilities by internally replacing or completely overhauling all mechanical components, including the trolleys, cable drums, sheaves, and gear reducers. Northrop Grumman did not want to spend millions of dollars modernizing the crane only to have it break down during a critical lift because they salvaged the existing wiring. Therefore, the crane was electrically ripped and stripped. Every strand of wire, control, electrical device, and light bulb was removed.

The Hammerhead crane originally employed gantry drives with exposed gearing, which constantly caused problems with dirt and debris getting into the gears. Replacement end trucks were designed, built, and installed as part of **Foley** Material Handling's scope. The new end trucks featured enclosed gearing, modified MCB bearing arrangements with rotating axles, and 24 reliable and easily maintained AC squirrel cage motors. Dual AC-variable frequency controls were provided for the gantry motion. Each system controls 12 of the 24 drive motors (six per side) and is capable of full operation without the other. This redundancy contributes to the reliability and safety objectives of the project.

Existing DC motors for the hoists, trolleys, and swing (slew) motions were replaced with new DC motors. Relay logic was replaced with programmable logic controllers.

**Increased efficiency**

A major project objective was to increase efficiency by taking advantage of new technology. By employing modern controls with a field-weakening feature, the updated crane has enhanced load control and can transport light loads and empty hooks at faster speeds to drastically reduce production-waiting time. The new controls permit simultaneous operation of gantry and hoisting motions, which vastly increased the efficiency of the crane.

Low- and high-speed gearing for the 200-metric ton hoist reducer was completely rebuilt. This unique gearing, combined with the field-weakening feature,



**New drum and gearing made in-house by Northrop Grumman Newport News.**

enabled the crane to lift 200 metric tons at a speed range of 0.2 to 13.5 feet/minute and 75 metric tons at a speed range of 0.6 to 33 feet/minute. Empty hook speeds were lifted at 27 feet/minute in low speed and 66 feet/minute in high speed.

The 120-metric ton hoist can lift rated loads at a range of 0.27 to 13.5 feet/minute. Lighter loads are lifted at speeds up to 27 feet/minute. This hoist also can work in tandem with the 200-metric ton hoist for greater flexibility. The 20-metric ton hoist raises loads between 10 and 20 metric tons at 0 to 45 feet/minute. Loads below 10 metric tons are raised at speeds up to 90 feet/minute. Empty hook speed is up to 135 feet/minute.

**Maintenance considerations**

Other objectives of the project included faster and easier maintenance of the crane. To facilitate this, **Foley** Material Handling built a new control house for the gantry drives and auxiliary electrical devices and installed it between two of the legs near the ground level. This puts the devices closer to the drive and allows easier access for maintenance and inspection. To couple the operator and other devices with the control, a unique fiber optic slip ring was built and installed with redundant channels for increased reliability.

Other significant features include a complete new weighing system for safety and operational functions. Cable trays replaced the old conduit to protect wiring and allow complete access for inspection and repair. Trolley festoon systems were replaced with power tracks. Old rail clamps were replaced with new ones. An automated storm tie-down system for the

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boom replaced the old manual system, and a new communication system to connect the operator with ground and maintenance stations was installed. Replacement components were designed to be robust and meet stringent service factors where practical to meet the crane's critical requirements. Its control system is designed to self-recover from all but the most serious faults. Many parts are interchangeable with the 900-metric ton Goliath crane for reduced parts inventory and maintenance efficiency.

#### Where man meets machine

The new climate-controlled cab is a marvel of efficiency. Operator field of vision is expanded for increased safety and operating efficiency. Operator interface for the daily checklist and operating functions are through multi-direction joysticks and touch screens with redundant capability. Joysticks, two touch screens, and auxiliary functions are mounted in consoles on each side of the operator's chair, which swivels a minimum of 230°. A larger touch screen is mounted on the ceiling in front of the operator. The controls look and feel similar to the 900-metric ton Goliath crane to allow safe, efficient operator interchangeability between the two cranes.

#### On time and under budget

Completed on time and under budget, this crane was restored, put into production in June 2003, and is now securing America by building the George H. Bush aircraft carrier. The new life expectancy of the Hammerhead crane is more than 20 years. Jones attributes the accomplishment mostly to collaboration and cooperation by all the stakeholders. In addition to the input of all affected personnel, it is obvious this successful project stayed on track and accomplished its objectives due to meticulous planning, effective project leadership, and the selection of a responsive, diligent vendor.

The project proves there is no magic to extracting the most value out of capital investment. Well-managed companies achieve it through hard work, vision, teamwork, and planning, which is how this company transformed a \$7 million project into a \$20 million asset. **CW**

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