

# Object Management Group

First Needham Place  
250 First Avenue, Suite 201  
Needham, MA 02494-2814

Telephone: +1-781-444-0404  
Facsimile: +1-781-444-0320

## CAD Services V1.0

### Request For Proposal

OMG Document: mfg/2000-06-07

**Submissions due: Dec. 18, 2000**

#### **Objective of this RFP**

This RFP solicits proposals for Mechanical Computer Aided Design (CAD) system interfaces that enable the interoperability of CAD, Computer Aided Manufacturing (CAM) and Computer Aided Engineering (CAE) tools. The aim is to provide users of design and engineering systems the ability to seamlessly integrate, best-in-class, software across a wide variety of CAD/CAM and CAE applications through CORBA interfaces. These standard interfaces enable a distributed product design environment that includes a variety of CAD systems.

This RFP focuses on establishing Mechanical CAD system interfaces that provide Geometry and Topology data to Analysis and Manufacturing applications and tools. The intent is to establish a series of high level engineering interfaces that do not require low-level data structures to answer mechanical engineering queries. The balance between low-level and high-level interfaces is not specified in this RFP and is left to the judgement of the respondents.

The intent is to expose the existing CAD functionality through high level functional and operational interfaces. These interfaces should complement existing standards such as STEP.

This RFP addresses the following aspects of CAD systems:

- Operations on Geometry and Topology.
- Operations on Parts and Assembly.
- Operations on Features and Attributes.
- Ability to modify Parts.
- Ability to select Geometry.

For further details see Chapter 6 of this document.

## **1 Introduction**

### **1.1 Goals of OMG**

The Object Management Group (OMG) is the world's largest software consortium with a membership of over 800 vendors, developers, and end users. Established in 1989, its mission is to promote the theory and practice of Object Technology (OT) for the development of distributed computing systems.

A key goal of OMG is create a standardized object-oriented architectural framework for distributed applications based on specifications that enable and support distributed objects. Objectives include the *reusability*, *portability*, and *interoperability* of object-oriented software components in heterogeneous environments. To this end, the OMG adopts interface and protocol specifications, based on commercially available object technology, that together define an Object Management Architecture (OMA).

### **1.2 Organization of this document**

The remainder of this document is organized as follows:

Chapter 2 - *Architectural Context* - background information on OMG's Object Management Architecture.

Chapter 3 - *Adoption Process* - background information on the OMG specification adoption process.

Chapter 4 - *Instructions for Submitters* - explanation of how to make a submission to this RFP.

Chapter 5 - *General Requirements on Proposals* - requirements and evaluation criteria that apply to all proposals submitted to OMG.

Chapter 6 - *Specific Requirements on Proposals* - problem statement, scope of proposals sought, mandatory and optional requirements, issues to be discussed, evaluation criteria, and timetable that apply specifically to this RFP.

Additional RFP-specific chapters may also be included following Chapter 6.

### 1.3 References

The following documents are referenced in this document:

Richard Soley (ed.), *Object Management Architecture Guide*, Third Edition, Wiley, June 1995. OMG Document ab/97-05-05, or successor.

*The Common Object Request Broker: Architecture and Specification*, Revision 2.1, August 1997. OMG Document formal/97-09-01, or successor.

*CORBA services: Common Object Services Specification*, Revised Edition, July 1997. OMG Document formal/97-07-04, or successor.

*CORBA facilities Architecture*, Revision 4.0, November 1995.

*Business Committee RFP Attachment*, OMG Document omg/97-10-01.

*Policies and Procedures of the OMG Technical Process*, OMG Document pp/97-06-01 or successor.

These documents can be obtained by contacting OMG at [document@omg.org](mailto:document@omg.org). Many OMG documents, including this document, are available electronically from OMG's document server. Send a message containing the single line "help" to [server@omg.org](mailto:server@omg.org) for more information, or visit the OMG Web page (URL <http://www.omg.org/>), which also has more information about OMG in general. If you have general questions about this RFP send email to [responses@omg.org](mailto:responses@omg.org).

## 2 Architectural Context

### 2.1 Object Management Architecture

The *Object Management Architecture Guide* (OMAG) describes OMG's technical objectives and terminology and provides the conceptual infrastructure upon which supporting specifications are based. The guide includes the *OMG Object Model*, which defines common semantics for specifying the externally visible characteristics of objects in a standard implementation-independent way, and the *OMA Reference Model*.

The Reference Model identifies and characterizes the components, interfaces, and protocols that compose the OMA. This includes the Object Request Broker (ORB) component that enables clients and objects to communicate in a distributed environment, and four categories of object interfaces:

- *Object Services* are interfaces for general services that are likely to be used in any program based on distributed objects.
- *Common Facilities* are interfaces for horizontal end-user-oriented facilities applicable to most application domains.
- *Domain Interfaces* are application domain-specific interfaces.
- *Application Interfaces* are non-standardized application-specific interfaces.

A second part of the Reference Model introduces the notion of domain-specific *Object Frameworks*. An Object Framework component is a collection of cooperating objects that provide an integrated solution within an application or technology domain and which is intended for customisation by the developer or user.

Through a series of RFPs, OMG is populating the OMA with detailed specifications for each component and interface category in the Reference Model. Adopted specifications include the Common Object Request Broker Architecture (CORBA), CORBAservices, and CORBAfacilities.

The wide-scale industry adoption of OMG's OMA provides application developers and users with the means to build interoperable software systems distributed across all major hardware, operating system, and programming language environments.

## 2.2 CORBA

The *Common Object Request Broker Architecture* defines the programming interfaces to the OMA ORB component. An ORB is the basic mechanism by which objects transparently make requests to - and receive responses from - each other on the same machine or across a network. A client need not be aware of the mechanisms used to communicate with or activate an object, how the object is implemented, nor where the object is located. The ORB thus forms the foundation for building applications constructed from distributed objects and for interoperability between applications in both homogeneous and heterogeneous environments.

The *OMG Interface Definition Language* (IDL) provides a standardized way to define the interfaces to CORBA objects. The IDL definition is the contract between the implementor of an object and the client. IDL is a strongly typed declarative language that is programming language-independent. Language mappings enable objects to be implemented and sent requests in the developer's programming language of choice in a style that is natural to that language.

CORBA 2.0 is an extension and restructuring of the earlier CORBA 1.2 specification. CORBA 2.0 is a family of specifications consisting of the following components:

- Core (including IDL syntax and semantics)
- Interoperability
- An expanding set of language mappings, including:

- C
- C++
- SmallTalk
- Ada95
- COBOL

Each component is a separate compliance point. The minimum required for a CORBA-compliant implementation is adherence to the core and one language mapping.

## 2.3 CORBA/Interoperability

Interoperability between CORBA-compliant ORBs is provided by OMG's *Internet Inter-ORB Protocol* (IIOP). Adopted in December 1994 as the mandatory CORBA 2.0 protocol for “out of the box” interoperability, IIOP is the TCP/IP transport mapping of a *General Inter-ORB Protocol* (GIOP).

IOP enables requests to be sent to networked objects managed by other ORBs in other domains.

The OMG interoperability architecture also accommodates communication using optional *Environment-Specific IOPs* (ESIOPs), the first of which is the DCE-CIOP.

## 2.4 CORBA services

Object Services are general purpose services that are either fundamental for developing useful CORBA-based applications composed of distributed objects, or that provide a universal - application domain-independent - basis for application interoperability.

Object Services are the basic building blocks for distributed object applications. Compliant objects can be combined in many different ways and put to many different uses in applications. They can be used to construct higher level facilities and object frameworks that can interoperate across multiple platform environments.

Adopted OMG Object Services are collectively called CORBA services and include Naming, Events, LifeCycle, Persistent Object, Relationships, Externalization, Transactions, Concurrency Control, Licensing, Query, Properties, Security, Time, Collections, and Trading Services.

## 2.5 CORBA facilities

Common Facilities are interfaces for horizontal end-user-oriented facilities applicable to most domains. Adopted OMG Common Facilities are collectively called CORBA facilities and include an OpenDoc-based Distributed Document Component Facility.

A specification of a Common Facility or Object Service typically includes the set of interface definitions - expressed in OMG IDL - that objects in various roles must support in order to *provide, use, or participate in* the facility or service. As with all specifications adopted by OMG, facilities and services are defined in terms of interfaces and their semantics, and not a particular implementation.

## 2.6 Object Frameworks and Domain Interfaces

Unlike the interfaces to individual parts of the OMA “plumbing” infrastructure, Object Frameworks are complete higher level components that provide functionality of direct interest to end-users in particular

application or technology domains. They are vertical slices down the OMG “interface stack”.

Object Frameworks are collections of cooperating objects categorized into *Application, Domain, Facility, and Service Objects*. Each object in a framework supports (through interface inheritance) or makes use of (via client requests) some combination of Application, Domain, CORBA facilities, and CORBA services *interfaces*.

A specification of an Object Framework defines such things as the structure, interfaces, types, operation sequencing, and qualities of service of the objects that make up the framework. This includes requirements on implementations in order to guarantee application portability and interoperability across different platforms.

Domain Task Force RFPs are likely to focus on Object Framework specifications that include new Domain Interfaces for application domains such as Finance, Healthcare, Manufacturing, Telecom, Electronic Commerce, and Transportation.

### **3 Adoption Process**

#### **3.1 Introduction**

OMG adopts specifications for interfaces and protocols by explicit vote on a technology-by-technology basis. The specifications selected each fill in a portion of the OMA Reference Model. OMG bases its decisions on both business and technical considerations. Once a specification is adopted by OMG, it is made available for use by both OMG members and non-members.

For more detailed information on the adoption process see the *Policies and Procedures of the OMG Technical Process*.

#### **3.2 Rôle of Board of Directors**

The OMG Board of Directors votes to formally adopt specifications on behalf of OMG. The OMG Technology Committees (Domain and Platform TCs) and Architecture Board (AB) provide technical guidance to the Board of Directors. In addition, the Business Committee of the Board provides guidance to ensure that implementations of adopted specifications are made commercially available.

#### **3.3 Rôle of Technology Committees and Architecture Board**

Submissions to RFPs are evaluated by the TC Task Force (TF) that initiated the RFP. Selected specifications are recommended to the parent TC after being reviewed by the Architecture Board for consistency with the OMA. The full TC then votes to *recommend adoption* to the OMG Board.

#### **3.4 Rôle of Task Forces**

The role of the initiating TF is to technically evaluate submissions and select one or more specifications that satisfy the requirements of the RFP. The process typically takes the following form:

- Voter Registration

Interested TF members may register to participate in specification selection votes for an RFP. Registration ends on a specified date 6 or more weeks after the announcement of the registration period. The registration closure date is typically around the time of initial

submissions. Companies who have submitted an LOI are automatically registered to vote.

- **Initial Submissions**

Initial submissions are due by a specified deadline. Submitters normally present their proposals at the next following meeting of the TF. Initial submissions are expected to be full and complete proposals and working implementations of the proposed specifications are expected to exist at the time of submission.

- **Evaluation Phase**

A period of approximately 120 days follows during which the TF evaluates the submissions. During this time submitting companies have the opportunity to revise and/or merge their initial submissions, if they so choose.

- **Revised Submissions**

Final revised submissions are due by a specified deadline. Submitters again normally present their proposals at the next following meeting of the TF. Finalists may be requested to demonstrate implementations of their proposal.

- **Selection Vote**

When the registered voters of the TF believe that they sufficiently understand the relative merits of the revised submissions, a specification selection vote is taken.

### **3.5 Goals of the evaluation**

The primary goals of the TF evaluation process are to:

- Provide a fair and open process
- Force a critical review of the submissions and discussion by all members of the TF
- Give feedback to allow submitters to address concerns in their revised submissions
- Build consensus on acceptable solutions
- Enable voting members to make an informed selection decision

Submitters are expected actively to contribute to the evaluation process.

## **4 Instructions for Submitters**

### **4.1 OMG Membership**

Submissions to this RFP may only be made by Contributing or Domain Contributing members of the OMG. To submit to an RFP issued by the Platform Technology Committee an organisation must be a Contributing member at the date of the submission deadline, while for Domain Technology RFPs the submitter or submitters must be either Contributing or Domain Contributing members. Submitters sometimes choose to name other organisations that support a submission in some way; however, this has no formal status within the OMG process, and for OMG's purposes confers neither duties nor privileges on the organisations concerned.

### **4.2 Submission Effort**

Unlike a submission to an OMG Request For Information (RFI), an RFP submission may require significant effort in terms of document preparation, presentations to the initiating TF, and participation in the TF evaluation process. Several staff months of effort might be necessary. OMG is unable to reimburse submitters for any costs in conjunction with their submissions to this RFP.

### **4.3 Letter of Intent**

A Letter of Intent (LOI) must be submitted to the OMG Business Committee signed by an officer of your organization signifying your intent to respond to the RFP and confirming your organization's willingness to comply with OMG's terms and conditions, and commercial availability requirements. These terms, conditions, and requirements are defined in the *Business Committee RFP Attachment* and are reproduced verbatim in section 4.4 below.

The LOI shall designate a single contact point within your organization for receipt of all subsequent information regarding this RFP and your submission. The name of this contact will be made available to all OMG members. The LOI is typically due 60 days before the deadline for initial submissions. LOIs must be sent by fax or paper mail to the "RFP Submissions Desk" at the main OMG address shown on the first page of this RFP.

Here is a suggested template for the Letter of Intent:

*This letter confirms the intent of <\_\_organisation required\_\_> (the organisation) to submit a response to the OMG <\_\_RFP name required\_\_> RFP. We will grant OMG and its members the right to copy our response for review purposes as specified in section 4.7 of the RFP. Shall our response be adopted by OMG we will comply with the OMG Business Committee terms set out in section 4.4 of the RFP and in document omg/98-03-01.*

*<\_\_contact name and details required\_\_> will be responsible for liaison with OMG regarding this RFP response.*

*The signatory below is an officer of the organisation and has the approval and authority to make this commitment on behalf of the organisation.*

*<\_\_signature required\_\_>*

#### **4.4 Business Committee RFP Attachment**

This section contains the text of the Business Committee RFP attachment concerning commercial availability requirements placed on submissions. This attachment, available separately as document omg/98-03-01, was approved by the OMG Board in February 1998.

---

### ***Commercial considerations in OMG technology adoption***

#### **A1 Introduction**

*OMG wishes to encourage rapid commercial adoption of the specifications it publishes. To this end, there must be neither technical, legal nor commercial obstacles to their implementation. Freedom from the first is largely judged through technical review by the relevant OMG Technology Committee; the second two are the responsibility of the OMG Business Committee. The BC also looks for evidence of a commitment by a submitter to the commercial success of products based on the submission.*

#### **A2 Business Committee evaluation criteria**

##### **A2.1 Viable to implement across platforms**

*While it is understood that final candidate OMG submissions often combine technologies before they have all been implemented in one system, the Business Committee nevertheless wishes to see evidence that each major feature has been implemented, preferably more than once, and by separate organisations. Pre-product implementations are acceptable. Since use of OMG specifications shall*

*not be dependant on any one platform, cross-platform availability and interoperability of implementations shall be also be demonstrated.*

## **A2.2 Commercial availability**

*In addition to demonstrating the existence of implementations of the specification, the submitter must also show that products based on the specification are commercially available, or will be within 12 months of the date when the specification was recommended for adoption by the appropriate Task Force. Proof of intent to ship product within 12 months might include:*

- *A public product announcement with a shipping date within the time limit.*
- *Demonstration of a prototype implementation and accompanying draft user documentation.*

*Alternatively, and at the Business Committee's discretion, submissions may be adopted where the submitter is not a commercial software provider, and therefore will not make implementations commercially available. However, in this case the BC will require concrete evidence of two or more independent implementations of the specification being used by end-user organisations as part of their businesses.*

*Regardless of which requirement is in use, the submitter must inform the OMG of completion of the implementations when commercially available.*

## **A2.3 Access to Intellectual Property Rights**

*OMG will not adopt a specification if OMG is aware of any submitter, member or third party which holds a patent, copyright or other intellectual property right (collectively referred to in this policy statement as "IPR") which might be infringed by implementation of such specification, unless OMG believes that such IPR owner will grant a license to implementers (whether OMG members or not) on non-discriminatory and commercially reasonable terms which wish to implement the specification. Accordingly, the submitter must certify that it is not aware of any claim that the specification infringes any IPR of a third party or that it is aware and believes that an appropriate non-discriminatory license is available from that third party. Except for this certification, the submitter will not be required to make any other warranty, and specifications will be offered by OMG for implementation "as is". If the submitter owns IPR to which an implementation of a specification based upon its submission would necessarily be subject, it must certify to the Business Committee that it will make a suitable license available to any implementer on non-discriminatory and commercially reasonable terms, to permit development and commercialisation of an implementation that includes such IPR.*

*It is the goal of the OMG to make all of its specifications available with as few impediments and disincentives to adoption as possible, and therefore OMG strongly encourages the submission of technology as to which royalty-free licenses will be available. However, in all events, the submitter shall also certify that any necessary license will be made available on commercially reasonable, non-discriminatory terms. The submitter is responsible for disclosing in detail all known restrictions, placed either by the submitter or, if known, others, on technology necessary for implementation of the specification.*

#### **A2.4 Publication of the specification**

*Shall the submission be adopted, the submitter must grant OMG (and its sublicensees) a world-wide, royalty-free licence to edit, store, duplicate and distribute both the specification and works derived from it (such as revisions and teaching materials). This requirement applies only to the written specification, not to any implementation of it.*

#### **A2.5 Continuing support**

*The submitter must show a commitment to continue supporting the technology underlying the specification after OMG adoption, for instance by showing the BC development plans for future revisions, enhancement or maintenance.*

---

### **4.5 Responding to RFP items**

#### **4.5.1 Separate proposals**

Unless otherwise indicated in Chapter 6, independent proposals are solicited for each separate item in the RFP. Each item is considered a separate architectural entity for which a proposal may be made. A submitter may respond to any or all items. Each item will be evaluated independently by the initiating TF. Submissions that do not present clearly separable proposals for multiple items may therefore be at a disadvantage.

It shall be noted that a given technology (e.g. software product) may support two or more RFP items. So long as the interfaces for each item are separable, this is not precluded.

#### 4.5.2 Complete proposals

Proposals for each separate RFP item must be complete. A submission must propose full specifications for each item and address all the relevant general and specific requirements detailed in this RFP.

#### 4.5.3 Additional specifications

Submissions may include additional specifications for items not covered by the RFP which they believe to be necessary and integral to their proposal. Information on these additional items shall be clearly distinguished.

Submitters must give a detailed rationale as to why these specifications shall also be considered for adoption. However submitters shall note that a TF is unlikely to consider additional items that are already on the roadmap of an OMG TF, since this would pre-empt the normal adoption process.

#### 4.5.4 Alternative approaches

Submitters may provide alternative RFP item definitions, categorizations, and groupings so long as the rationale for doing so is clearly stated. Equally, submitters may provide alternative models for how items are provided within the OMA if there are compelling technological reasons for a different approach.

### 4.6 Confidential and Proprietary Information

The OMG specification adoption process is an open process. Responses to this RFP become public documents of the OMG and are available to members and non-members alike for perusal. No confidentiality or proprietary information of any kind will be accepted in a submission to this RFP.

### 4.7 Copyright Waiver

If a submitted document is copyrighted, a waiver of copyright for unlimited duplication by the OMG is required to be stated in the document. In addition, a limited waiver of copyright is required that allows each OMG member to make up to fifty (50) copies of the document for review purposes only.

## 4.8 Proof of Concept

Submissions must include a “proof of concept” statement, explaining how the submitted specifications have been demonstrated to be technically viable. The technical viability has to do with the state of development and maturity of the technology on which a submission is based. This is not the same as commercial availability. Proof of concept statements can contain any information deemed relevant by the submitter, for example:

“This specification has completed the design phase and is the process of being prototyped.”

“An implementation of this specification has been in beta-test for 4 months.”

“A named product (with a specified customer base) is a realization of this specification.”

It is incumbent upon submitters to demonstrate to the satisfaction of the TF the technical viability of their proposal. OMG will favour proposals based on technology for which sufficient relevant experience has been gained in CORBA-based or comparable environments.

## 4.9 Format of RFP Submissions

This section provides guidance on how to structure your RFP submission.

### 4.9.1 General

- Submissions that are concise and easy to read will inevitably receive more consideration.
- Submitted documentation shall be confined to that directly relevant to the items requested in the RFP. If this is not practical, submitters must make clear what portion of the documentation pertains directly to the RFP and what portion does not.
- The models and terminology in the *Object Management Architecture Guide* and *CORBA* shall be used in your submission. Where you believe this is not appropriate, describe and provide a rationale for the models and terminology you believe OMG shall use.

### 4.9.2 Suggested Outline

A three part structure for submissions is suggested:

## **PART I**

- Copyright Waiver (see 4.5)
- Submission contact point (see 4.2)
- Overview or guide to the material in the submission
- Overall design rationale (if appropriate)
- Statement of proof of concept (see 4.6)
- Resolution of RFP mandatory and optional requirements

*Explain how your proposal satisfies the mandatory and (if applicable) optional requirements stated in Chapter 6. References to supporting material in Part II shall be given.*

*In addition, if your proposal does not satisfy any of the general requirements stated in Chapter 5, provide a detailed rationale.*

- Responses to RFP issues to be discussed

*Discuss each of the “Issues To Be Discussed” identified in Chapter 6.*

## **PART II**

- Proposed specification

## **PART III**

- Summary of optional versus mandatory interfaces

*Submissions must clearly distinguish interfaces that all implementations must support from those that may be optionally supported.*

- Proposed compliance points

*Submissions shall propose appropriate compliance points for implementations.*

- Changes or extensions required to adopted OMG specifications

*Submissions must include a full specification of any changes or extensions required to existing OMG specifications. This shall be in a form that enables “mechanical” section-by-section revision of the existing specification.*

- Complete IDL definitions

*For reference purposes and to facilitate electronic usage, submissions shall reproduce in one place a complete listing in compilable form of the IDL definitions proposed for standardization.*

#### **4.10 How to Submit**

Submitters shall send an electronic version of their submission to the *RFP Submissions Desk* (rfp@omg.org) at OMG by 5:00 PM U.S. Eastern Standard Time (22:00 GMT) on the day of the submission deadline. Acceptable formats are Postscript, ASCII, PDF, FrameMaker, Word, and WordPerfect. However, it shall be noted that a successful submission must be supplied to OMG's technical editors in Framemaker source format, using the most recent available OMG submission template (document ab/97-06-02 at the time of writing). The AB will not endorse adoption of any submission for which appropriately-formatted Framemaker sources are not available; it may therefore be convenient to prepare all stages of a submission using this template.

Submitters shall make sure they receive electronic or voice confirmation of the successful receipt of their submission. Submitters shall also send, within three (3) working days after the submission deadline, a single hardcopy version of their submission to the attention of the "RFP Submissions Desk" at the main OMG address shown on the first page of this RFP.

In addition, submitters are responsible for making available 100 paper copies to attendees of the TF meeting immediately following a submission deadline. There are normally two such presentation meetings, one for the initial and one for the revised submissions.

## 5 General Requirements on Proposals

### 5.1 Mandatory Requirements

- 5.1.1 Proposals shall express interfaces in OMG IDL. Proposals shall follow accepted OMG IDL and CORBA programming style. The correctness of the IDL shall be verified using at least one IDL compiler (and preferably more than one). In addition to IDL quoted in the text of the submission, all the IDL associated with the proposal shall be supplied to OMG in compiler-readable form.
- 5.1.2 Proposals shall specify operation behaviour, sequencing, and side-effects (if any).
- 5.1.3 Proposals shall be *precise* and *functionally complete*. There shall be no implied or hidden interfaces, operations, or functions required to enable an implementation of the proposed specification.
- 5.1.4 Proposals shall clearly distinguish *mandatory* interfaces and other specification elements that all implementations must support from those that may be *optionally* supported.
- 5.1.5 Proposals shall *reuse* existing OMG specifications including CORBA, CORBAservices, and CORBAfacilities in preference to defining new interfaces to perform similar functions.
- 5.1.6 Proposals shall justify and fully specify any *changes or extensions* required to existing OMG specifications. This includes changes and extensions to CORBA inter-ORB protocols necessary to support interoperability. In general, OMG favours *upwards compatible* proposals that minimize changes and extensions to existing OMG specifications.
- 5.1.7 Proposals shall factor out functions that could be used in different contexts and specify their interfaces separately. Such *minimality* fosters re-use and avoids functional duplication.
- 5.1.8 Proposals shall use or depend on other interface specifications only where it is actually necessary. While re-use of existing interfaces to avoid duplication will be encouraged, proposals shall avoid gratuitous use.

- 5.1.9 Proposals shall specify interfaces that are *compatible* and can be used with existing OMG specifications. Separate functions doing separate jobs shall be capable of being used together where it makes sense for them to do so.
- 5.1.10 Proposals shall preserve maximum *implementation flexibility*. Implementation descriptions shall not be included, however proposals may specify constraints on object behaviour that implementations need to take into account over and above those defined by the interface semantics.
- 5.1.11 Proposals shall allow *independent implementations* that are *substitutable* and *interoperable*. An implementation shall be replaceable by an alternative implementation without requiring changes to any client.
- 5.1.12 Proposals shall be compatible with the architecture for system distribution defined in ISO/IEC 10746, Reference Model of Open Distributed Processing (ODP). Where such compatibility is not achieved, the response to the RFP must include reasons why compatibility is not appropriate and an outline of any plans to achieve such compatibility in the future.
- 5.1.13 In order to demonstrate that the service or facility proposed in response to this RFP, can be made secure in environments requiring security, answers to the following questions shall be provided:
- What, if any, are the security sensitive objects that are introduced by the proposal?
  - Which accesses to security-sensitive objects must be subject to security policy control?
  - Does the proposed service or facility need to be security aware?
  - What CORBA security level and options are required to protect an implementation of the proposal? In answer to this question, a reasonably complete description of how the facilities provided by the level and options (e.g. authentication, audit, authorization, message protection etc.) are used to protect access to the sensitive objects introduced by the proposal shall be provided.
  - What default policies shall be applied to the security sensitive objects introduced by the proposal?
  - Of what security considerations must the implementers of your proposal be aware?

5.1.14 Proposals shall specify the degree of internationalization support that they provide. The degrees of support are as follows:

- a) Uncategorized: Internationalization has not been considered.
- b) Specific to <region name>: The proposal supports the customs of the specified region only, and is not guaranteed to support the customs of any other region. Any fault or error caused by requesting the services outside of a context in which the customs of the specified region are being consistently followed is the responsibility of the requester.
- c) Specific to <multiple region names>: The proposal supports the customs of the specified regions only, and is not guaranteed to support the customs of any other regions. Any fault or error caused by requesting the services outside of a context in which the customs of at least one of the specified regions are being consistently followed is the responsibility of the requester.

## 5.2 Evaluation criteria

Although the OMG adopts interface specifications, the technical viability of implementations will be taken into account during the evaluation process. The following criteria will be used:

### 5.2.1 Performance

Potential implementation trade-offs for performance will be considered.

### 5.2.2 Portability

The ease of implementation on a variety of ORB systems and software platforms will be considered.

### 5.2.3 Securability

The answer to questions in section 5.1.13 shall be taken into consideration to ascertain that an implementation of the proposal is securable in an environment requiring security.

### 5.2.4 Compliance: Inspectability and Testability

The adequacy of proposed specifications for the purposes of compliance inspection and testing will be considered. Specifications shall provide

sufficient constraints on interfaces and implementation characteristics to ensure that compliance can be unambiguously assessed through both manual inspection and automated testing.

#### 5.2.5 Standardised Metadata

Where proposals incorporate metadata specifications, usage of OMG standard XMI metadata representations will be considered, since this allows specifications to be easily interchanged between XMI compliant tools and applications. Since use of XML (including XMI, XML/Value) is evolving rapidly, the use of industry specific XML vocabularies (which may not be XMI compliant) is acceptable where justified.

## 6 Specific Requirements on Proposals

The purpose of this RFP is to establish Mechanical CAD system interfaces that provide Geometry and Topology data to Analysis and Manufacturing applications and tools.

### 6.1 Problem Statement

Most organizations seek to design and develop new products in increasingly shorter time periods. At the same time, increased performance demands require a team-based multidisciplinary design process that may span several organizations. One approach to meet these demands is to use “Geometry Centric” design. In this approach, design engineers team their efforts through one united representation of the design that is usually captured in a CAD system. Unfortunately, there are many barriers in today’s design systems that prevent this approach:

1. CAD systems represent geometry in incompatible propriety formats. A geometry captured in one CAD system must be translated (usually through a STEP file) to be imported into a different CAD system.
2. CAD system programming interfaces are very complex. Computer Aided Engineering (CAE) and Manufacturing (CAM) applications would require extensive programming efforts to link into multiple CAD systems and the number of customized “links” would grow as  $N \times M$ .

Standards-based CORBA interfaces could provide uniform, simple, distributed services that enable the “Geometry Centric” design approach. This new standard would provide a uniform interface to design Geometry and Topology features that can be easily and accurately shared among design team members. These high-level interfaces can respond to engineering queries without the need for data translation or low-level data structures. These interfaces can, therefore, shield the design engineer from the full complexity of a CAD system.

## 6.2 Scope of Proposals Sought

The purpose of this Request for Proposal is to solicit CAD interfaces for Analysis and Manufacturing tools. Responses to this RFP shall define CORBA interfaces for the exchange of Geometry and Topology information. A limited capability to modify selected CAD part representations is also sought.

Geometry and Topology information involves both high-level (coarse grained) and low-level (fine grained) data. In some cases low-level information is needed, but accessing this information over a network could impose significant performance penalties. The trade-off between low-level and high-level interfaces shall be considered.

In general, the CAD system is the primary source of geometry and topology information and it provides accurate representations of this geometry to various (CAE / CAM) applications that consume the information.

In accordance with the OMG's vision of interoperability, the services consist of interfaces that map to business requirements. The responses to this RFP are expected to propose standard CAD Interfaces that interoperate with and use standard CORBA Services and other adopted Domain standards where applicable.

## 6.3 Relationship to Existing OMG Specifications

The following CORBA specifications are particularly relevant.

### 6.3.1 PDM Enablers

Submissions are encouraged to use the PDM Enablers Specification where appropriate (Revised JPDM Submission, mfg/1998-01-01, as modified by the Errata, mfg/1998-02-01, the PDM Enablers V1.1 Revision Task Force Final Report, dtc/1999-02-01, and the PDM Enablers V1.2 Revision Task Force Final Report, dtc/1999-10-02.)<sup>1</sup>

---

<sup>1</sup> Note at the time of this writing, there are active and relevant PDM Enabler Activities:

- A Formal Document based on PDM Enablers V1.2 is currently being prepared.
- There is usually a seated PDM Enablers Revision Task Force.
- There is an active RFP for a PDM Enablers V2.0 Specification, mfg/2000-01-02.

### 6.3.2 CORBA Component Model

Submissions may use CORBA Component technology (orbos/99-02-05). These capabilities may be useful in simplifying interfaces, improving performance, and providing additional functionality. They should be utilized where it is advantageous to do so.

### 6.3.3 CORBA Services

Submitters shall make an effort to utilize and/or comply with CORBA Services (formal/98-12-09 CORBA Services complete book) which are general purpose services that are either fundamental for developing useful CORBA-based applications composed of distributed objects, or that provide a universal – application domain independent – basis for application interoperability.

In particular it may be useful for submitters to be familiar with the following CORBA Services:

- Object Collection Service
- Notification
- Query Service
- Property Service
- Relationship Service (This service may be used as a set of design principles as opposed to a stand-alone Service.)
- Transaction Service
- Event Service
- Persistent State Service
- Naming Service
- Trading Object Service
- Security Service

## 6.4 Related Documents and Standards

The objects and interfaces that will be specified in response to this RFP may be correlated with one or more forthcoming OMG specification responses and other standards.

In particular it may be useful for submitters to be familiar with the following specifications:

- STEP PDM Schema (URL: [http://www.pdm-if.org/pdm\\_schema](http://www.pdm-if.org/pdm_schema))
- STEP AP203 (ISO 10303-203:1994 Configuration-controlled mechanical design)

- STEP AP209 (ISO 10303-209) Composite and Metal Structure, Analysis and Related Design
- STEP ISO 10303- 42 Geometric and Topological Representation
- STEP ISO 10303-47 Shape Variation Tolerances
- STEPAP214 (ISO 10303-214:1999 Core data for automotive mechanical design process)
- STEPAP232 (ISO DIS 10303-232:2000 Technical Data Package)
- OAG Interface specification OAGIS v6.2
- Design and Manufacturing Automation Corporation (DMAC – URL: <http://www.dmac.org>)
- XMI Metadata Interchange V1.1 (ad/99-10-02 and ad/99-10-03)

The following OMG Request for Proposals (RFP) may also be of interests to submitters:

- XML/Value (orbos/1999-08-20)
- PDM Enablers V2.0 (mfg/2000-01-02)

## **6.5 Mandatory Requirements**

- 6.5.1 The interface(s) shall provide a manifold topology representation of CAD system entities.
- 6.5.2 Geometry information shall be provided through both tessellated representations and point queries for CAD system entities.
- 6.5.3 The interface(s) shall provide the ability to query for mass properties of components and assemblies, including volume, center-of-gravity (CG), principal axes, and moments of inertia.
- 6.5.4 The interface(s) shall provide parametric evaluation of all curve and surface elements. Options shall exist for positional as well as various derivative evaluations.
- 6.5.5 Error conditions. Geometry access warnings and error conditions shall be clearly identified for appropriate interfaces.
- 6.5.6 The interface(s) shall provide the ability to query / modify entities and features, including the suppressing of features in the representation. The feature set shall include parameters that define the geometry (for example, a hole or fillet).
- 6.5.7 The interface(s) shall provide the ability to query CAD model accuracy. Accuracy reports shall contain local and global tolerances, approximations used in curve and surface fitting, precision, and any other information that is known about the accuracy of the CAD representation.
- 6.5.8 The interface(s) shall provide attribute / geometry information including:
  - 6.5.8.1 STEP attributes and geometry / topology as defined by ISO 10303-42, Geometric and Topological Representation.
  - 6.5.8.2 Tag the geometry with external application information. For example, cost, inflow boundary conditions, etc.
- 6.5.9 The interface(s) shall provide a publish and subscribe capability for events that occur within the CAD system or external applications. This interface shall be compatible with PDM Enablers, where appropriate.

- 6.5.10 The interface(s) shall provide support for model representation of CAD system entities and features.
- 6.5.11 Interface(s) shall provide the ability to query model parameters for expressions/rules that might have been used to compute their values.
- 6.5.12 The interface shall provide the ability to query components and assembly parameters, including explicit mating conditions and component placement.
- 6.5.13 Performance. Interfaces shall be designed to minimize network overhead. For example, high-level (coarse grained) data access requests would provide a maximum amount of data with a minimal network overhead penalty.

## 6.6 Optional Requirements

Proposals may satisfy the following optional requirements. The satisfaction of optional requirements is desirable (and will be taken into account in evaluating the submissions).

- 6.6.1 CAD interface(s) may provide access to non-manifold topology. Specifically, 3D solid (region), 2D surface (shell, face), and 1D wireframe (edge) entities may be supported in all geometry representations.
- 6.6.2 Interfaces may provide the ability to query the model for specific geometry checks, including, but not limited to, tiny/misaligned objects, self-intersecting faces/edges, smoothness characteristics, etc.
- 6.6.3 Geometry interfaces that provide tessellated representations may provide control for the generation of the tessellation. Suggested controls include: the maximum number of facets, maximum facet size, and maximum deviation from geometry (i.e. for surface curvature corrected tessellation).
- 6.6.4 Interfaces may support activation or deactivation of the Graphical User Interface for the CAD model representation.
- 6.6.5 The interface(s) may provide the ability to modify CAD system representation accuracy. For example, there could be an accuracy

modification interface that modifies an imported solid model resulting in fully-joined boundaries per a specified accuracy.

## 6.6 Issues to be discussed

There are two issues to be discussed in proposals to this RFP. The first issue involves rolling-out varying levels of functionality through several compliance points. For example, one vendor may decide to support read-only queries, while another vendor supports the same read-only interfaces, but also adds modification queries as part of a planned series of compliance points. Any proposals following this approach should clearly identify compliance points.

The second issue involves the future extensibility of the proposed interfaces. The MfgDTF issued a Request for Information (RFI) (mfg/1999-02-02) that identified extensive requirements for CAD functionality. This RFP focuses on only a subset of these identified requirements. Future RFPs may address additional requirements such as:

- Capturing design intent
- Manufacturing
- Collaborative CAD.

All of these areas are critical elements in the overall interoperability model. Thus, the success of CAD Services proposals depend on their extensibility. The proposal should address the extensibility of the proposed interface(s) to provide future functionality

## 6.7 Evaluation Criteria

The primary concerns in evaluating proposals will be:

- Functionality richness, i.e. the degree to which the proposal supports a wide range of Geometry and Topology data access.
- Granularity of data access. Support for coarse grained queries, i.e. the degree to which interfaces allow a minimum of individual messages to obtain collections of data so as to maximize data exchange performance.
- Timeliness of the available functionality will be considered.
- Ease of use, i.e. the degree to which the proposal eases the writing client code.
- Commonality with existing data standards (PDM Enablers, STEP and DMAC) will be considered.

## 6.8 Other information unique to this RFP

There are, at least, three different approaches to CAD / Computer Aided Engineering (CAE) usage. The three scenarios described below demonstrate how, for example, a CAE application will use the CAD interfaces being proposed in this RFP. These scenarios are provided to assist respondents in understanding the motivation behind some of the requirements.

**Scenario 1: Stand Alone CAE** – In this scenario, the native CAD application is integrated with a CAE application on a single computer through CAD services interfaces. In this case, no external (distributed) requests are needed. The integration process is eased and the engineer is shielded from the complete CAD API through the use of CAD Services interfaces.

**Scenario 2: Non-Interactive Mode** - In this scenario, a CAE application plays the role of a client and the CAD system plays the role of a server. The client and the server interact without visual presentation of these requests.

**Scenario 3: Interactive Mode** - As in scenario 2, a CAE application plays the role of a client and the CAD system plays the role of a server, however, the server visually displays interactions with the client. For example, the client (CAE application) requests the CAD service that provides manipulation of the CAD model. This manipulation could include the selection and modification of CAD model parameters. These changes would be visually presented.

**6.9 RFP Timetable**

The timetable for this RFP is given below. Note that the TF may, in certain circumstances, extend deadlines while the RFP is running, or may elect to have more than one revised submission step. The latest timetable can always be found in the Member Services section of OMG's Web page (URL <http://www.omg.org/>)

<b>Approx Day</b>	<b>Event or Activity</b>	<b>Actual Date</b>
	<i>Preparation of RFP by TF</i>	
	<i>Approval of RFP by Architecture Board Review by TC</i>	<i>June 15, 2000</i>
<i>0</i>	<i>TC votes to issue RFP</i>	<i>June 16, 2000</i>
<i>60</i>	<i>LOI to submit to RFP due</i>	<i>September 20, 2000</i>
<i>120</i>	<i>Initial submissions due</i>	<i>December 18, 2000</i>
<i>134</i>	<i>Voter registration closes</i>	<i>January 15, 2001</i>
<i>141</i>	<i>Initial submission presentations</i>	<i>February 26, 2001</i>
	<i>Preliminary evaluation by TF</i>	
<i>240</i>	<i>Revised submissions due</i>	<i>May 15, 2001</i>
<i>261</i>	<i>Revised submission presentations</i>	<i>June 15, 2001</i>
	<i>Final evaluation and selection by TF Recommendation to AB and TC</i>	
	<i>Approval by Architecture Board Review by TC</i>	
<i>330</i>	<i>TC votes to recommend specifications</i>	<i>August 15, 2001</i>
<i>360</i>	<i>BOD votes to adopt specifications</i>	<i>September 15, 2001</i>