CDI Business Solutions SM

THE QUARTERLY DIGEST

of CDI Marine Systems Development Division (SDD)
(formerly Band, Lavis & Associates)
900 Ritchie Highway, Severna Park, MD 21146

Volume 30 July 2005

FROM DAVE'S DESK

In this latest issue of our Digest, we have three articles that discuss: (i) our support in **emergency response** preparedness, (ii) the recent testing of our innovative advanced marine **waterjet propulsion** pumps, and (iii) our unique capabilities in assessing the **cost & benefits** of technology options for high-speed ships. These are just a few of the diverse capabilities that we and our parent company are continually improving and expanding to offer to our clients worldwide.

As I hope most of you are aware, we are now known as the **CDI Marine Systems Development Division, CDIM-SDD**, (formerly **Band, Lavis & Associates)** with a 28-year commitment to and **Tradition of Excellence** in Advanced Marine Technology. We operate as a division within the **CDI Government Services (CDI-GS)** Group which, in turn, is a business unit within **CDI Business Solutions**, a division of **CDI Corp**, that employs a cadre of over **8500 engineers and technicians** serving the **marine, aerospace, pharmaceutical, petrochemical and industrial markets worldwide**.

Our parent company, **CDI Corp (CDI)**, is one of the nation's largest engineering and technical services firms. Headquartered in Philadelphia, PA since its founding in 1950, **CDI** is traded on the New York Stock Exchange and has more than 17,000 employees worldwide with annual revenues over $1 billion.

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"THIS IS A DRILL"
By Dan Bagnell, Director of Naval Architecture

Recently, CDI Marine Systems Development Division (CDIM-SDD) participated in a planned exercise by Tyco Telecommunications, one of the world's leading suppliers of undersea fiber optic networks and marine services, to exercise their emergency response system for their cable laying ships. The exercise assumed one of the Tyco Telecommunications cable ships had experienced an explosion which was the result of a terrorist attack. A temporary "war room" was quickly established and a team of key individuals from Tyco Telecommunications was assembled to assess the situation and prepare contingency plans. CDIM-SDD personnel were part of this team providing independent naval architectural support and advice.

While this team was being assembled, the crew of the ship, which was actually moored just outside of the war room, started calling in situation reports on the extent of damage and the procedures being taken onboard. In addition, since the exercise simulated a terrorist attack, local law enforcement personnel brought in dogs to check the building, parking lot and other ships in port for other possible explosive devices. This was actually a coordinated effort with a training exercise by local law enforcement personnel and their team of dogs. Also, to add a further sense of reality to the situation, one member of Tyco Telecommunications' staff had arranged for his wife to call in pretending to be the distraught wife of a crewman.

Throughout this exercise, CDIM-SDD personnel worked with the Tyco Telecommunications staff to assess the stability and structural integrity of the vessel and to determine what collateral damage might have occurred. This exercise marks the beginning of a support effort that CDIM-SDD will be providing to Tyco Telecommunications on a 24/7 basis, hoping that we will only ever have to deal with "This is a drill" and not "This is not a drill!"

Tyco C/S DURABLE

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FROM DAVE'S DESK, continued from page 1

CDI-GS is composed of (i) the CDI Marine **Ship Design** Division **(CDIM-SD)**, (ii) the **M&T Company**, which provides **Naval Aviation Engineering**-related support, and (iii) ourselves **(CDIM-SDD)**, providing focus mostly on **RDT&E**. Together, this group of three divisions is one of the largest marine design groups in the USA and provides to industry and government sectors a very wide range of services ranging from detail design & CAD drafting support for Gulf Coast, Mid-Atlantic & West Coast shipyards, to advanced computational hydrodynamics, prototyping, RDT&E, ship acquisition support, light manufacturing, Alteration-Installation Team (AIT) and combat, and systems engineering services covering virtually all of the functional areas required of naval and commercial ship life-cycle support. For specialty disciplines not covered by our current staff, we call upon a cadre of highly regarded subcontractors, or consultants, as required.

CDIM-SDD has provided **RDT&E**, engineering, and programmatic support to many **USN, USCG**, and **commercial clients**, spanning the range from early-stage feasibility studies (at the component, system, whole-ship and force level), through sub-system and system engineering development and test, to Fleet introduction and support for ships, boats, craft and other marine systems. We have provided significant innovative design and development support to critical non-marine related **Homeland Defense** efforts as well.

Building on this experience, **CDIM-SDD** is involved today in providing these kinds of technical, programmatic and engineering services to fast craft programs overseas and to numerous mature and newly emerging, high-profile, U.S. Government programs such as **LCAC, LCAC(X), LCS, JHSV, DD(X), AOE(X), MPF(F)**, and the new **USCG DeepWater and Homeland Security Craft** programs. CDIM-SDD also plays a significant role in supporting current RDT&E for the Office of Naval Research **(ONR)** and the Naval Surface Warfare Centers **(NSWC)** at Carderock, MD, Suffolk, VA, and Panama City, FL.

We are excited by the significant contributions that we make to these and other programs around the world. We do this by continuing to adapt and evolve our services to better meet the ever-changing needs of our customers.

CAVITATION TESTING OF AN ADVANCED AXIAL-FLOW WATERJET PUMP MODEL
By John Purnell, Senior Engineer

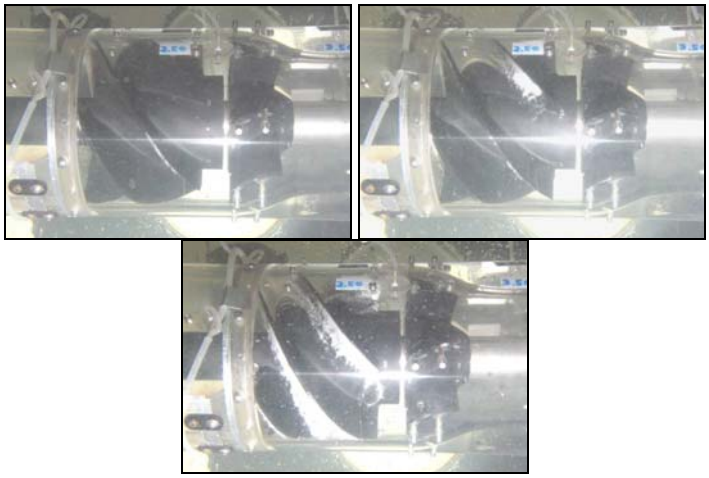
CDIM-SDD has been involved in development of advanced axial-flow waterjet pumps for high-speed ships for more than fifteen years. Most recently, under sponsorship from the Center for Commercial Deployment of Transportation Technologies (CCDoTT) and the Office of Naval Research (ONR), we have focused on high-power advanced compact waterjet systems for both military and commercial applications involving very high ship speeds.

The axial-flow pumps that CDIM-SDD has been developing offer significant weight savings over present commercially available waterjet systems which rely on mixed-flow impeller technology. CDIM-SDD's axial-flow pumps are lighter and have smaller diameters than comparable commercially available waterjet systems. CDIM-SDD's more slender systems are less difficult to install in the weight-sensitive, high length-to-beam slender hulls that are favored for high-speed ship applications.

CDIM-SDD's axial-flow pumps also operate at higher rotational speeds than commercial mixed-flow waterjets. A smaller pump, running at a comparatively higher rpm, reduces not only the pump weight, but also offers significant synergistic benefits from lighter weight machinery systems.

However, the benefits of higher rotational speed also introduce the specter of cavitation inception and performance degradation. To specifically address this phenomenon, a critical portion of the CDIM-SDD current effort for CCDoTT involves cavitation testing of a model of a large axial-flow waterjet pump. CDIM-SDD's advanced axial-flow waterjet pump was recently water tunnel tested in the 24-inch water tunnel at the Naval Surface Warfare Center, Carderock Division (NSWCCD).

In general, in conducting cavitation testing, the tunnel pressure was incrementally reduced for a given flow rate and constant pump rpm. Reducing tunnel pressure lowers the Net Positive Suction Head (NPSH) in front of the pump face. NPSH is the total pressure in front of the pump face *less* the local vapor pressure. As NPSH is reduced, the pump will inevitably begin to cavitate. Further reduction in NPSH drives the pump toward Cavitation Breakdown, and, if continued, the pump no longer is able to maintain its design headrise. Cavitation Breakdown is typically defined as a decrease in pump design headrise of 3% (or more).



Cavitation Runs at 2000 rpm with NPSH Reducing from Left to Right and Top to Bottom Photo

The photos on page 2 were taken from our recent tests at NSWCCD. They show the build-up of cavitation in the pump as the tunnel pressure is reduced incrementally. The top left photo was taken at the pump's design NPSH and shows almost no cavitation. The cavitation evident in the bottom photo is occurring well below the pump's design NPSH. This cavitation is tip leakage cavitation (or sometimes called backflow cavitation) where the pressure difference between the pressure and suction side of the blade is such that acceleration of flow through the small tip gap reduces the static local pressure below vapor pressure.

These results, and other related data, are presently being reviewed and codified to confidently establish the cavitation performance of a full-scale axial-flow waterjet design.

THE COST & BENEFIT OF TECHNOLOGY OPTIONS FOR HIGH-SPEED SHIPS
By Drew Eisele, Naval Architect

Every new ship acquisition program is faced with the challenge of determining how to provide the operator the needed mission capabilities within the limits of budgetary pressures. A key element of this process is the desire to play "what if" games very early in the evolution of the program. Well designed trade studies and "what if" games not only address mission requirements, but also attempt to determine what technologies are necessary and available to support the desired mission within the state of technology and within budget.

CDIM-SDD has long been an industry leader in the evaluation of the impacts of varying operational requirements and sub-system technology options on the acquisition and life-cycle costs of advanced ship solutions. With the emerging industry focus on smaller, high-speed vessels, and renewed interest in the exploration of alternative hullforms, materials and propulsion systems, the need for CDIM-SDD's unique capabilities has never been greater.

Relying on the speed and technical accuracy of our well-established design synthesis modeling tool, PASS™, CDIM-SDD engineers are able to rapidly explore the solution space for a multitude of design options to arrive at a set of parameters representing the most cost-effective variant based on each customer's unique requirements (see sample Figures 1 through 3).

Furthermore, using the PASS™ physics-based synthesis engine, our engineers are able to quickly and accurately explore out-of-the-box and quantify the impact of technology insertion on both performance and cost (see sample Figure 4). More detailed operational parameters and design discriminators, such as seakeeping performance, are also commonly introduced into CDIM-SDD parametric studies through file translators and interfaces with several industry-standard stand-alone motion prediction programs and codes (see sample Figure 5).

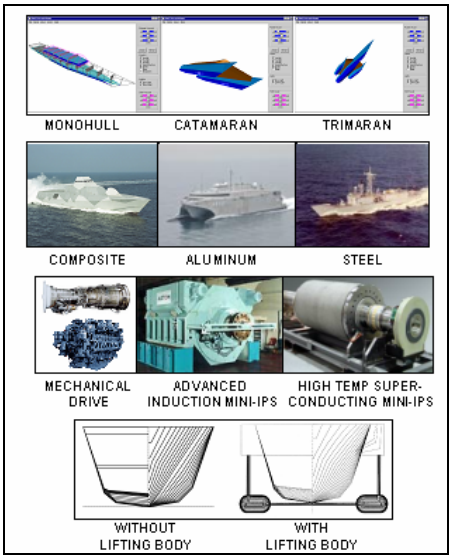


Figure 1. Technology Matrix from a Recent CDIM-SDD Parametric Study

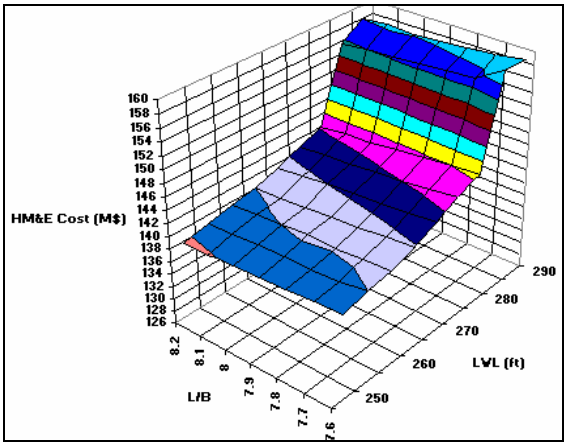


Figure 2. PASS™-Generated Solution Space for a Representative Design

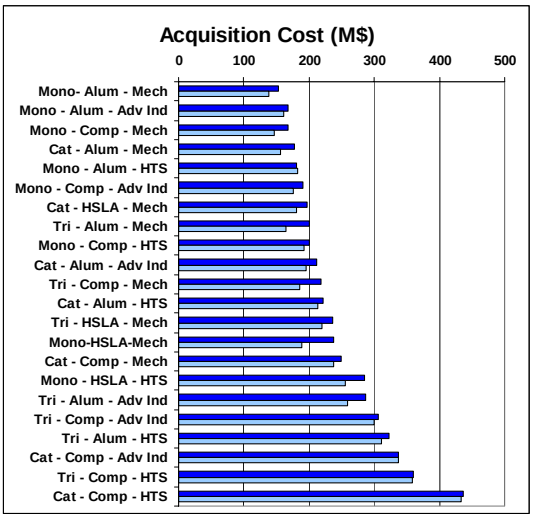


Figure 3. Relative Acquisition Cost

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THE COST & BENEFIT OF TECHNOLOGY OPTIONS FOR HIGH-SPEED SHIPS, Continued from page 3

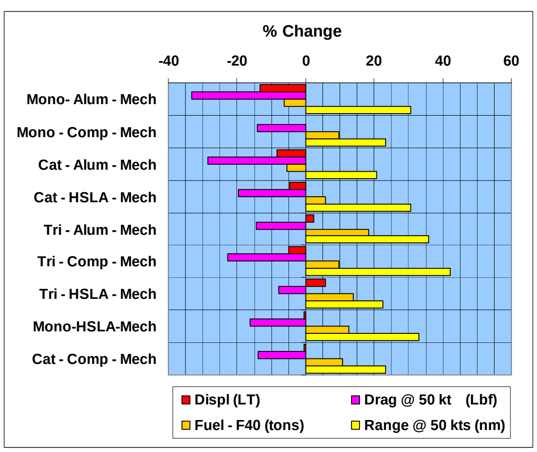

Figure 4. Impact of Lift-Assist on Key Operational Parameters

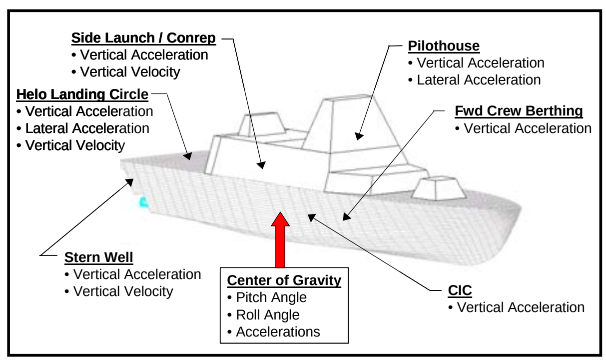

Figure 5. Typical Seakeeping Discriminators

This proven ability to explore wide-ranging design options and sub-system technologies under the umbrella of a single, rapidly executable program architecture relying on first-principle physics (as opposed to historical data) places CDIM-SDD in a unique position to provide program and acquisition managers with a wealth of technical data at the earliest stages of the design spiral. Armed with this information, effective decisions regarding the highly sensitive balance between budget and capability can be made and supported.