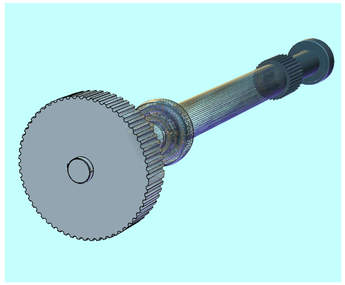
Lightweight Formats for Product Model Data Exchange and Preservation

The Context

Up until the turn of the millennium, Engineering software was used to support a paper-based workflow. Computer-aided design (CAD) packages were used to create virtual models of designs, from which drawings and other design documentation could be produced. The manufacture or construction process was based on this documentation.



Within the last five years or so, the industry has moved over to using the CAD models directly for communicating designs, not only to manufacturers and builders, but also to regulating authorities and maintenance crews. At the same time, the companies that design and build the products are increasingly entering into contracts to provide through-life support for them. For products such as cruise ships, military aircraft, hospitals and schools, this could mean contracts lasting thirty years, seventy years or even longer.

The Right Format

Full CAD formats are large, complex and proprietary, and are rarely backwards compatible. This makes them unsuitable both for long-term archiving, reference and reuse, and for distributed collaborative design work. Furthermore, they cannot be used directly by project partners, maintenance crews or marketing departments because of the cost of the software and the possibility of leaking intellectual property to competitors.

Lightweight formats are a potential solution to this problem. They have smaller file sizes, a simpler and more open structure, more affordable software support and need only contain as much information as a particular recipient needs. Choosing the right one for the right purpose can still be difficult, though. The University of Bath, as part of the KIM Project — a collaboration of eleven UK universities with funding from the EPSRC and ESRC — has been looking at ways of automating some of these decisions, using information like that presented in the table below.

Format	Model fidelity	Metadata support	Security features	File size reduction	Software support	Openness
3D XML	Exact surfaces, polygon meshes	None	Data approximation	Reference-instance, instance modification, some compression	Dassault Systèmes products, Lotus Notes, Microsoft Word/PowerPoint, Internet Explorer, free viewer	Proprietary specification is cost-free to view
HSF	NURBS surfaces, polygon meshes	Arbitrary user data, text objects	Data approximation	Data compression, streaming	Autodesk, Dassault Systèmes and PTC products	Proprietary specification is cost-free to view and implement
JT	B-Rep, polygon meshes	Arbitrary user data, PMI	Data approximation	Reference-instance, data compression	UGS products, Microsoft Word/Excel/PowerPoint, free viewer	Proprietary specification is cost-free to view and implement, toolkit can be purchased
PLM XML	NURBS surfaces, 2D and 3D vector graphics, feature modelling	Arbitrary user data, design or manufacturing notes, dimension information, surface finish information, mass and material information, text objects	Data approximation, access restriction	Reference-instance	UGS applications	Proprietary schemata are free to view, implement and extend; toolkit can be purchased
U3D	NURBS surfaces, triangle meshes	Aribtrary key/value data	Data approximation	Reference-instance, some compression	Adobe PDF software	ECMA standard, cost-free to view
X3D	NURBS surfaces, polygon meshes, 2D and 3D vector graphics	Arbitrary key/value data	Data approximation	Reference-instance	Various open source and proprietary viewers and processors, e.g. Xj3D, Flux, BS Contact	ISO standard, cost-free to view, open source libraries
XGL/ZGL	Triangle meshes	None	Data approximation	Reference-instance, whole-file compression	Autodesk, various minor CAD products	Specification no longer maintained

Further Information

KIM Project ..... ⟨http://www.kimproject.org/⟩
Digital Curation Centre ..... ⟨http://www.dcc.ac.uk/⟩

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