Data-Driven Logistics

Transforming logistics from exploitable vulnerability to lethal competitive advantage

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Gunny Ellis jerked awake. It was 0348, and her wrist comms were buzzing. It was a priority message from higher headquarters that bypassed her do-not-disturb setting. "Seriously?" She murmured, as she clawed her way to the surface. OpTempo was high, and her team worked late into the night all week. Today was supposed to be a recovery day. She quickly flicked her left wrist over to activate the projection screen function on her wrist comms to see what the issue was. Blinking several times to remove the sleep from her eyes, she read the encrypted email message projected onto the inside of her forearm. For the hundredth time this week, she was thankful for that mobile server stack in the truck that was about the size of a 1.5 cubic foot dorm room fridge.

As she read the message, the rest of the sleep cobwebs were swept away. An unscheduled mission—a big one—and they had less time than usual to prepare. She eagerly sat up in her cot and ran through a quick mental checklist of all the things they needed. This is what they had trained for, and why they were stationed in this remote area far away from any other unit. With the mission at hand, she knew her team needed several key things that could not wait until the unmanned submersible arrived at the dock next week with their scheduled resupply. They had alot of prep to do. Throwing on her boots, she stepped out.

After she instructed Sgt Meyer to get the team moving and checked in with Capt Velazquez, who had also received the message and was doing his mission prep, she set about getting ready. They had most of what they needed (and very little extra), as the predictive algorithms they used for planning were quite accurate, and the automated push-resupplies based on their LOGSTAT reports (an automated report generated from their on-hand inventories using a network of sensors) had been right on time. However, with their heavier than anticipated OpTempo, combined with the nature of this upcoming mission, they were going to be short infrared chem lights, batteries, energy cells, and some other critical items. They also could not wait on the scheduled delivery of that repair part for the truck. She needed to order them now, and the supplies and parts needed to be on hand within the next several hours. Their 3D printers could solve some of their shortage issues, but not all of them. Once again flicking her wrist to activate the projection screen, she swiped left on her forearm until she reached the rapid resupply screen. After a few drop down menus and swipes, she selected the items she needed, added in the location and requested time, and hit submit. Within seconds, she received a notification that the order was received. The message contained a link that she could activate and track the status.

One-hundred-twenty nautical miles away in the South Pacific, an unmanned cargo vessel sprang into action. These ships were relatively small. While they could not carry huge volumes, there were many of them spread all across the Pacific, and they had low signatures to make them less visible. Their large numbers meant they could easily be replaced should an incident occur. Back in the States, the supply chain designers and planners used modeling and simulation software to design the distribution network and optimize their inventory nodes (of which this ship was one). Using the enormous amounts of data that the planners and data scientists had access to, they built a number of models and used discreet event simulations to predict needs for a number of different scenarios with a high degree of accuracy.

Having received Gunny Ellis' order, the rails and robot arms in the cargo hold whizzed and whirred in dizzying motion. The robotic arms picked out

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the items ordered and dropped them into the small shipping container. Closed and sealed, the box whooshed away on the conveyer belt to the loading area, where more robotic arms attached it to the medium-sized electric cargo drone. Another robot, this one on wheels, pushed the cargo drone out of the hangar to the small flight deck, where it launched into the night sky. Gunny Ellis looked at her forearm again as it buzzed with a notification. The cargo drone was inbound. "Reminds me of my pizza delivery status notifications back home," she thought wryly.

In its current state, the Marine Corps logistics enterprise represents an industrial era model built around mass and brute force. Indeed, the *Marine Corps Operating Concept* (MOC) makes this abundantly clear when it states, "We cannot meet the demands of an agile, distributed 21st century MAGTF with a 20th century approach to logistics."[1] In truth, the Marine Corps has been able to accept risk in modernizing logistics to keep pace with modern technology and industry because we have enjoyed maritime and air superiority—even supremacy—and robust fixed bases that took months to build and enormous resources to maintain. While the Marine Corps achieved many great successes with this model in past and recent conflicts, the logistics enterprise certainly is not optimized to support the type of operations or the operational environments described in the National Defense Strategy or the MOC. The MOC states the need to:

> [Redesign] our logistics to support distributable forces across a dynamic and fully contested battlespace–*because iron mountains of supply and lakes of liquid fuel are liabilities and not supportive of maneuver warfare.*[2]

Littoral Operations in the Contested Environment (LOCE) and Expeditionary Advanced Base Operations (EABO) require an agile, flexible, and responsive logistics enterprise that generates MAGTF lethality. In fact, senior leadership noted that in this environment, logistics is the Marine Corps' pacing function—and our legacy configuration—is no longer sufficient. *We must transform our logistics enterprise from an exploitable vulnerability to a lethal competitive advantage.*

Configuring our logistics enterprise with new and advanced distribution capabilities, the ability to integrate diverse sources of supply with global visibility and awareness demands a modern, information age construct. It demands data-driven logistics (D2L). Fully realizing D2L, however, will not be easy. This is not simply a matter of developing and acquiring "wrist comms," deployable server stacks, cargo drones, robotic floating warehouses, and other modern tech gear. Achieving the underlying data infrastructure to allow for the precise planning, agile decisions, and predictive analytics required to accomplish this will require an immediate, comprehensive, and *executable* roadmap. We must rapidly identify required actions the Service must pursue *now*, while informing future capability development and resourcing decisions.

To meet this challenge, one small team of "logistician insurgents" (of which there are many), have proposed a method to build a rapid, detailed, and executable pathway to this digital transformation. This proposal was submitted to the 3rd Annual Logistics Innovation Challenge and the CMC 1st Quarter FY19 Innovation Challenge. While this article is being written, results of those challenges are pending.

The Proposal

We propose conducting a twelve-month D2L experiment focusing on capability development, organizational structure, and culture. The experimentation force will consist of specialized cells within MLGs (Marine Logistics Groups) that will experiment with data (collection, analysis, visualization, decision support) to tangibly *demonstrate* capabilities, limitations, and requirements of D2L. Specifically, these cells will seek to collect, access, and analyze data; produce actionable insights with clear visualizations; and answer questions or solve problems to enable decisions of their host MLG (or, in fact, host MAGTF). (See Figure 1.) In so doing, the experimentation force will outline the roadmap to achieve a true D2L capability that will project MAGTF lethality. This proposal is unique in that it seeks to address the root of the issue—organize, train, and equip—rather than attacking a niche capability.

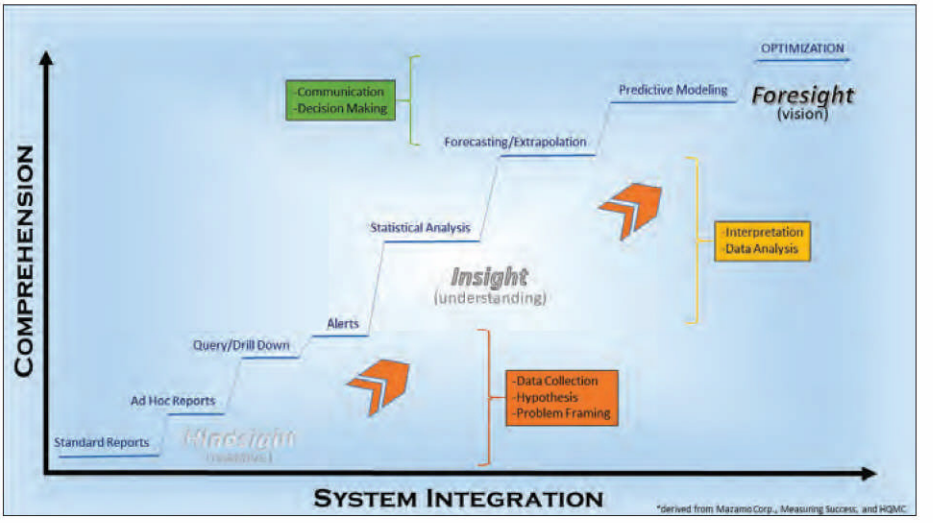

Figure 1. *(Image provided by author.)*

Background and Thesis

What do we really mean by D2L, and what can it actually *accomplish* for logisticians, leaders, decision makers, and commanders? In other words, how do we *operationalize* D2L? Rather than chasing the latest techy gadgets or gear, this submission seeks to help the Marine Corps answer this critically important question. *To put D2L into practice, we*

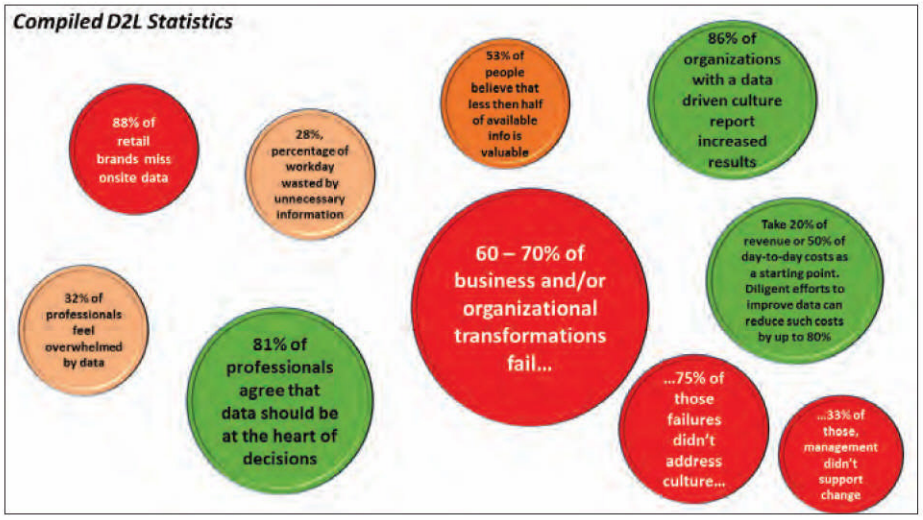

Figure 2. *(Image provided by author.)*

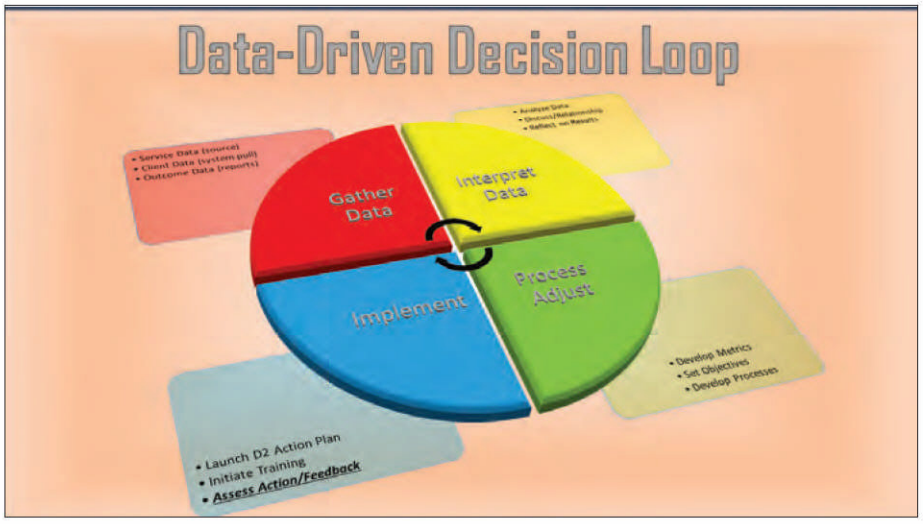

Figure 3. *(Image provided by author.)*

Figure 4. *(Image provided by author.)*

must build the organizational and technical infrastructure to execute it: manpower and structure, roles and responsibilities, hardware and software. The best sensors, gadgets, and information technology systems in the world will not turn the Marine Corps logistics enterprise into a data-driven, information-based organization if we are still organized and trained as an industrial era force. In other words, *we cannot buy a materiel solution for an organizational and cultural problem.* (See Figure 2.)

D2L

At its core, D2L is about decision making. We need the ability to rapidly and consistently make hyper-informed, accurate decisions resulting in better outcomes that are measurable, less manpower intensive, and cheaper. We need capable decentralized decision making with greater accountability while providing leaders greater transparency on causality of outcomes. We need feedback loops for ongoing measurement and improvement. (See Figure 3.) We need our leaders to focus their time and effort on those *qualitative* decisions that require their experience whilst alleviating the burden of the *quantitative* decisions that can easily be handled (or even automated) with math, algorithms, and data. Ultimately, we need to compensate for a declining technological advantage (which must of course still be addressed) by creating an *intellectual* advantage over our adversary—the ability to out-cycle his decisions, use our logistics speed and agility to generate tempo, enhance the MAGTF's lethality and keep the adversary unbalanced and uncertain. All of these advantages are within our realm of capabilities, but the only question is how will we leverage them? That is where our proposal comes in.

Experimentation Force Actions

Each experimentation cell supports the MLG to which it is assigned, while maintaining connections with the other cells and a central coordinating body at HQMC. While each cell will naturally adjust to its host's priorities, key topics to analyze include supply chain, readiness metrics, fiscal metrics, and

manpower. These topics represent key opportunities because of high volumes of associated data and the ways in which analysis can drive decisions. (See Figure 4.)

The experimentation cells will meet for plenary sessions three times during the experiment—at kickoff (level-setting, senior leader guidance, and portions of the training), at mid-year (cross-talk and in-progress reviews for senior leaders), and at the conclusion (out briefs, findings, and after-action reports). They should also stay connected throughout the year to share ideas and collaborate on D2L strategy development. Throughout the year the cells will educate and provide experiment feedback at key advocacy forums (Logistics Consolidated Operational Advisory Group, MAGTF Logistics Board, Installations and Logistics Board). To enhance the learning experience and output quality, the cells will conduct limited engagements with select academic and industry leaders. Additionally, while at home station the cells will provide education to leaders throughout their respective MEFs on the D2L concept, the experiment, its expected outputs, and the cell's capabilities (e.g., a roadshow; likely midway through). This could include conducting targeted analysis for other elements of the MAGTF as part of the learning experience. Finally, because of the broad implications and desired results (D2L roadmap), the cell will need tie-ins (via the Deputy Commandant Installations & Logistics project sponsor) with other staff elements and senior leaders in Training and Education Command and the Deputy Commandants.

In addition to the analytic and decision support the cells provide, each cell will also record the challenges they face and their requirements in terms of hardware, software, facilities, authorities, access, roles and responsibilities, data quality, etc. For example, a cell attempting to conduct maintenance analysis based on GCSS-MC data could be hampered by improperly entered serial numbers, mileage that reads 123,456 or 0,000, or other similar issues from manually entered data. Through such findings, a cell could recommend corrective actions (procedural, structural, or technical) to improve the quality of the data to which they have access and the subsequent analysis that comes from it.

Experimentation Force Structure

Establish cells in three of the four MLGs (leaving one to serve as a control group), Marine Corps Logistics Command, and HQMC I&L. Each cell should be composed slightly differently to allow for diversity in results. The disparate requirements and distributed laydown of Marine Forces Reserve, as well as the diverse experience base of Reserve Marines, make 4th MLG a critical participant in the experiment. Cell size should vary between six and fifteen people, with a mix of Marines and civilians. While core data science capability (the PhDs) is likely more appropriately consolidated at HQMC in general support, minimum expertise requirements within each cell should include:

- Data engineer.
- Systems engineer.
- Software designer.
- Trained analysts, such as Marines who graduated from Naval Postgraduate School with specialties in operations research, systems analysis, or logistics and materiel management.

The remaining cell membership links the core analytic expertise with functional/tactical knowledge and experience. A mix of officer and enlisted Marines should be carefully chosen from among logisticians, maintainers, suppliers, engineers, and administrators. Forming this cell may prove among the most difficult aspect of the experiment because of already strained manpower; thus, sourcing solutions may differ by MLG but could also include tapping into existing resources such as the Logistics Systems Coordination Offices, Materiel Readiness Training Centers, or various innovation cells.

The cells should also be paired with an industry and/or academic mentor to help guide their actions (e.g., UNC-Chapel Hill Institute for Defense & Business; leading industry experts). Lastly, the cell will need to be tied in with an experiment sponsor within DC I&L to monitor progress and provide enterprise-level guidance. However, it must be clear that the cells are independent and work for the host MLG. (See Figure 5.)

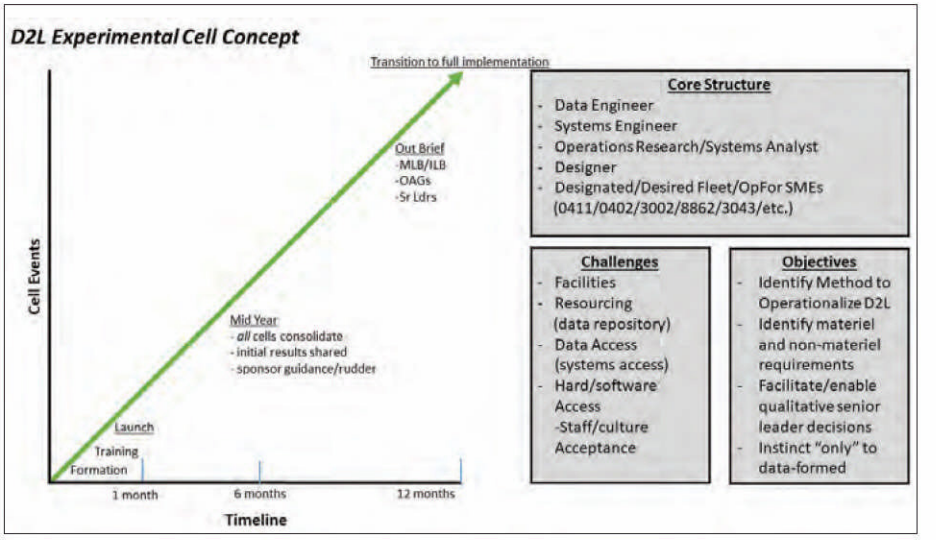

Figure 5. *(Image provided by author.)*

Experimentation Force Requirements

The following minimum requirements are required for the experimentation force:

- Facilities: A place to work.
- Computers and other hardware.
- Software tools (analytics, visualization tools, etc.).
- Access to Marine Corps data.

The Marine Corps must effectively realize D2L capabilities and benefits. *(Photo by LCpl A.J. Van Fredenberg.)*

- Training on software, basic analytics, and relevant systems and tools.
- Travel funds for various engagements.
- Senior leader access.

Experiment Outputs

This experiment seeks to identify a "roadmap" for operationalizing D2L. The cells will help the Service to understand materiel and non-materiel requirements, propose solutions, and identify actions the enterprise could take to effectively realize D2L capabilities and benefits. Furthermore, by enabling real data-driven decisions and actions, the experimentation force will help leaders understand the realm of the possible and begin to address the cultural challenges that inhibit progress. Gaining the support of tactical commanders and senior leaders in the Operating Forces by demonstrating real results is critical to enabling the cultural shift away from "intuition-driven logistics" and toward data-driven logistics.

During the experiment, the cells will encounter obstacles, identify opportunities, and discover organizational infrastructure requirements that will span the entire doctrine, organization, training, material, leadership, personnel, and facilities spectrum. Some questions to inform the roadmap development include:

- Effects on the organization: How did the experimenters affect MLG business practices and decision making?
- Staff organization: What permanent positions and/or offices are needed? How many? Where do they fit on organization charts? What are appropriate roles for contractors and civilians?
- Training and education: What tasks should be written in the training and readiness manuals by MOS, that will drive formal school curricula? What education should be pursued? What training is needed in the operating forces, and how should it be conducted?
- Hardware and software: What are the materiel requirements?
- Leadership roles and responsibilities: What is appropriate and/or required? How do we attack data quality and data governance?
- MOS skills: Do some MOSs need to be reviewed for relevance, or remade into new functions to implement D2L (readiness analysts, supply chain analysts, etc.)?
- Physical infrastructure: What is required? How do we actually collect the data, where do we store it, what are the access requirements?

In summary, while strategic documents such as the National Defense Strategy and the MOC make it abundantly clear that the Marine Corps logistics enterprise must transform, such a large transformation requires a holistic plan. Certainly, the enterprise should not wait to take those discreet actions that are already known (cloud migration, data storage, and access, etc.), but a comprehensive approach must be developed to steer the large, bureaucratic machine that is tailor-made to continue on with the status quo. This proposal seeks to provide the Marine Corps a way to develop that roadmap in a reasonably responsive timeframe. To quote our Secretary of Defense, this proposal represents our efforts to "pursue urgent change at significant scale."[3] It is past time to move out.

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Notes

1. Headquarters Marine Corps, *Marine Corps Operating Concept*, (Washington, DC: September 2016).

2. Ibid.

3. Department of Defense. *Summary of the 2018 National Defense Strategy of the United States of America*, (Washington, DC: 2018).