Apparel Product Data Exchange Standard

Y. Tina Lee

Factory Automation Systems Division
Manufacturing Engineering Laboratory
National Institute of Standards and Technology
Gaithersburg, MD 20899

ABSTRACT

The apparel industry is increasingly reliant on computer technologies to support activities throughout the product life cycle. As computers become more widely used in design, pattern making, grading, and automated manufacturing, the industry is becoming more aware of the potential benefits of exchanging information electronically. A standard for communication among different CAD/CAM systems is also becoming a very important issue. The Standard for the Exchange of Product Model Data (STEP) is an emerging international standard, the result of an effort to develop a mechanism for digitally representing the physical and functional characteristics of a product throughout a product's life cycle. In recent years, the National Institute of Standards and Technology (NIST), under the Defense Logistics Agency's sponsorship, has been working on extending STEP to include apparel product data to support computer integration of the apparel life cycle. The work is continuing to be carried out with support from, and in cooperation with, standards organizations, the apparel manufacturing industry, and academia. NIST recently proposed to the American Apparel Manufacturers Association (AAMA) that they establish a task group to develop formal application protocols as extensions to STEP for apparel. The AAMA has agreed to this proposal. This paper describes the proposed activities.

KEY WORDS

APDES; apparel; apparel PDES; application protocols; CIM; pattern; PDES; product data; product data exchange; STEP

INTRODUCTION

The apparel industry is in a transition from a labor-intensive, manually operated technology base to a more competitive computer technology base. Apparel companies are using an increasingly larger number of computer systems in all phases of design, analysis, manufacture, and support of their products. This increasing role of computer systems in manufacturing, logistic support and system integration is leading to a greater need for standards. The apparel industry, through the American Apparel Manufacturers Association (AAMA), has recognized the importance of computer-integrated manufacturing (CIM) and has started to develop standards in this area.

The objective of the CIM Subcommittee of the AAMA Apparel Research Committee, (formerly the CIM Committee or CIM/COM), is to promote the utilization of CIM concepts in the apparel industry through the development and establishment of standards and protocols. Over the last several years, the CIM Subcommittee has accomplished several tasks, such as the establishment of a standard for numerically controlled (N/C) fabric cutting machines, the recommendation of a standard for a CIM network protocol, and the development of a pattern data exchange standard. Currently, there are six task groups for standards development within the CIM Subcommittee: CIM Architecture, Cutter, Pattern Data Interchange, Spreading, N/C Stitching, and Education/Publication.

In November, 1989, the CIM/COM asked the University of Southwestern Louisiana (USL) and the National Institute of Standards and Technology (NIST) to recommend a strategy for developing a neutral data format for the representation and exchange of pattern piece data. The resulting report [1] recommended a two-phase approach. The initial effort would be to develop a standard based on some file format already in widespread use. The report recommended using the popular DXF format defined by AutoDesk, Inc[1]. For the second phase of work, the report recommended that the Standard for the Exchange of Product Model Data (STEP), an international standard still under development, be extended to support apparel applications. This second phase would result in a standard that would have capabilities beyond those envisioned for DXF. The CIM/COM accepted these recommendations, and work was begun within the Pattern Data Interchange (PDI) Task Group to standardize the use of DXF to exchange pattern data. At the same time, NIST began an effort to define how STEP could be extended to support apparel manufacturing.

The first phase of work is now nearly complete and it is time for the Task Group to enter the second phase of work. A set of conventions for using DXF as a pattern data exchange standard has been developed, and USL, under contract to the AAMA, is preparing these conventions for consideration as a U.S. national standard under guidelines of the American National Standards Institute (ANSI). Meanwhile, NIST has prepared a road map for how the new work should proceed.

This paper describes the work that the Task Group is starting. The next section presents some background information about STEP and the history of the CIM/COM activities in product data exchange. We then describe STEP application protocols: the established framework for extending STEP to new application areas. Following that, we discuss how the Task Group will use this framework to extend STEP to support the apparel industry. The final section of the paper reports the current status of these activities.

BACKGROUND

STEP is an emerging standard, the result of an international effort to develop a mechanism for the exchange of product data among all stages of the life cycle of a product. STEP is considered by many to be a critical technology for improving America's competitiveness in manufacturing [2]. Product Data Exchange Using STEP (PDES) is the United States' organizational activity that supports the development and implementation of STEP. A National PDES Testbed, under the sponsorship of the Computer-aided Acquisition and Logistic Support

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[1]Disclaimer: Certain trade names and company products are mentioned in this document in order to adequately specify the software and equipment to be used. In no case does such identification imply recommendation or endorsement by the National Institute of Standards and Technology.

program of the Department of Defense, has been established at NIST. This facility provides testing and validation for the emerging standard [3]. The applications addressed by PDES to date include mechanical piece parts; mechanical assemblies; architecture, engineering, and construction; finite element models; manufacturing applications; drafting applications; and electrical printed wiring board products. A software toolkit for manipulating PDES data has been developed at the Testbed [4]. The apparel industry can greatly leverage its own efforts by joining in the PDES effort. An Apparel Pattern Information Model was developed at NIST to demonstrate the feasibility of extending STEP to include the exchange of apparel pattern data [5]. A computer program, an implementation of the Apparel Pattern Information Model, has also been developed at NIST [6]. It demonstrates the exchange of two-dimensional pattern data between different industry formats.

In recent years, NIST, under the Defense Logistics Agency (DLA) sponsorship, has been working on developing the apparel product data exchange standard (APDES). Both NIST and DLA have a strong interest in encouraging the development of apparel PDES. However, the work can only be achieved with support from, and in cooperation with, standards organizations, the apparel manufacturing industry, government, and academia. The AAMA can provide the industry leadership needed to make this effort succeed.

In May 1991, NIST proposed a strategy for APDES implementation by formally establishing an APDES task group within the CIM Subcommittee. The mission of this task group would be to extend STEP to include apparel product data. The final goal of this task group would be to provide STEP application protocols for specific apparel application systems required to design and manufacture a garment. The proposed activities are reiterated in a later section of this paper. The AAMA CIM Subcommittee accepted the proposal and decided that the PDI Task Group that developed the DXF pattern exchange standard would be the best organization to work on APDES.

The PDI Task Group will be restructured. The group will continue the work to complete the DXF standardization procedure. It will also begin the longer term work of developing APDES. The restructured Task Group will be more in the nature of a technical working group rather than a review committee for technical work done outside of the organization. An expanded scope statement of the Task Group's new mission is now under development.

STEP AND STEP APPLICATION PROTOCOLS

STEP provides a neutral mechanism for representing product data throughout the life cycle of a product. STEP defines the information that describes products within different computer applications and across different enterprises. STEP application protocols are essentially subsets of STEP. STEP application protocols are themselves standards that define the context, the use, and the kind of product data for a particular data sharing scenario. An application protocol is a standardized way of implementing a portion of STEP for a specific application. The concept of an application protocol allows vendors to build an application system that can interface with STEP data in a standard manner. The expectation is that there will be many STEP application protocols. Our APDES project is aimed at developing application protocols for different apparel applications. For example, an application protocol for apparel pattern design may be developed to address the use of a pattern design system to provide pattern pieces of garments to a marker system.

Application protocols employ three types of models: an application activity model, an application reference model, and an application interpreted model [7]. These models are defined as follows:

- Application activity model:	A representation of one or more activities which use product data in a specific application context. The model defines the scope and information requirements that the application protocol will address. It is used to establish an understanding of an agreement on the application activities and processes.
- Application reference model:	A model that describes the information requirements and constraints for an application domain. The model uses application-specific terminology and rules familiar to an expert from the application domain.
- Application interpreted model:	A specification of standardized STEP data that match the requirements described in the application reference model. This model ties the application reference model to the rest of STEP.

An application protocol also includes a complete set of abstract test cases to support conformance testing and a validation report. An abstract test case is a complete and implementation-independent specification of the actions required to achieve a specific test purpose. (For example, one of the abstract test cases for marker-making may be to find all the pattern pieces in the garment.) Validation testing is the process to ensure that the application protocol is complete, unambiguous, and functional. Validating an application protocol is a complex process that includes: evaluating the scope and requirements; validating the application reference model and the application interpreted model; evaluating conformance requirements and test purposes; and implementing prototype systems to test the application protocol.

APDES ACTIVITIES

The work to develop APDES includes administrative and technical activities. NIST, under DLA sponsorship, will provide administrative guidance to coordinate the work of the PDI Task Group with the national and international activities. NIST will also provide technical support in STEP development methods and tools. This work will be a formal and active standards-development effort.

Administrative Activities

(1) Restructure the PDI Task Group. A new charter and scope of the work will be drafted, reviewed by the CIM Subcommittee, and documented. A chairman will be selected from group members. This group will be expanded to include experts from the CIM Subcommittee, ARC, and other interested parties. The Task Group needs recruits and more participation, including

non-AAMA members.

(2) Obtain recognition from the IGES/PDES Organization (IPO). The IPO is the body of volunteers who have developed IGES and are participating in the development of STEP. The IPO is working with other standards-making organizations, both foreign and domestic, to achieve the formal adoption of STEP as an international standard [8]. The IPO is the U.S. liaison to the International Organization for Standardization (ISO). The IPO comprises three components: Steering Committee, General Assembly, and Administration Office. The Steering Committee provides management direction, policies, and procedures. The General Assembly is a working body that is charged by the Steering Committee to develop standards and specifications and gain consensus approval for them. The Administration Office provides administrative services and professional staff to support the work of the IPO. The General Assembly comprises a Chairman, Standing Committees, Technical Committees, and Interest Groups that together perform the technical development and validation work required to create and approve standards and specifications. To start development of APDES, the PDI Task Group will propose to the IPO Chairman that the Task Group should serve as an Interest Group within IPO to undertake specific technical projects in its domain of interest. Once the project activity is ongoing for a long enough period of time, the Task Group may seek recognition as a Technical Committee.

(3) Participate in the IPO meetings. The General Assembly of the IPO will meet in regular session four times a year. In addition to the quarterly meetings, special meetings may be called as needed. Task Group representatives will participate in the IPO meetings as needed.

(4) Provide PDES/STEP training courses to group members. NIST will help to establish training courses as needed.

(5) Hold Task Group meetings. The Task Group will meet quarterly or as determined by the Task Group chairman. The CIM Subcommittee will accommodate this Task Group activity in its meeting agenda. The Task Group will also meet independently as needed. These group meetings will be used to define objectives, identify topical areas, develop plans, discuss technical and non-technical issues, perform technical reviews, and generally manage the evolution of the apparel standards based on STEP.

(6) Perform the standardization process. STEP is being developed by the ISO Technical Committee 184 (Industrial Automation Systems and Integration). Subcommittee 4 of ISO Technical Committee 184 (ISO TC184/SC4) is responsible for manufacturing data and languages. The Task Group will follow established procedures of ISO TC 184/SC4 for obtaining an international standard.

Technical Activities

The technical activities are aimed at developing application protocols within the procedural guidelines for international standardization. The APDES work will parallel the existing work in other STEP application areas. Prior to developing application protocols, the Task Group will define a glossary of terms used in apparel design and production. To begin with, the Task Group will identify specific topical areas and their corresponding application systems for application protocol development. Other topical areas will be started at a later date. The process of producing an application protocol includes five steps [7]:

(1) Develop and document an application protocol summary. This defines the scope and requirements of the application protocol. The task group will clearly define what the application protocol applies to and what the application protocol's functionality includes. This activity will

be performed using the IDEF0 modeling methodology [9] and will produce an application activity model. Definition of scope and information requirements shall be reviewed by experts in the application.

(2) Develop and document an application reference model. The application reference model, a data model that defines the information requirements in terms familiar to an expert in the relevant application area, will be developed using the EXPRESS [10] or the IDEF1X information modeling methodology [11]. This model shall be reviewed by both expert modelers and application experts.

(3) Develop and document an application interpreted model. When the application reference model has been developed and reviewed, the model must be integrated with the STEP resource models. This integration process maps the application specific data requirements from the application reference model to the general STEP data models where applicable. The activity will generate an application interpreted model using EXPRESS. This model shall be reviewed by both STEP experts and application experts to ensure that it is complete and correct.

(4) Develop conformance requirements and test purposes. This defines simulations or prototype systems and evaluation criteria for the purpose of evaluating implementation concerns and performing tests using actual data. A complete set of abstract test cases shall be provided in the application protocol. These are derived from three areas: scope and requirements, the application reference model, and the application interpreted model. The Task Group will recruit organizations to implement simulations or prototype systems that will be used to perform conformance testing.

(5) Validate the application protocol. This process leads to the development and execution an application protocol validation plan. The scope and requirements evaluation, application reference model validation, application interpreted model validation, conformance requirements and test purposes evaluation, and application protocol validation via prototypes will be performed. The development and validation of a STEP application protocol is an iterative process. Each step in this process provides critical feedback for the next iteration.

STATUS OF APDES

The PDI Task Group of the CIM Subcommittee is now moving toward a long-term goal: the development of a comprehensive standard for sharing apparel product data throughout the entire product life cycle using the STEP technology. The Task Group is now seeking recognition as a Special Interest Group from the IPO. The Task Group has been compiling a glossary of terms used in the apparel design and manufacturing arenas. The Task Group has also begun to develop an informal application protocol for apparel pattern making. The informal application protocol will be developed using the STEP methodology, but will not include development of an application interpreted model. This informal application protocol will be used to study the STEP methodology within the context of the apparel industry. Based on a successful evaluation, the next phase will be the development of formal application protocols for the apparel industry.

APDES is an on-going project which was initiated by DLA and is being carried out by NIST. APDES provides a neutral mechanism capable of completely representing product data throughout the entire apparel life cycle. Recently, the CIM Subcommittee of the AAMA endorsed and began actively participating in the effort. The APDES standard is for the apparel industry; therefore, the engagement of the industry is critical. Broader participation in this effort will help the work proceed more quickly and will improve the value of APDES to the industry.

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