Foreword

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After its people the single most valuable asset of any organization is information, and the effective utilization of that information is critical to quality, innovation, competitiveness, and even corporate survival. Although manufacturers currently enjoy a panoply of innovative products from a variety of vendors, these benefits are accompanied by information exchange incompatibilities, which come with costs such as missed opportunities, product quality shortcomings, data translation costs, data quality problems, and unnecessary software license and training fees. Data exchange problems hamper effective information utilization. The technical term for the effective utilization of information is *interoperability*.[1] In summary, manufacturers would like to achieve interoperability, while avoiding unnecessary costs and while still exploiting the broad array of product options. But is this possible, and if so, how?

We'll begin with how manufacturers currently pursue interoperability: the translation approach, the single vendor mandate approach, and the information exchange standards[2] mandate approach.

In the translation approach, a manufacturer chooses to use systems and components from multiple vendors to support the enterprise. To achieve interoperability, data translators (from one proprietary format to another) must be built and maintained.

In the single vendor mandate approach, a manufacturer mandates a single vendor's product line throughout the enterprise. As long as the mandate is fully implemented (not always possible), interoperability is achieved at the manufacturer's plants. However, since the manufacturer's suppliers also provide products and services to other manufacturers, who commonly mandate products from competing vendors, the suppliers will suffer a variety of interoperability costs, such as data translation, the payment of unnecessary fees, training fees, and fixing data quality errors. These costs are passed on to the manufacturer in the form of increased fees for products and services from the supplier. The manufacturer also experiences loss of agility and higher product and component costs due to its commitment to the single vendor. Furthermore, when the manufacturer experiences a merger or acquisition (a common experience), massive and sudden retraining and translation are commonly required to achieve interoperability between the incompatible software systems of the newly merged organizations.

In the information exchange standards mandate approach, a manufacturer chooses to use systems and components from multiple vendor to support the enterprise, but only if vendor products demonstrably exchange information in specified standard (non-proprietary) formats. To achieve interoperability, standards for the information used by the manufacturer must exist and be implemented by the manufacturer, its suppliers, and its system vendors.

Manufacturers achieve interoperability through some blend of these three paths. The information exchange standards mandate option offers both freedom of choice and no translation requirement. It appears that the standards approach might be the path to interoperability that is the most cost-effective while still maintaining freedom of product choice. For this path to be available, however, manufacturers, suppliers, and system vendors must support standards development efforts.

Close examination of the costs suffered under a proprietary-based data exchange environment reveals that having a single standard for each data interface would eliminate a multitude of costs and risks unique to the other two options[3]. Furthermore, it is plainly cheaper to develop and maintain one standard versus

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[1] *Interoperability* is the successful performance of required tasks by two or more agents requiring the exchange of information.

[2] An *information exchange standard* is a common (non-proprietary) language constraining the information transferred between activities performed by devices, software, or humans, whose goal is to enable effective encoding and decoding of information to successfully perform required tasks.

[3] Horst, J., Hartman, N., Wong, G., "Metrics for the Cost of Proprietary Information Exchange Languages in Intelligent Systems," PerMIS'10, September 28-30, 2010, Baltimore, MD, USA.

developing and maintaining a large number of proprietary formats for the same underlying information[4], as long as all product vendors worldwide adopt and comply with the standard. The latter is achieved when a critical mass of manufacturers mandates the standard, and the standard continues to meet the changing needs of all these manufacturers.

Having a language standard adopted by vendors worldwide does not ensure that the language will be encoded and decoded correctly, so the standards-based path must (and commonly does) include conformance and certification definitions and requirements.

Therefore, we conclude that standards-based path to interoperability is the optimal one from a standpoint of information quality, cost, risk, and a host of other reasons. A common objection at this point is: Don't information exchange standards constrain product innovation? Constraining the language used between tools supporting dimensional metrology activities does not constrain innovation in those activities or innovation in the design of those tools, as long as the interface standard is expeditiously maintained and well-supported by a broad range of manufacturers. However, admittedly, this is a consummation devoutly to be wished, but alas, rarely evidenced in reality.

This line of reasoning establishes that information critical to accomplish dimensional metrology activities can and should be defined by the industry in standard formats (*i.e.*, languages), as long as the standards keep up with information definition needs required by the steady stream of new product innovations. To the degree that these requirements are satisfied, the entire industry can provide products that are less expensive, more innovative, feature-rich, and of higher quality. Arguably, this will grow the market for all players (user, supplier, and vendor), benefitting all.

So, why aren't information exchange standards more widely developed and mandated? The answer to this would require another essay, however, the two top reasons are 1) the dearth of support for information exchange standards by manufacturers, and 2) the natural resistance of solution providers, particularly the large ones, to information exchange standards, due in part to concern about loss of market share.

Happily, there have been significant information exchange standards successes in the dimensional metrology sector. Dimensional metrology information exchange standards have been developed and implemented since the early 1980's. These standards are described in some detail in this book, but here is a brief summary of key successes and new standards ventures, starting with the first standard dimensional metrology programming language, the Dimensional Measuring Interface Standard (DMIS). DMIS has had broad market penetration and, for those manufacturers who have mandated DMIS enterprise-wide, savings have been substantial.

Starting in the early 2000's, the Inspection Plus-Plus (I++) Group of European automotive manufacturers generated, and currently maintain, a widely adopted open specification called the I++ DME (Dimensional Measurement Equipment) Interface, which defines commands from a dimensional metrology program execution module to a coordinate measuring machine controller. As with DMIS, manufacturers who have mandated I++ DME enterprise-wide have enjoyed substantial savings.

Building on these successes and lessons learned, the Dimensional Metrology Standards Consortium (DMSC), which is currently the official DMIS development organization, has recently introduced a holistic approach to dimensional metrology information exchange standards development, called the Quality Information Framework (QIF).

The importance of improving and maintaining the quality of manufactured goods can hardly be overemphasized. Ours is a litigious age with an instantaneously worldwide news cycle, within which a company can be ruined in a moment over a single product defect. Dimensional metrology is essential for ensuring product quality, and improving product quality, in a way that is cost-effective, timely, and error-free, is therefore of great value.

Dimensional metrology solutions providers, manufacturers, and suppliers are encouraged to join in the exciting and rewarding work of information exchange standards research and development.

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[4] Horst, J., "Reduce Costs and Increase Quality with Information Exchange Standards for Manufacturing Quality," CMM Quarterly, Sept. 4, 2009, www.cmmquarterly.com, Special DMSC Edition.