NISTIR 5719

Mapping Integration Definition for Function Modeling (IDEF0) Model into CASE Data Interchange Format (CDIF) Transfer File

Igor Simakhodskiy
Guest Researcher

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Institute of Standards
and Technology
Gaithersburg, MD 20899

NIST

NISTIR 5719

Mapping Integration Definition for Function Modeling (IDEFO) Model into CASE Data Interchange Format (CDIF) Transfer File

Igor Simakhodskiy
Guest Researcher

U.S. DEPARTMENT OF COMMERCE
Technology Administration
National Institute of Standards
and Technology
Gaithersburg, MD 20899

September 1995

U.S. DEPARTMENT OF COMMERCE
Ronald H. Brown, Secretary

TECHNOLOGY ADMINISTRATION
Mary L. Good, Under Secretary for Technology

NATIONAL INSTITUTE OF STANDARDS
AND TECHNOLOGY
Arati Prabhakar, Director

Table of Contents

IDEF0 MAPPING

Structure of this Document:

This document is organized into the following sections:

Section 1: Background

This gives some background information on IDEF0, CDIF, and the idea of a general information exchange between different tools.

Section 2: Introduction

This introduces the audience to this document and gives some more information about CDIF.

Section 3: CDIF - Case Data Interchange Format

This explains the CDIF structure and shows how CDIF can be used as a standard means for exchanging information between IDEF tools.

Section 4: Semantical Mapping

This gives the full description of the semantical mapping of IDEF0 graphical models (diagrams) into CDIF transfer files.

Section 5: Syntactical Mapping

This gives the full description of the syntactical mapping of IDEF0 graphical models into CDIF transfer files.

Appendix A: Figures

This shows all the figures used in the report as well as the figures with the graphical representation of the mapping of some IDEF0 structures.

Appendix B: Alternative Solutions

This gives other ways to map specific IDEF0 components into the CDIF transfer file.

Appendix C: Transfer Summary

This gives a summary of the IDEF0 to CDIF transfer and gives a list of additional CDIF structures needed for the 100% transfer.

References

This provides the references to the documents used in creating this report.

Conventions:

Italics: CDIF meta-entities, meta-relationships, meta-attributes.
Italics & Bold: values for meta-attributes.

1.0 BACKGROUND

The Integration Definition for Function Modeling (IDEF0) is a standard modeling technique used in the logical definition of an organization's data resources. The standard defines the syntax and semantics of the language constructs used in creating a function model. With the acceptance of the standard, more vendors are providing support for this technique.

One serious limitation to the standard is the lack of a formal standard mechanism for transferring information between different IDEF tools and between IDEF tools and other tools supporting different modeling techniques. This leaves the users of IDEF tools at a great disadvantage. A user is restricted to using a particular tool provided by a particular vendor thus seriously hindering the reusability of the information represented in a model. This may also force an organization to mandate the use of a specific tool. This infringes on a users freedom to use a tool that best supports both the work and the users particular style.

One solution is the use of a standard method to exchange data between tools. The CASE Data Interchange Format (CDIF) Family of Standards is primarily designed to be used as a description of a mechanism for transferring information between CASE tools.

Vendors who support the CDIF standards need only define the exchange mechanism once for their particular tool. This would allow the exchange of information developed using a particular vendor's tool with other vendors' tools that support the CDIF standards. Not only would the use of these standards allow users of IDEF tools to exchange data between IDEF tools, it could also support the exchange of information captured by an IDEF tool with other CASE tools.

The ability to freely exchange data between tools benefits an organization by promoting the reuse of information resources. It also allows the IDEF users to focus more on the analysis of business and information problems instead of problems and limitations of tools.

2.0 INTRODUCTION

This document will describe a conceptual mapping of an IDEF0 model into the CDIF transfer file. The document will cover both syntax and semantics of the model. This work will demonstrate that it is possible to use the standard exchange for moving information between different tools.

This ATP funded work was to research a standard transfer mechanism for IDEF0 models. The document covers the Normative section of IDEF0.

CDIF has defined a Meta-model which captures the syntax and semantics of data used by numerous tools. The Meta-model has a set of different subject areas allowing the vendors to express the contents of their tool repositories using a standard format. This provides a common definition of model data for communicating between different tools.

CDIF can also be used in situations where vendor defined data that does not map to the Meta-model (extensible data) needs to be transferred. The CDIF Family of Standards includes a Framework for Modeling and Extensibility Standard which allows a vendor to define new meta-objects used to capture this extensible data. It also defines the relationships which link the newly defined meta-objects to the existing standard Meta-model.

3.0 CDIF - CASE DATA INTERCHANGE FORMAT

3.1 Introduction

CDIF consists of a set of standards referred to as the CDIF Family of Standards which provides a standard means for exchanging information between CASE tools. These standards can move both the syntax and semantics of information captured within a particular tool.

The current set of standards is broken into four sections: Overview, Framework, Integrated Meta-model, and Transfer Format. This report uses information defined in the Integrated Meta-model section.

The Integrated Meta-model is divided into partitions or subject areas. Each subject area defines a meta-model for specific types of information that could be developed using a CASE tool. For example, the Data Flow Modeling Subject Area defines meta-data for process flow models, the Data Model Subject Area defines meta-data captured in data models, and Presentation Location and Connectivity Subject Area is used to capture the syntactic data about a particular model.

The components of CDIF that were used for this mapping were Common Subject Area, Data Flow Model Subject Area, and Presentation Location and Connectivity Subject Area. All three subject areas were necessary for capturing the types of information created by the IDEF0 tools.

The Common Subject Area applies to all of the CDIF Meta-model standards. It is used to capture information relevant to all system development objects. It addresses such items as who created the object, when it was last updated and possible synonyms for the object.

The Data Flow Modeling Subject Area provides support for modeling the input-process-output view of a system. It provides all the concepts needed for data flows into and out of processes, with associated data stores and external entities.

The Presentation Location and Connectivity Subject Area covers information that provides either spatial position information for specific instances, or relative position in the directed graph sense (nature of the connectivity between related objects), relating to the graphical representation of semantic objects.

3.2 Using CDIF to Transfer IDEF Models

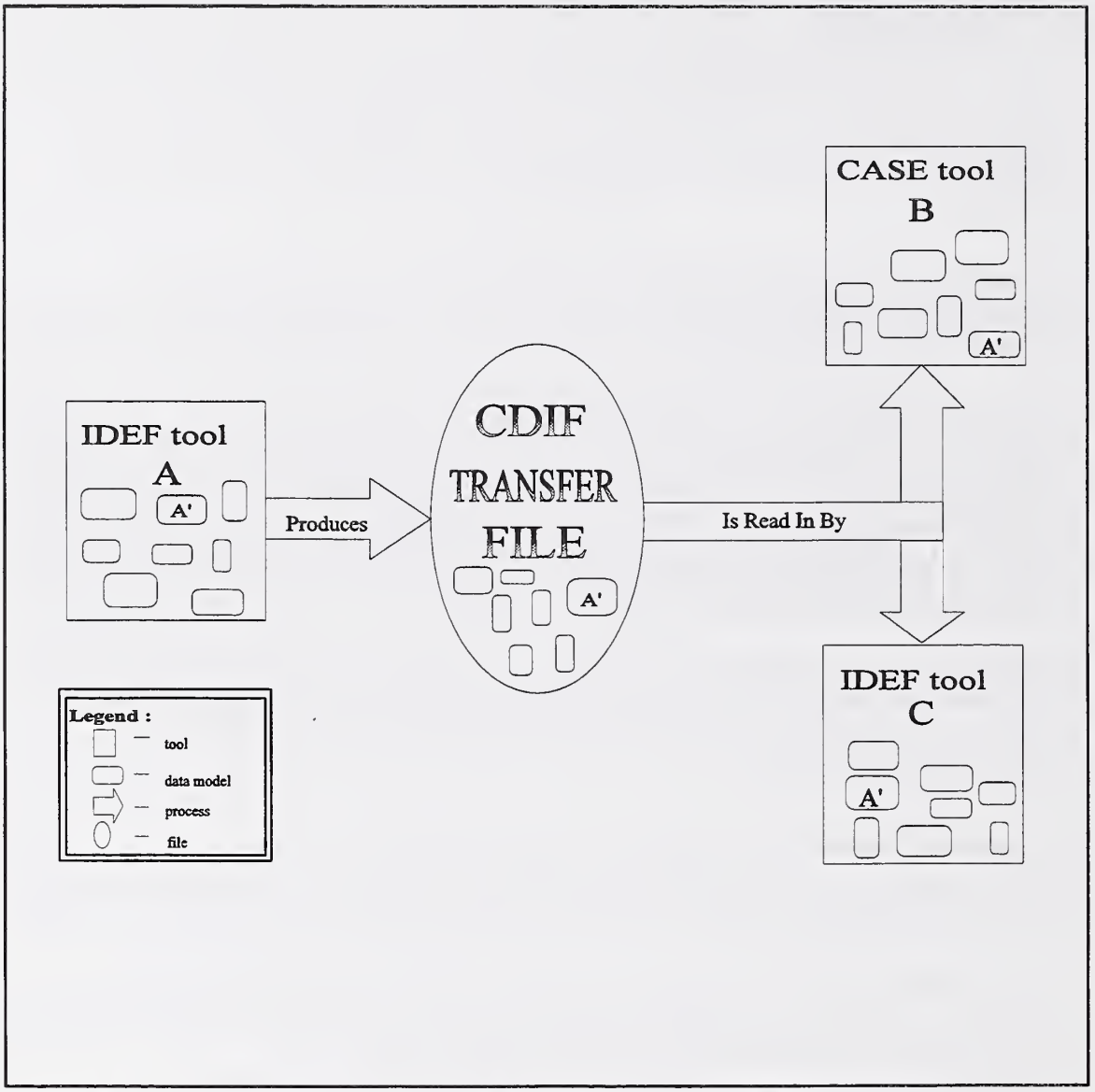

Figure 1. Transferring IDEF Models Using CDIF

It is very important to understand the basic concepts of a CDIF based transfer. There exists an IDEF tool A with some process models. This tool produces a CDIF transfer file for a particular process model A'. This file can then be read in by another IDEF tool C or a CASE tool B. The CDIF transfer file preserves the concepts of A' through the transfer into the other tools. A' can now be accessed, printed, and modified by a user of tool C or a user of tool B without any influence on the model A' in tool A.

3.3 Benefits

Many benefits can be gained from the use of the standard transfer mechanism. One great benefit to the users of IDEF tools is the ability to reuse already created models. Much time and money is currently spent on developing models, when a lot of information represented on these models already exist.

To promote reuse organizations are developing procedures for managing this information. CDIF can be used to assist in this effort by providing the standard exchange mechanism.

Another benefit to the user is the ability to use tools best suited for a particular job. Models created by one user for a project using a particular tool can be read and modified by other users using different tools. This can also save time and money by reducing the effort spent on purchasing and learning new tools.

If an organization chooses to exchange information between different tools it usually invests in customized converters to get the job done. These converters may not work on updated versions of those specific tools. Also additional converters would be needed for expanding this information exchange between other tools. As the number of tools increases so does the problem of managing the transfers. The benefit to using CDIF as a solution to this problem is that CDIF reduces or even eliminates the need for customized converters for the transfer of information between different tools.

A benefit to IDEF tool vendors is that their tools would be able to interface with multiple tools thus increasing marketability. As the figure 1 indicates, an IDEF tool stores the contents of a model in a file which then can be converted into a CDIF transfer file using the converter developed by the IDEF tool vendor. Through a converter developed by another vendor the CDIF transfer file can then be changed into a file format which is used by the specific CASE or IDEF tool. Since the transfer mechanism is standard, vendors could spend more time on enhancing and developing features for their tools.

Moreover, there is another great benefit to using CDIF as a transfer format. CDIF transfers the syntax and semantics of a model. This is very important to IDEF users because more than the diagrams are transferred between tools. It would be incorrect to simply map a box from an IDEF (or CASE) tool to a box in some other CASE tool without checking the semantics for a box in both tools because those boxes may have different meanings.

3.4 Issues

One issue of transfer formats is that there is no guarantee for 100% transfer of data. This occurs because one tool might not support all the concepts of another tool, in which case some information may be lost. Another situation would be if a tool handles multiple meanings of a concept of another tool. For example, one tool might have a classification of calls, while another tool just handles one concept of a call (refer to the section 4.2.3 for types of calls).

Another issue is that vendors currently are not implementing the CDIF Family of Standards. The reason is that most of the CDIF work has yet to be approved as official standards. Also tool vendors may have a difficult time realizing the benefit of using CDIF. Users of tools should stress the importance of having a standard transfer format.

4.0 SEMANTICAL MAPPING

4.1 Basic IDEF0 Structures

4.1.1 IDEF0 Top-Level Context Diagram

To map an IDEF0 top-level context diagram into a CDIF transfer file, create an instance of the CDIF meta-entity *DataFlowModel* and *DFMProcessDefinition*. There is no meta-entity DataFlowModelDefinition in CDIF; therefore we must use *DFMProcessDefinition* in order to capture the true meaning of the model. This *DFMProcessDefinition* will then contain the top-level function A0 and the ICOMs going in and out of A0. Create an instance of the CDIF meta-entity *DFMProcessDefinition* for A-0, and connect this instance with the instance of the CDIF meta-relationship *DataFlowModel* via the CDIF meta-relationship *DataFlowModel.HasRoot.DFMProcessDefinition*.

4.1.2 IDEF0 Functions

To map an IDEF0 function (process) into a CDIF transfer file, create instances of the CDIF meta-entities: *DFMProcessDefinition* and *DFMProcess*. Then create instances of the CDIF meta-relationships: *DFMProcess.References.DFMProcessDefinition* and *DFMProcessDefinition.Contains.DFMProcess*. The CDIF meta-relationship *DFMProcess.References.DFMProcessDefinition* allows the function (process) to be connected with its definition. The CDIF meta-relationship *DFMProcessDefinition.Contains.DFMProcess* allows a process definition to declare its structure.

4.1.3 IDEF0 ICOMs

To map an IDEF0 ICOM into a CDIF transfer file, create instances of CDIF meta-entities: *FlowDefinition* and *Flow*. Then create an instance of the CDIF meta-relationship *Flow.References.FlowDefinition*. This meta-relationship allows a flow to be linked with its definition. An instance of the CDIF meta-relationship *DFMProcessDefinition.Contains.Flow* is also needed to be created. This meta-relationship, like *DFMProcessDefinition.Contains.DFMProcess*, is needed to build the architecture of that *DFMProcessDefinition* which contains the *DFMProcess* or *Flow*.

4.1.4 Putting Together ICOMs and Functions

In CDIF, flows (ICOMs) cannot enter (or leave) a process directly: they need to go through a *FlowPort* -- a subtype of a *Port*.

The meta-entity *Port* is a generic, abstract concept for *DefinitionObject*s (supertype of *DFMProcessDefinition* and *FlowDefinition*) to declare their interfaces to other objects. There are two types of interfaces to be specified: the formal interface to the outside of the *DefinitionObject* is formed by all instances of subtypes of *Port* which have the value of its meta-attribute *IsFormal* set to ***True***. To specify the actual Ports that reference the formal Ports, instances of subtypes of Port are used which have the value of the meta-attribute *IsFormal* set to ***False***.

Because the interface of *DFMProcesses* is accessed by *Flows* only, concrete meta-entity FlowPort was provided instead of the abstract meta-entity *Port*. *Flows* cannot "cross" the boundary of a *Process* without using the concept of a *FlowPort*.

A *Port* has the following subtypes:

- o *FlowInputPort*
- o *ConstraintPort*
- o *FlowOutputPort*
- o *SupportPort*

These subtypes correspond directly to the IDEF0 ICOMs:

Input	- *FlowInputPort*
Control	- *ConstraintPort*
Output	- *FlowOutputPort*
Mechanism	- *SupportPort*

Like in IDEF0, a CDIF flow is just a stream. A CDIF flow is not an Input flow or an Output flow without a port. The IDEF0 role of a flow is represented in the CDIF concept of a port.

4.1.5 Process Decomposition: Crossing an Abstraction Level

In CDIF, *DefinitionObject*s are not contained by other *DefinitionObject*s. Only *ComponentObject*s are contained by *DefinitionObject*s. Every *DFMProcessDefinition* used in the mapping represents a line between levels of abstraction. A *DFMProcessDefinition* itself is not contained by a particular abstraction level. However, a *DFMProcessDefinition* contains all the components (CDIF meta-entities) which exist within an abstraction level "below the abstraction line" (see Figure 2). The dashed lines on the Figure 2 are the lines between different abstraction levels. A *DFMProcessDefinition* contains various CDIF Meta-entities (CDIF ME) such as *Flow*, *FlowInputPort*, *FlowOutputPort*, *ConstraintPort*, *SupportPort*, *EquivalenceSet*, *ReferencedElement*, *DFMProcess*, and others.)

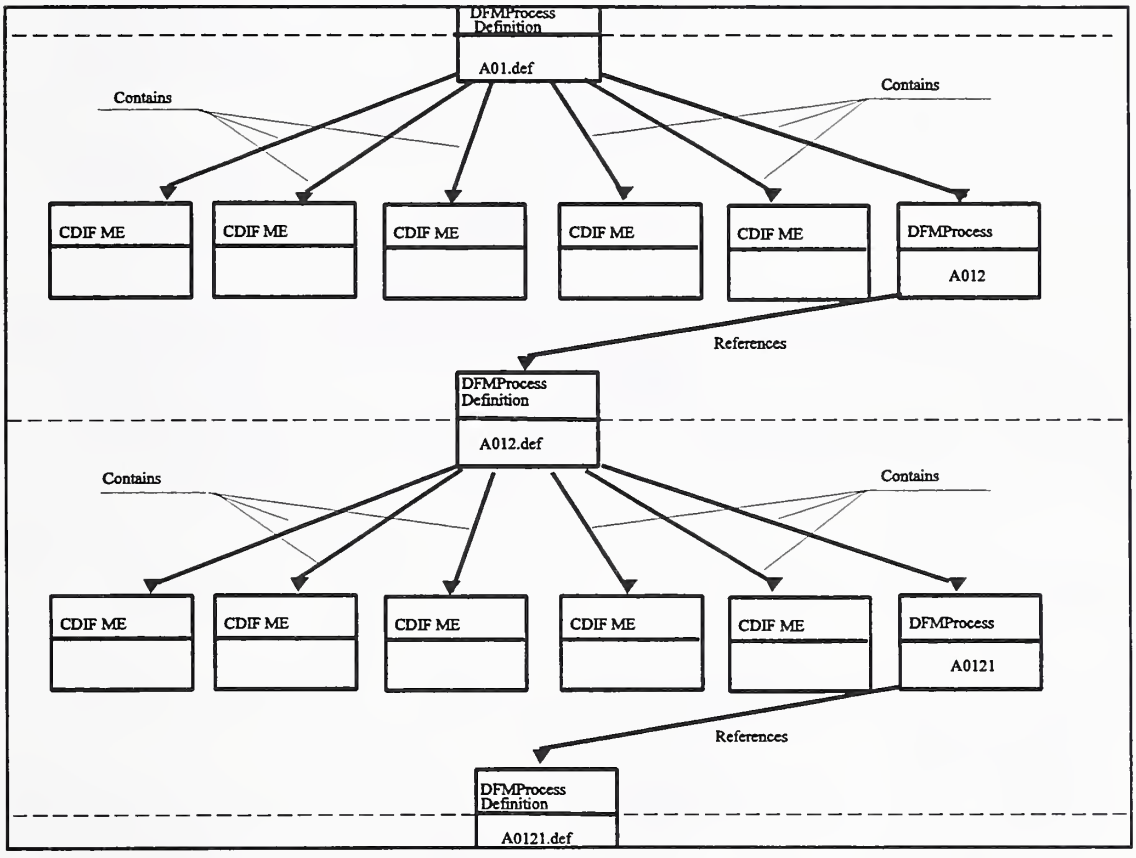

Figure 2. Crossing an Abstraction Level

4.1.6 Example: Mapping A-0 Diagram into CDIF Transfer File

The figure below is a typical A-0 diagram. We are at the highest level of abstaction at which we see the purpose and viewpoint of the model. At this level we need to define the whole model (or diagram) A-0 in CDIF. This is done using CDIF meta-entity *DataFlowModel*. The purpose and viewpoint of the model can be captured using the local meta-attribute *FullDescription* of the *DataFlowModel*.

Below we will find the mapping of this diagram into the CDIF transfer file.

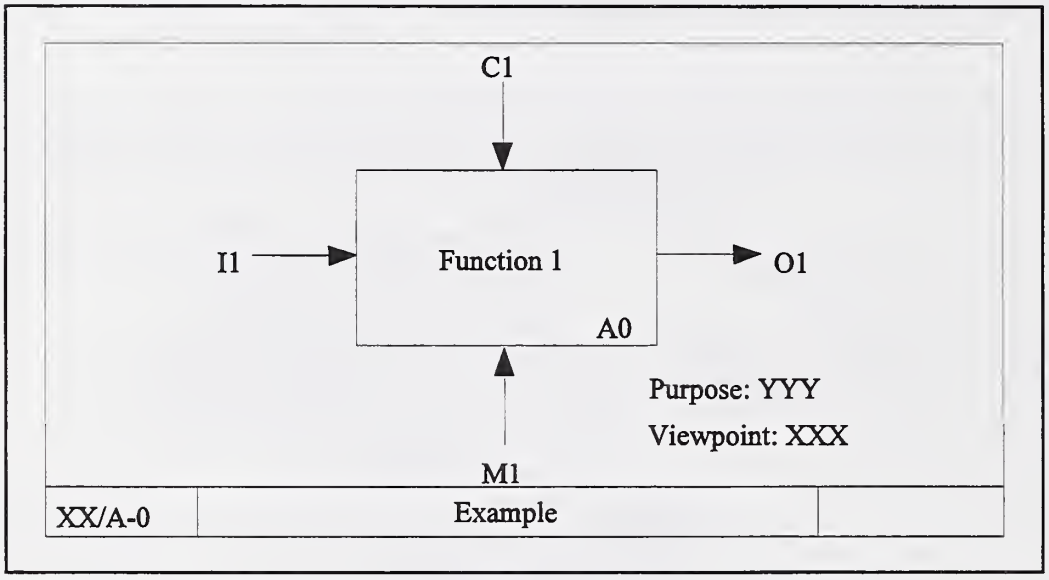

Figure 3. A-0 Diagram

CDIF Transfer File

Meta-entity . . . . . DataFlowModel
    Meta-attributes
    CDIFIdentifier . . . . . dfm_example
    Name . . . . . "Example"
    FullDescription . . . . . "Purpose: YYY. Viewpoint: XXX."

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A-0
    Name . . . . . "A-0_def"

Meta-relationship . . . . . DataFlowModel.HasRoot.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . hr
SourceEntity . . . . . dfm_example
DestinationEntity . . . . . pd_A-0

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A0
Name . . . . . "A0"
BriefDescription . . . . . "Function 1"

Meta-relationship . . . . . DFMProcessDefinition.Contains.DFMProcess
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.dfmp_A0
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . dfmp_A0

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_A0
Name . . . . . "A0_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A0.r.pd_A0
SourceEntity . . . . . dfmp_A0
DestinationEntity . . . . . pd_A0

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_I1
Name . . . . . "I1"
ContextDescription . . . . . This is a generic input for the function 1.

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.f_I1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . f_I1

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_I1a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.fip_I1a
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . fip_I1a

Meta-relationship . . . . . FlowInputPort.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_I1a.c.f_I1
SourceEntity . . . . . fip_I1a
DestinationEntity . . . . . f_I1

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_I1

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.es_I1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . es_I1

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_I1.hm.fip_I1a
SourceEntity . . . . . es_I1
DestinationEntity . . . . . fip_I1a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_I1

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.re_I1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . re_I1

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_I1.hm.re_I1
SourceEntity . . . . . es_I1
DestinationEntity . . . . . re_I1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_I1.dp.dfmp_A0
SourceEntity . . . . . re_I1
DestinationEntity . . . . . dfmp_A0
SequenceNumber 1

Meta-entity . . . . . FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fd_I1
Name . . . . . "I1_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_I1.r.fd_I1
SourceEntity . . . . . f_I1
DestinationEntity . . . . . fd_I1

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_I1a.r.fd_I1
SourceEntity . . . . . fip_I1a
DestinationEntity . . . . . fd_I1

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_I1f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.fip_I1f
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fip_I1f

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_I1f.r.fd_I1
SourceEntity . . . . . fip_I1f
DestinationEntity . . . . . fd_I1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_I1.dp.fip_I1f
SourceEntity . . . . . re_I1
DestinationEntity . . . . . fip_I1f
SequenceNumber 2

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_C1
Name . . . . . "C1"
ContextDescription . . . . . This is a generic control for the function 1.

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.f_C1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . f_C1

Meta-entity . . . . . ConstraintPort
Meta-attributes
CDIFIdentifier . . . . . cp_C1a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.ConstraintPort
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.cp_C1a
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . cp_C1a

Meta-relationship . . . . . ConstraintPort.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . cp_C1a.c.f_C1
SourceEntity . . . . . cp_C1a
DestinationEntity . . . . . f_C1

Meta-entity . . . . . EquivalenceSet
    Meta-attributes
    CDIFIdentifier . . . . . es_C1

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
    Meta-attributes
    CDIFIdentifier . . . . . pd_A-0.c.es_C1
    SourceEntity . . . . . pd_A-0
    DestinationEntity . . . . . es_C1

Meta-relationship . . . . . EquivalenceSet.HasMember.ConstraintPort
    Meta-attributes
    CDIFIdentifier . . . . . es_C1.hm.cp_C1a
    SourceEntity . . . . . es_C1
    DestinationEntity . . . . . cp_C1a

Meta-entity . . . . . ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . re_C1

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . pd_A-0.c.re_C1
    SourceEntity . . . . . pd_A-0
    DestinationEntity . . . . . re_C1

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . es_C1.hm.re_C1
    SourceEntity . . . . . es_C1
    DestinationEntity . . . . . re_C1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_C1.dp.dfmp_A0
    SourceEntity . . . . . re_C1
    DestinationEntity . . . . . dfmp_A0
    SequenceNumber 1

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_C1
    Name . . . . . "C1_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_C1.r.fd_C1
SourceEntity . . . . . f_C1
DestinationEntity . . . . . fd_C1

Meta-relationship . . . . . ConstraintPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . cp_C1a.r.fd_C1
SourceEntity . . . . . cp_C1a
DestinationEntity . . . . . fd_C1

Meta-entity . . . . . ConstraintPort
Meta-attributes
CDIFIdentifier . . . . . cp_C1f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.ConstraintPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.cp_C1f
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . cp_C1f

Meta-relationship . . . . . ConstraintPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . cp_C1f.r.fd_C1
SourceEntity . . . . . cp_C1f
DestinationEntity . . . . . fd_C1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_C1.dp.cp_C1f
SourceEntity . . . . . re_C1
DestinationEntity . . . . . cp_C1f
SequenceNumber 2

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_O1
Name . . . . . "O1"
ContextDescription . . . . . This is a generic output for the function 1.

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.f_O1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . f_O1

Meta-entity . . . . . FlowOutputPort
Meta-attributes
CDIFIdentifier . . . . . fop_O1a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowOutputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.fop_O1a
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . fop_O1a

Meta-relationship . . . . . FlowOutputPort.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . fop_O1a.p.f_O1
SourceEntity . . . . . fop_O1a
DestinationEntity . . . . . f_O1

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_O1

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.es_O1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . es_O1

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowOutputPort
Meta-attributes
CDIFIdentifier . . . . . es_O1.hm.fop_O1a
SourceEntity . . . . . es_O1
DestinationEntity . . . . . fop_O1a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_O1

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.re_O1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . re_O1

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_O1.hm.re_O1
SourceEntity . . . . . es_O1
DestinationEntity . . . . . re_O1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_O1.dp.dfmp_A0
SourceEntity . . . . . re_O1
DestinationEntity . . . . . dfmp_A0
SequenceNumber 1

Meta-entity . . . . . FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fd_O1
Name . . . . . "O1_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_O1.r.fd_O1
SourceEntity . . . . . f_O1
DestinationEntity . . . . . fd_O1

Meta-relationship . . . . . FlowOutputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fop_O1a.r.fd_O1
SourceEntity . . . . . fop_O1a
DestinationEntity . . . . . fd_O1

Meta-entity . . . . . FlowOutputPort
Meta-attributes
CDIFIdentifier . . . . . fop_O1f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowOutputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.fop_O1f
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fop_O1f

Meta-relationship . . . . . FlowOutputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fop_O1f.r.fd_O1
SourceEntity . . . . . fop_O1f
DestinationEntity . . . . . fd_O1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_O1.dp.fop_O1f
SourceEntity . . . . . re_O1
DestinationEntity . . . . . fop_O1f
SequenceNumber 2

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_M1
Name . . . . . "M1"
ContextDescription . . . . . This is a generic mechanism for the function 1.

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.f_M1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . f_M1

Meta-entity . . . . . SupportPort
Meta-attributes
CDIFIdentifier . . . . . sp_M1a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.SupportPort
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.sp_M1a
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . sp_M1a

Meta-relationship . . . . . SupportPort.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . sp_M1a.c.f_M1
SourceEntity . . . . . sp_M1a
DestinationEntity . . . . . f_M1

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_M1

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.es_M1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . es_M1

Meta-relationship . . . . . EquivalenceSet.HasMember.SupportPort
Meta-attributes
CDIFIdentifier . . . . . es_M1.hm.sp_M1a
SourceEntity . . . . . es_M1
DestinationEntity . . . . . sp_M1a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_M1

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A-0.c.re_M1
SourceEntity . . . . . pd_A-0
DestinationEntity . . . . . re_M1

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_M1.hm.re_M1
SourceEntity . . . . . es_M1
DestinationEntity . . . . . re_M1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_M1.dp.dfmp_A0
SourceEntity . . . . . re_M1
DestinationEntity . . . . . dfmp_A0
SequenceNumber 1

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_M1
    Name . . . . . "M1_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_M1.r.fd_M1
    SourceEntity . . . . . f_M1
    DestinationEntity . . . . . fd_M1

Meta-relationship . . . . . SupportPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . sp_M1a.r.fd_M1
    SourceEntity . . . . . sp_M1a
    DestinationEntity . . . . . fd_M1

Meta-entity . . . . . SupportPort
    Meta-attributes
    CDIFIdentifier . . . . . sp_M1f
    IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.SupportPort
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.sp_M1f
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . sp_M1f

Meta-relationship . . . . . SupportPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . sp_M1f.r.fd_M1
    SourceEntity . . . . . sp_M1f
    DestinationEntity . . . . . fd_M1

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_M1.dp.sp_M1f
    SourceEntity . . . . . re_M1
    DestinationEntity . . . . . sp_M1f
    SequenceNumber 2

4.1.7 Node References

Each diagram in an IDEF0 model has a node reference, which is used to uniquely identify the diagram and its position in the model hierarchy. The node references is composed of the abbreviated model name and the diagram node number, separated by a slash (/). For example, a model named Example might be abbreviated as EX, and a node reference might then be EX/A132. References to a diagram in the same model may omit the model name abbreviation, using only the diagram node number.

Node references can be handled in two different ways in CDIF. The first and easiest way is to put the node reference in the local meta-attribute *Name* of the *DFMProcess*. But in this case we will need to capture the real name of the function in *BriefDescription*. The second way is to create a CDIF local meta-attribute NodeReference (TYPE: string) using the CDIF Framework for Modeling and Extensibility.

4.1.8 Model Notes

Even though model notes are optional, we would like to mention them in this report. Model notes are denoted by an integer inside a small square box. For a particular diagram, the note number is formed in a consecutive sequence, starting at 1. (Vertical pipes surrounding the note number are used as an alternative notation: |n|.)

The easiest way to represent a model note in CDIF is to put it into the *ContextDescription* of the *DFMProcess* for which this model note was created. The sequencing is presented using the local meta-attribute *ContextIdentifier*.

4.1.9 FEOs, Text, and Glossary

The node-numbering extension notation consists of a single letter appended to the associated node number to provide the basis for coordinating FEOs, text, and glossary terms. If there is more than one FEO, glossary term, or text page associated with given IDEF0 node, the pages should be designated with an additional number to uniquely identify each. For example, node numbers for the second glossary term shall contain "G2" for "second glossary" (e.g., A132G2).

If a FEO, text, or glossary term refers to the type of the process (not to the particular instance of this type, but to all the instances of this type), then this FEO, text, or glossary term can be captured using the local meta-attribute *SpecificationText* of the meta-entity *DFMProcessDefinition*. If, however, the FEO, text, or glossary term refers to the particular instance of the process, it can be captured using *FullDescription* of the *DFMProcess*.

4.2 Forks, Joins, and Calls

4.2.1 IDEF0 Forks

All the IDEF0 Forks can be categorized into three groups:

- "A Copy" Fork
- "A Portion" Fork
- "The Sum" Fork

4.2.1.1 "A Copy" Fork

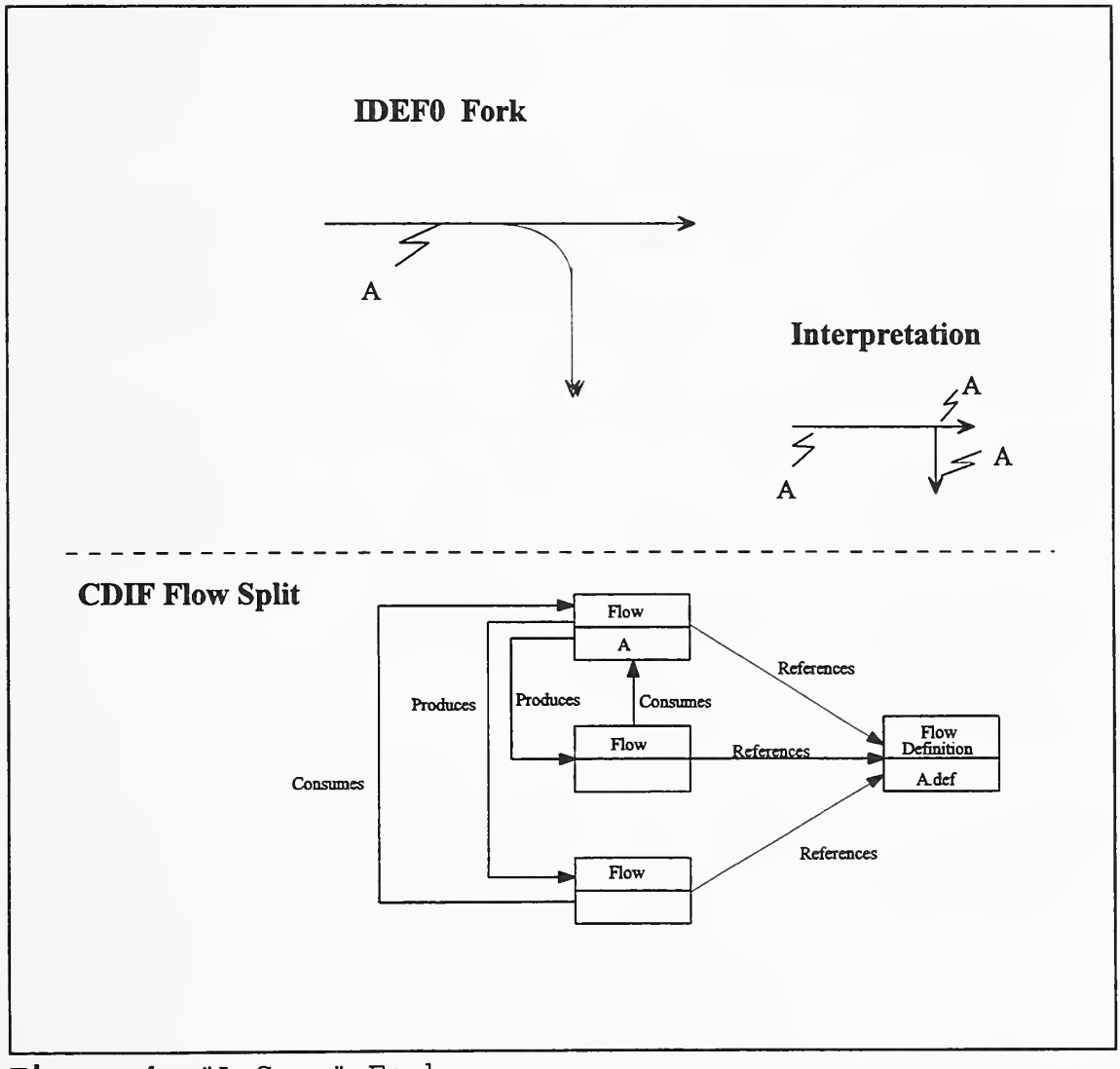

Figure 4. "A Copy" Fork

The diagram above shows the "Copy" type of IDEF0 Fork and its mapping into the CDIF graphical representation of the transfer format. We need to create a *FlowDefinition* for A, and then reuse it for all the *Flow*s. The following is the CDIF transfer file for the figure above. Since we have three instances of *Flow* A and we cannot have the same *CDIFIdentifiers* for all of them[1], we will use single and double quoted letter A. In general, a single or double quoted letter which plays a role of a CDIFIdentifier will identify a particular instance of the flow indicated by that letter.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.r.fd_A
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A"

---

[1] CDIFIdentifiers are unique.

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A".r.fd_A
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A.p.f_A'
SourceEntity . . . . . f_A
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A.p.f_A"
SourceEntity . . . . . f_A
DestinationEntity . . . . . f_A"

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A'.c.f_A
SourceEntity . . . . . f_A'
DestinationEntity . . . . . f_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A".c.f_A
SourceEntity . . . . . f_A"
DestinationEntity . . . . . f_A

4.2.1.2 "A Portion" Fork

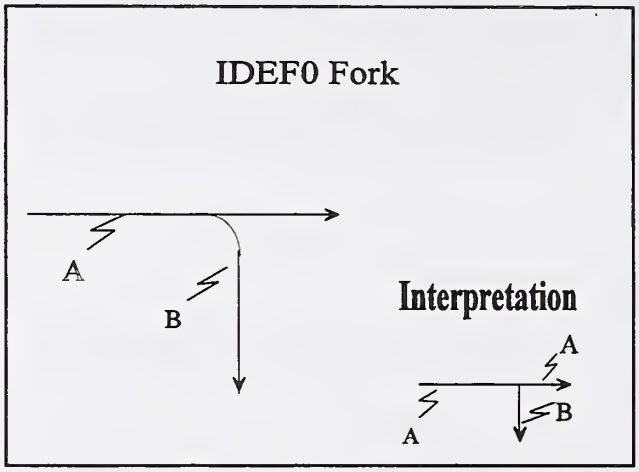

Figure 5. "A Portion" Fork

The above figure is another type of IDEF0 Fork. The flow B is created as a portion of the flow A. In this case, we need to create a *FlowDefinition* for A and a *FlowDefinition* for B. We will reuse the *FlowDefinition* for A to reference the second A flow. A graphical mapping of this type of fork can be found in Appendix A. The following is the CDIF transfer file for the Figure 5.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_b

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_b.r.fd_A:b
    SourceEntity . . . . . f_b
    DestinationEntity . . . . . fd_A:b

Meta-relationship . . . . . FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fd_A.c.f_b
    SourceEntity . . . . . fd_A
    DestinationEntity . . . . . f_b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.r.fd_A
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_B

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_B.r.fd_A:b
    SourceEntity . . . . . f_B
    DestinationEntity . . . . . fd_A:b

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A.p.f_A'
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . f_A'

Meta-relationship ..... FlowProducerConsumer.Produces.Flow
    Meta-attributes
    CDIFIdentifier ..... f_A.p.f_B
    SourceEntity ..... f_A
    DestinationEntity ..... f_B

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier ..... f_A'.c.f_A
    SourceEntity ..... f_A'
    DestinationEntity ..... f_A

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier ..... f_B.c.f_A
    SourceEntity ..... f_B
    DestinationEntity ..... f_A

/* The following is needed to show semantically that the flow B is a part of the flow A, and that it's the part b which is contained by the FlowDefinition fd_A[2]*/

Meta-entity ..... EquivalenceSet
    Meta-attributes
    CDIFIdentifier ..... es_b

Meta-relationship ..... EquivalenceSet.HasMember.Flow
    Meta-attributes
    CDIFIdentifier ..... es_b.hm.f_B
    SourceEntity ..... es_b
    DestinationEntity ..... f_B

Meta-entity ..... ReferencedElement
    Meta-attributes
    CDIFIdentifier ..... re_b

---

[2] The capital letter B indicates the actual flow B, whereas the small letter b is used to show the structure of the flow A which consists of flow b (and possibly some other flows). The capital B represents the actual flow B from the diagram, whereas the small b represents the conceptual flow which is a part of the flow A.

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_b.hm.re_b
SourceEntity . . . . . es_b
DestinationEntity . . . . . re_b

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_A
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_A
SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_b
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_b
SequenceNumber 2

4.2.1.3 "The Sum" Fork

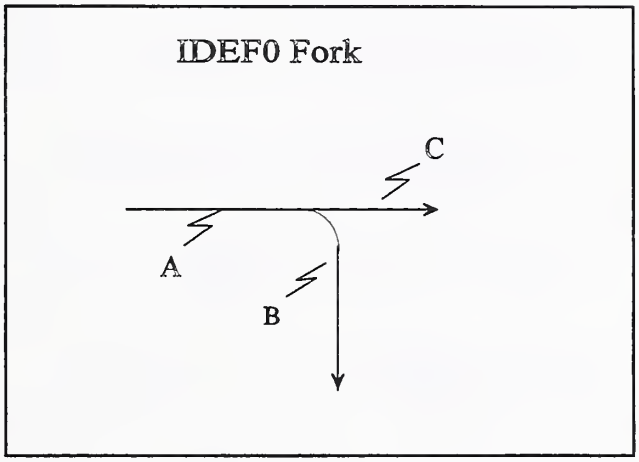

Figure 6. "The Sum" Fork

The above figure is the third type of IDEF0 Fork. The flow A contains flows B and C in its structure. We need to create a *FlowDefinition* for A, a *FlowDefinition* for B, and a *FlowDefinition* for C. A graphical representation of the mapping of this type of fork can be found in Appendix A. The following is the CDIF transfer file for the Figure 6.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_b

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_b.r.fd_A:b
    SourceEntity . . . . . f_b
    DestinationEntity . . . . . fd_A:b

Meta-relationship . . . . . FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fd_A.c.f_b
    SourceEntity . . . . . fd_A
    DestinationEntity . . . . . f_b

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:c

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_c

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_c.r.fd_A:c
    SourceEntity . . . . . f_c
    DestinationEntity . . . . . fd_A:c

Meta-relationship . . . . . FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fd_A.c.f_c
    SourceEntity . . . . . fd_A
    DestinationEntity . . . . . f_c

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_B

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_B.r.fd_A:b
    SourceEntity . . . . . f_B
    DestinationEntity . . . . . fd_A:b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_C
    Name . . . . . "C"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_C.r.fd_A:c
    SourceEntity . . . . . f_C
    DestinationEntity . . . . . fd_A:c

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A.p.f_B
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . f_B

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A.p.f_C
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . f_C

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_B.c.f_A
    SourceEntity . . . . . f_B
    DestinationEntity . . . . . f_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_C.c.f_A
    SourceEntity . . . . . f_C
    DestinationEntity . . . . . f_A

/* This is needed to show semantically that the flow B is a part of the flow A, and that it's the part b which is contained by the FlowDefinition fd_A. We show the same semantics for the flow C.*/

Meta-entity . . . . . EquivalenceSet
    Meta-attributes
    CDIFIdentifier . . . . . es_b

Meta-relationship . . . . . EquivalenceSet.HasMember.Flow
    Meta-attributes
    CDIFIdentifier . . . . . es_b.hm.f_B
    SourceEntity . . . . . es_b
    DestinationEntity . . . . . f_B

Meta-entity . . . . . ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . re_b

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . es_b.hm.re_b
    SourceEntity . . . . . es_b
    DestinationEntity . . . . . re_b

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
    Meta-attributes
    CDIFIdentifier . . . . . re_b.dp.f_A
    SourceEntity . . . . . re_b
    DestinationEntity . . . . . f_A
    SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_b
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_b
SequenceNumber 2

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_c

Meta-relationship . . . . . EquivalenceSet.HasMember.Flow
Meta-attributes
CDIFIdentifier . . . . . es_c.hm.f_C
SourceEntity . . . . . es_c
DestinationEntity . . . . . f_C

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_c

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_c.hm.re_c
SourceEntity . . . . . es_c
DestinationEntity . . . . . re_c

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_c.dp.f_A
SourceEntity . . . . . re_c
DestinationEntity . . . . . f_A
SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_c.dp.f_c
SourceEntity . . . . . re_c
DestinationEntity . . . . . f_c
SequenceNumber 2

4.2.2 IDEF0 Joins

IDEF0 Joins can be also categorized into similar to IDEF0 Forks categories:

- "A Copy" Join
- "A Portion" Join
- "The Sum" Join

4.2.2.1 "A Copy" Join

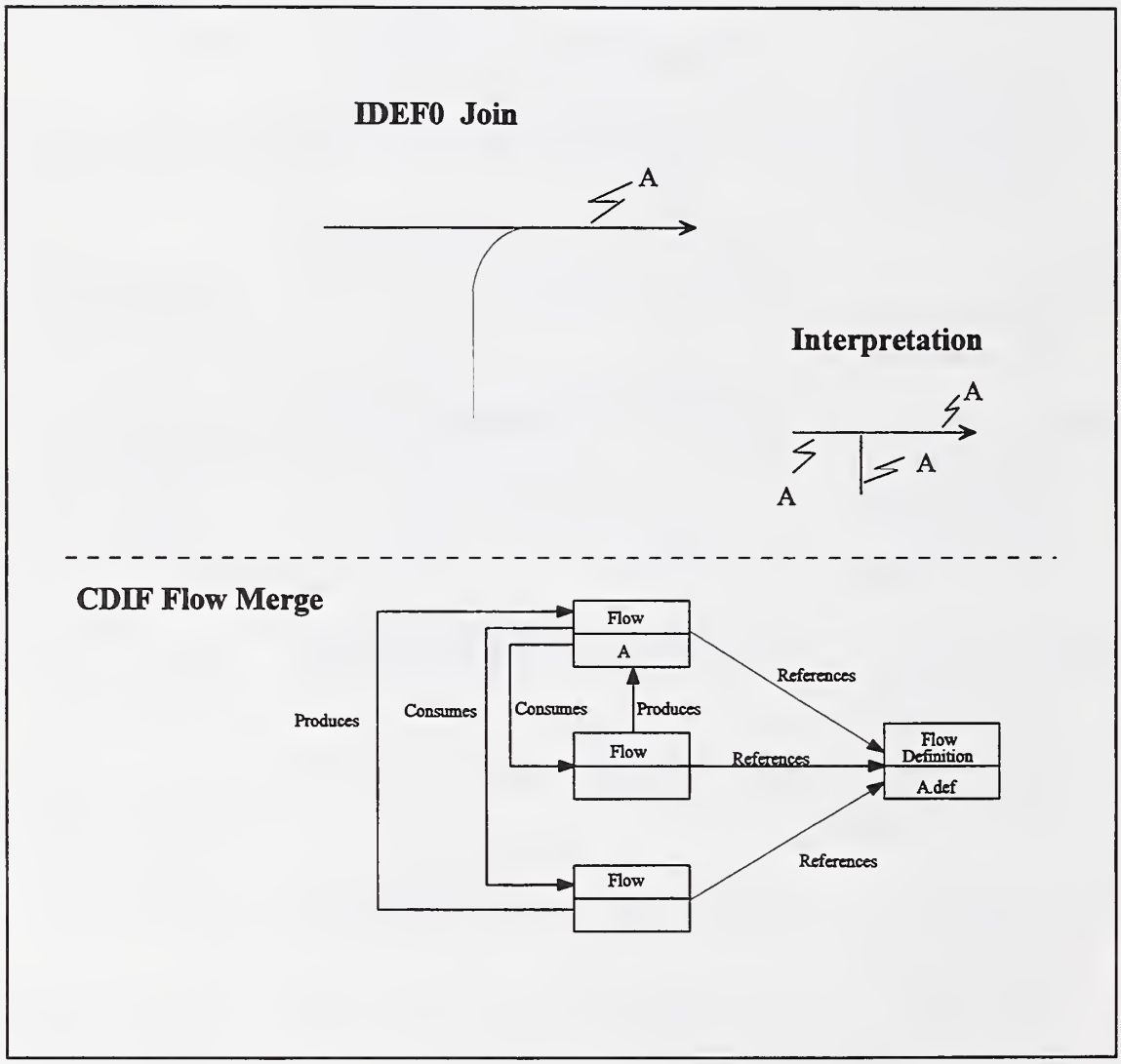

Figure 7. "A Copy" Join

The diagram above shows the "Copy" type of IDEF0 Join and its mapping into the CDIF graphical representation of the transfer format. The mapping is very similar to the mapping of the IDEF0 "A Copy" Fork. The only difference is in role players for consumers and producers. In the "Copy" Fork, *Flow* A produces *Flow*s (copies of A), whereas in the "Copy" Join, Flow A consumes *Flow*s (copies of A). Also, in the "Copy" Fork, *Flow*s (copies of A) consume *Flow* A, whereas in the "Copy" Join, *Flow*s (copies of A) produce *Flow* A. The following is the CDIF mapping (graphically) of the example above.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.r.fd_A
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A".r.fd_A
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fd_A

/* The following part of the mapping is in **Bold** to emphasize the difference between the mapping of an IDEF0 Fork and a Join. */

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A'.p.f_A
SourceEntity . . . . . f_A'
DestinationEntity . . . . . f_A

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A".p.f_A
SourceEntity . . . . . f_A"
DestinationEntity . . . . . f_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A.c.f_A'
SourceEntity . . . . . f_A
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A.c.f_A"
SourceEntity . . . . . f_A
DestinationEntity . . . . . f_A"

4.2.2.2 "A Portion" Join

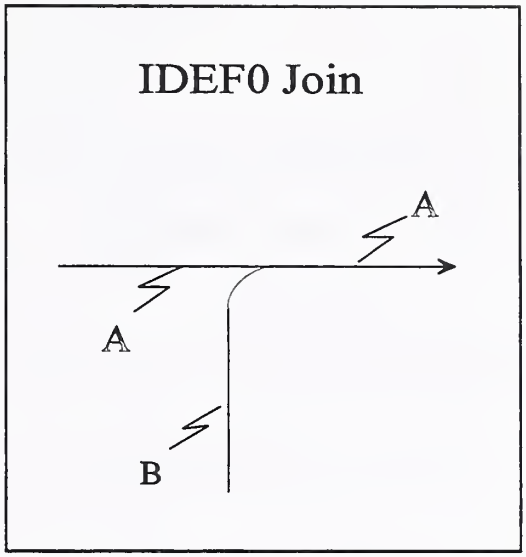

Figure 8. "A Portion" Join

The above figure is another type of IDEF0 Join. The interpretation for this type of IDEF0 Join is the following: flow A consists of flow B (and possibly something else); more of B flows into A. A graphical mapping of this type of fork can be found in Appendix A. Again, the mapping for "A Portion" Join can be obtained from the mapping of the "A Portion" Fork by flipping the CDIF meta-relationship *FlowProducerConsumer.Consumes.Flow* with *FlowProducerConsumer.Produces.Flow*, and vise versa. The following is the CDIF transfer file for the Figure 8.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_b

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_b.r.fd_A:b
    SourceEntity . . . . . f_b
    DestinationEntity . . . . . fd_A:b

Meta-relationship . . . . . FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fd_A.c.f_b
    SourceEntity . . . . . fd_A
    DestinationEntity . . . . . f_b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.r.fd_A
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_B

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_B.r.fd_A:b
    SourceEntity . . . . . f_B
    DestinationEntity . . . . . fd_A:b

Meta-relationship ..... FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier ..... f_A'.p.f_A
SourceEntity ..... f_A'
DestinationEntity ..... f_A

Meta-relationship ..... FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier ..... f_B.p.f_A
SourceEntity ..... f_B
DestinationEntity ..... f_A

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier ..... f_A.c.f_A'
SourceEntity ..... f_A
DestinationEntity ..... f_A'

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier ..... f_A.c.f_B
SourceEntity ..... f_A
DestinationEntity ..... f_B

/* This is needed to show semantically that the flow B is a part of the flow A, and that it's the part b which is contained by the FlowDefinition fd_A. */

Meta-entity ..... EquivalenceSet
Meta-attributes
CDIFIdentifier ..... es_b

Meta-relationship ..... EquivalenceSet.HasMember.Flow
Meta-attributes
CDIFIdentifier ..... es_b.hm.f_B
SourceEntity ..... es_b
DestinationEntity ..... f_B

Meta-entity ..... ReferencedElement
Meta-attributes
CDIFIdentifier ..... re_b

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_b.hm.re_b
SourceEntity . . . . . es_b
DestinationEntity . . . . . re_b

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_A
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_A
SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_b
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_b
SequenceNumber 2

4.2.2.3 "The Sum" Join

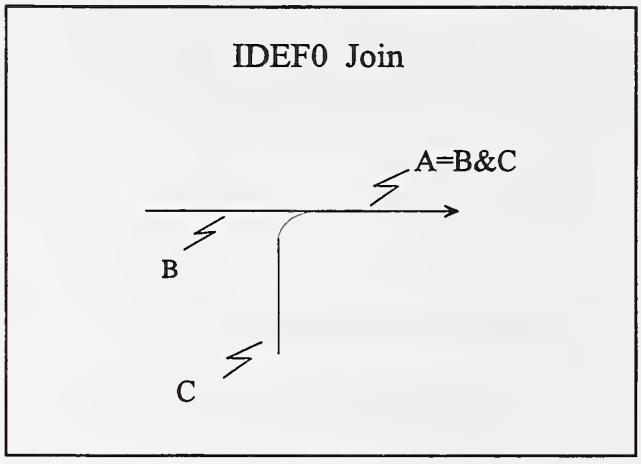

Figure 9. "The Sum" Join

The above figure is the third type of IDEF0 Join. The flow A contains flows B and C in its structure. A graphical representation of the mapping of this type of fork can be found in Appendix A. Again, like in the previous types of Join, by flipping *Consumes* and *Produces* we can transform "The Sum" Fork mapping into "The Sum" Join mapping The following is the CDIF transfer file for the Figure 9.

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A.def"

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A
    Name . . . . . "A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:b

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_b

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_b.r.fd_A:b
    SourceEntity . . . . . f_b
    DestinationEntity . . . . . fd_A:b

Meta-relationship . . . . . FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fd_A.c.f_b
    SourceEntity . . . . . fd_A
    DestinationEntity . . . . . f_b

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A:c

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_c

Meta-relationship ..... Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier ..... f_c.r.fd_A:c
    SourceEntity ..... f_c
    DestinationEntity ..... fd_A:c

Meta-relationship ..... FlowDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier ..... fd_A.c.f_c
    SourceEntity ..... fd_A
    DestinationEntity ..... f_c

Meta-entity ..... Flow
    Meta-attributes
    CDIFIdentifier ..... f_B

Meta-relationship ..... Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier ..... f_B.r.fd_A:b
    SourceEntity ..... f_B
    DestinationEntity ..... fd_A:b

Meta-entity ..... Flow
    Meta-attributes
    CDIFIdentifier ..... f_C
    Name ..... "C"

Meta-relationship ..... Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier ..... f_C.r.fd_A:c
    SourceEntity ..... f_C
    DestinationEntity ..... fd_A:c

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier ..... f_A.p.f_B
    SourceEntity ..... f_A
    DestinationEntity ..... f_B

Meta-relationship ..... FlowProducerConsumer.Consumes.Flow
    Meta-attributes
    CDIFIdentifier ..... f_A.p.f_C
    SourceEntity ..... f_A
    DestinationEntity ..... f_C

Meta-relationship ..... FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier ..... f_B.c.f_A
SourceEntity ..... f_B
DestinationEntity ..... f_A

Meta-relationship ..... FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier ..... f_C.c.f_A
SourceEntity ..... f_C
DestinationEntity ..... f_A

/* This is needed to show semantically that the flow B is a part of the flow A, and that it's the part b which is contained by the FlowDefinition fd_A. We show the same semantics for the flow C.*/

Meta-entity ..... EquivalenceSet
Meta-attributes
CDIFIdentifier ..... es_b

Meta-relationship ..... EquivalenceSet.HasMember.Flow
Meta-attributes
CDIFIdentifier ..... es_b.hm.f_B
SourceEntity ..... es_b
DestinationEntity ..... f_B

Meta-entity ..... ReferencedElement
Meta-attributes
CDIFIdentifier ..... re_b

Meta-relationship ..... EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier ..... es_b.hm.re_b
SourceEntity ..... es_b
DestinationEntity ..... re_b

Meta-relationship ..... ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier ..... re_b.dp.f_A
SourceEntity ..... re_b
DestinationEntity ..... f_A
SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_b.dp.f_b
SourceEntity . . . . . re_b
DestinationEntity . . . . . f_b
SequenceNumber 2

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_c

Meta-relationship . . . . . EquivalenceSet.HasMember.Flow
Meta-attributes
CDIFIdentifier . . . . . es_c.hm.f_C
SourceEntity . . . . . es_c
DestinationEntity . . . . . f_C

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_c

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_c.hm.re_c
SourceEntity . . . . . es_c
DestinationEntity . . . . . re_c

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_c.dp.f_A
SourceEntity . . . . . re_c
DestinationEntity . . . . . f_A
SequenceNumber 1

Meta-relationship . . . . . ReferencedElement.DefinesPath.Flow
Meta-attributes
CDIFIdentifier . . . . . re_c.dp.f_c
SourceEntity . . . . . re_c
DestinationEntity . . . . . f_c
SequenceNumber 2

4.2.3 IDEF0 Calls

Like with the IDEF0 Forks and Joins, we can categorize IDEF0 Calls into four groups:

- "Another Data Model"
- "A Document"
- Split By Type
- A Drop in the Level of Abstraction

4.2.3.1 "Another Data Model" Call

The following figure shows a situation when the calls refer to another data model. An instance of *DFMProcessDefinition* for that data model had to be created (while mapping that data model into CDIF). Reference all the *DFMProcesses* (processes) which have a call to that data model to the *DFMProcessDefinition* for that data model. The processes A01and A0211 (see Figure 10) both have calls to the stand-alone data model B-0. The *DFMProcessDefinition* B-0.def had to be originally created for the data model B-0. In the current data model, *DFMProcesses* A01 and A0211have to reference that same *DFMProcessDefinition* to reuse the structure and definition of the data model B-0.

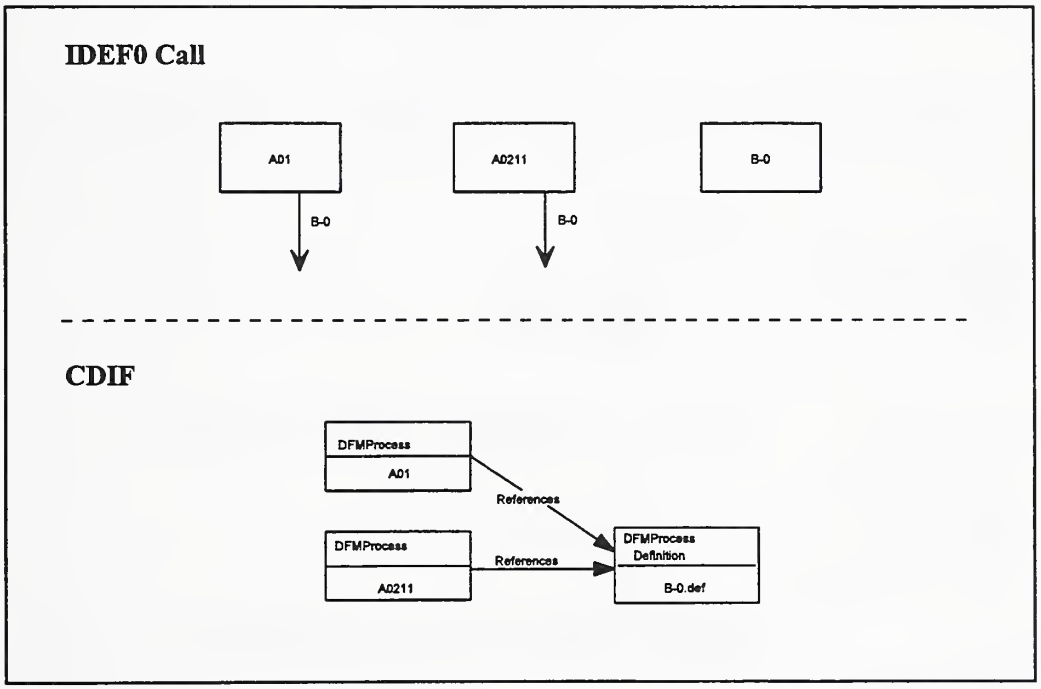

Figure 10. "Another Data Model" Call

The following is the CDIF mapping of the "Another Data Model" Call above.

/* The following was defined for the data model B-0. */

Meta-entity . . . . . DataFlowModel
    Meta-attributes
    CDIFIdentifier . . . . . call1_example
    Name . . . . . "Example"

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_B-0
    Name . . . . . "B-0_def"

Meta-relationship . . . . . DataFlowModel.HasRoot.DFMProcessDefinition

    Meta-attributes
    CDIFIdentifier . . . . . call1_example.hr.pd_B-0
    SourceEntity . . . . . call1_example
    DestinationEntity . . . . . pd_B-0
.....
.....

/* The following should be difined for the current mapping of the processes A01 and A0211. */

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A01
    Name . . . . . "A01"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A01.r.pd_B-0
    SourceEntity . . . . . dfmp_A01
    DestinationEntity . . . . . pd_B-0

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A0211
    Name . . . . . "A0211"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A0211.r.pd_B-0
SourceEntity . . . . . dfmp_A0211
DestinationEntity . . . . . pd_B-0

4.2.3.2 "A Document" Call

This is another type of IDEF0 Call. This call is simply a reference to a book, an article, or a document. In this case, a *DFMProcess* that has this type of call should have a pointer (usually the same content as in IDEF0 call) to the document in its local meta-attribute *BriefDescription* and/or *FullDescription*.

The following is an example of "A Document" Call. The process A01 references the document FIPS184 (see Figure 12).

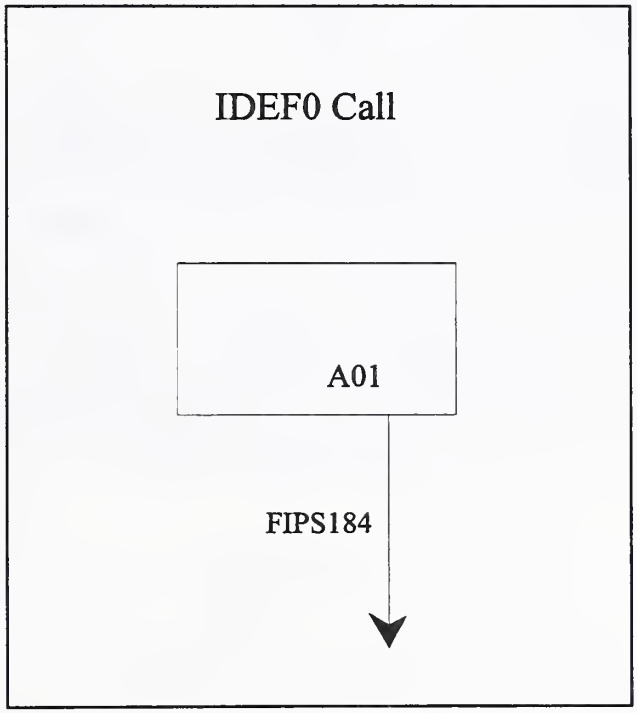

Figure 11. "A Document" Call

The following is the CDIF mapping of the call above.

Meta-entity ..... DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier ..... pd_A01
    Name ..... "A01_def"

Meta-entity ..... DFMProcess
    Meta-attributes
    CDIFIdentifier ..... dfmp_A01
    Name ..... "A01"
    BriefDescription ..... "See FIPS184"

Meta-relationship ..... DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier ..... dfmp_A01.r.pd_A01
    SourceEntity ..... dfmp_A01
    DestinationEntity ..... pd_A01

4.2.3.3 SBT (Split By Type) Call

This is the third type of IDEF0 Call. A single box (process, function) in a decomposition calls one from a set of many activities at a lower level of abstraction. The activities at the lower level are of a certain type. For example, Mechanical Process Model, Bending Process Model, and Chemical Treating Process Model are all types of process models.

The following is an example of a SBT Call[3]. The process A01 will either call Mechanical Process Model, Bending Process Model, or Chemical Treating Process Model. The structure of SBT Call can be captured by the CDIF meta-relationship *DFMProcessDefinition.Contains.DFMProcess* (an instance for each member of the set). Also, the meta-attribute *Operator* of the meta-entity *DFMProcessDefinition* shall be set to ***XOR***.

---

[3] This example was taken from Clarence Feldmann's article on calls and mechanisms.

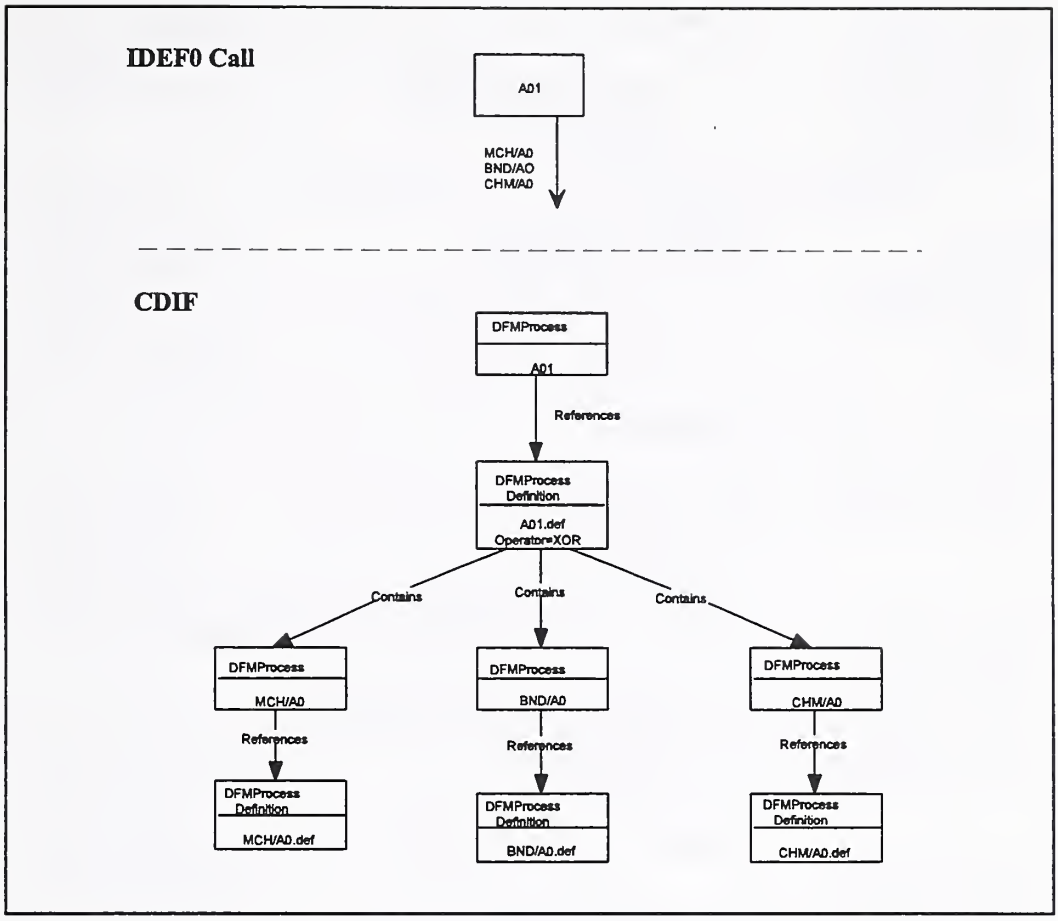

Figure 12. SBT Call

The following is the CDIF mapping of the call above.

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_A01
Name . . . . . "A01_def"
Operator . . . . . XOR

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A01
Name . . . . . "A01"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A01.r.pd_A01
SourceEntity . . . . . dfmp_A01
DestinationEntity . . . . . pd_A01

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_MCH/A0
Name . . . . . "MCH/A0_def"

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_MCH/A0
Name . . . . . "MCH/A0"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_MCH/A0.r.pd_MCH/A0
SourceEntity . . . . . dfmp_MCH/A0
DestinationEntity . . . . . pd_MCH/A0

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_BND/A0
Name . . . . . "BND/A0_def"

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_BND/A0
Name . . . . . "BND/A0"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_BND/A0.r.pd_BND/A0
SourceEntity . . . . . dfmp_BND/A0
DestinationEntity . . . . . pd_BND/A0

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_CHM/A0
Name . . . . . "CHM/A0_def"

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_CHM/A0
    Name . . . . . "CHM/A0"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_CHM/A0.r.pd_CHM/A0
    SourceEntity . . . . . dfmp_CHM/A0
    DestinationEntity . . . . . pd_CHM/A0

/* This is needed to show the structure of the DFMProcessDefinition A01_def. */

Meta-relationship . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A01.c.dfmp_MCH/A0
    SourceEntity . . . . . pd_A01
    DestinationEntity . . . . . dfmp_MCH/A0

Meta-relationship . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A01.c.dfmp_BND/A0
    SourceEntity . . . . . pd_A01
    DestinationEntity . . . . . dfmp_BND/A0

Meta-relationship . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A01.c.dfmp_CHM/A0
    SourceEntity . . . . . pd_A01
    DestinationEntity . . . . . dfmp_CHM/A0

4.2.3.4 A Drop in the Level of Abstraction Call

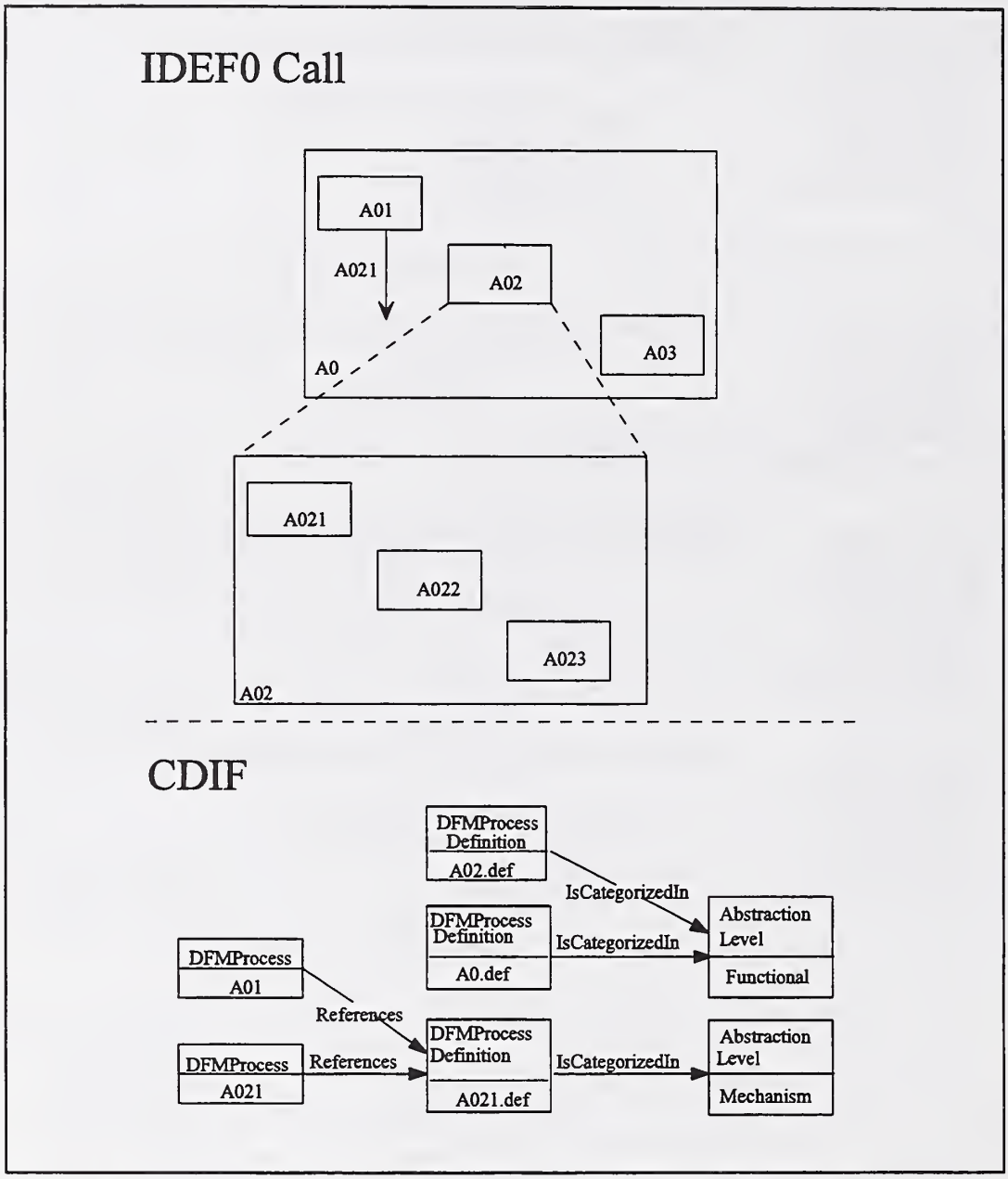

Figure 13. A Drop in the Level of Abstraction Call

This is the fourth type of IDEF0 Call. The figure above demonstrates the mapping of this Call, which indicates a drop in the Level of Abstraction (from the functional level to the mechanism level). The functions A01and A021are at different levels of abstraction, and the call provides a link between these levels.

The following is the CDIF mapping of the above call. A couple of new CDIF objects are introduced. By the means of the meta-entity *AbstractionLevel* and the meta-relationship *DFMProcessDefinition.IsCategorizedIn.AbstractionLevel* we are able to provide that link between the Functional level and Mechanism level of abstraction.

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0
    Name . . . . . "A0_def"

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A02
    Name . . . . . "A02_def"

Meta-entity . . . . . AbstractionLevel
    Meta-attributes
    CDIFIdentifier . . . . . al_Functional
    Name . . . . . "Functional"

Meta-relationship . . . . . DFMProcessDefinition.IsCategorizedIn.AbstractionLevel
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.ici.al_Functional
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . al_Functional

Meta-relationship . . . . . DFMProcessDefinition.IsCategorizedIn.AbstractionLevel
    Meta-attributes
    CDIFIdentifier . . . . . pd_A02.ici.al_Functional
    SourceEntity . . . . . pd_A02
    DestinationEntity . . . . . al_Functional

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A021
    Name . . . . . "A021_def"

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A01
    Name . . . . . "A01"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A01.r.pd_A021
SourceEntity . . . . . dfmp_A01
DestinationEntity . . . . . pd_A021

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A021
Name . . . . . "A021"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A021.r.pd_A021
SourceEntity . . . . . dfmp_A021
DestinationEntity . . . . . pd_A021

Meta-entity . . . . . AbstractionLevel
Meta-attributes
CDIFIdentifier . . . . . al_Mechanism
Name . . . . . "Mechanism"

Meta-relationship . . . . . DFMProcessDefinition.IsCategorizedIn.AbstractionLevel
Meta-attributes
CDIFIdentifier . . . . . pd_A01.ici.al_Mechanism
SourceEntity . . . . . pd_A01
DestinationEntity . . . . . al_Mechanism

Meta-relationship . . . . . DFMProcessDefinition.IsCategorizedIn.AbstractionLevel
Meta-attributes
CDIFIdentifier . . . . . pd_A021.ici.al_Mechanism
SourceEntity . . . . . pd_A021
DestinationEntity . . . . . al_Mechanism

4.3 Process/Flow Decomposition

We have already mentioned Process Decomposition in section 4.1.5 (pg. x). In this section we will take a look at six different types of combinations of Process Decomposition with Flow Decomposition.

Process Decomposition is the same for all the combinations: process A0 decomposes into processes A01, A02, and A03. The difference is in Flow Decomposition.

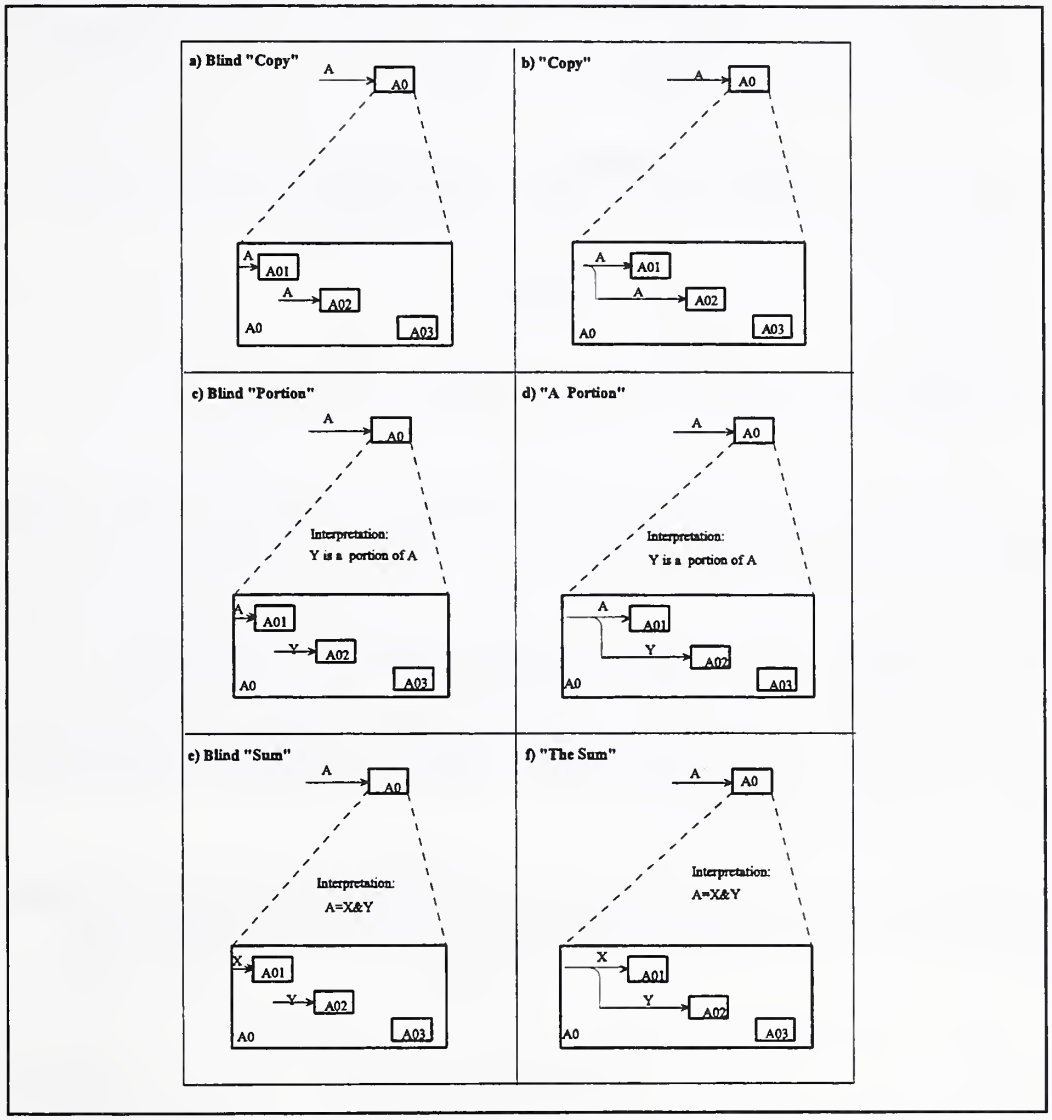

Figure 14. Types of Flow Decomposition

In all the cases, an input A flows into the process (function) A0 (see Figure 14). The only difference is how this flow A decomposes on the lower level of abstraction. As with IDEF0 Forks and Joins, a similar argument about Fork/Join types can be applied to a flow decomposition. We can look at a flow decomposition as a simple Fork (or Join) combined with a process decomposition.

Like with Forks and Joins, we have the "Copy" type of a flow decomposition: the input A gets "copied", and the flow A and its copy are the inputs for A01and A02 on the lower level of abstraction (fig. 14.b). The difference between the figure 14.a and 14.b is how (or where) input A gets "copied." On the figure 14.a, we do not see that A gets "copied", but we assume so. On the figure 14.b, we do see the split (or "A Copy" in this case) of the flow A from the higher level into two flows. That is why the title of the figure 14.a is "Blind Copy", and the title of the figure 14.b is just "A Copy."

Similar argument can be applied to the figures 14.c and 14.d, and figures 14.e and 14.f. The following are the six different types of Flow Decomposition:

- "Blind Copy"
- "A Copy"
- "Blind Portion"
- "A Portion"
- "Blind Sum"
- "The Sum"

You can find graphical representations for the CDIF mappings of all these types of Flow Decomposition in the Appendix A.

Note:

One of the mapping rules hold the following: If there exists a relationship *FlowProducerConsumer.Produces.Flow*, where *FlowProducerConsumer* is a source flow F1, and *Flow* is a destination flow F2, then there also exists a relationship *FlowProducerConsumer.Consumes.Flow,* where *FlowProducerConsumer* is the flow F2, and *Flow* is the flow F1.

The graphs, however, do not follow this rule because of the limited space on a page. Only one from each pair of the correspondent relationships is shown.

4.3.1 "Blind Copy" Flow Decomposition

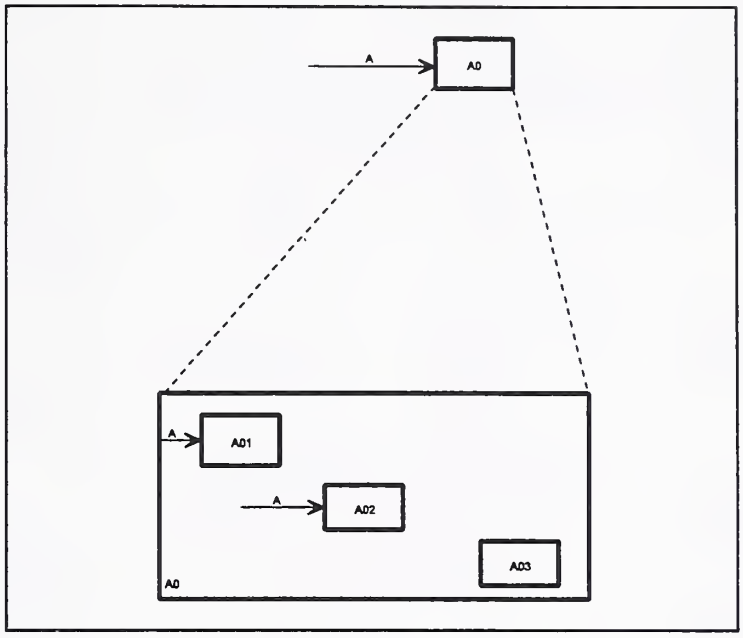

Figure 15. "Blind Copy" Decomposition

The flow A was (blindly) "copied", which means that there are two instances of the same flow (same structure). One instance of flow A is an input to the process A01, and another instance is an input to the process A02. We can reuse the same *FlowDefinition* for all the instances of flow A because they all have the same structure.

The following is the CDIF mapping of the above decomposition. A graphical representation of the mapping can be found in the Appendix A.

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A0
    Name . . . . . "A0"

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0
    Name . . . . . "A0_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A0.r.pd_A0
SourceEntity . . . . . dfmp_A0
DestinationEntity . . . . . pd_A0

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_A
Name . . . . . "A"

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_Aa
IsFormal . . . . . FALSE

Meta-relationship . . . . . FlowInputPort.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_Aa.c.f_A
SourceEntity . . . . . fip_Aa
DestinationEntity . . . . . f_A

Meta-relationship . . . . . Flow.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A.p.fip_Aa
SourceEntity . . . . . f_A
DestinationEntity . . . . . fip_Aa

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A.hm.fip_Aa
SourceEntity . . . . . es_A
DestinationEntity . . . . . fip_Aa

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
    Meta-attributes
    CDIFIdentifier . . . . . es_A.hm.re_A
    SourceEntity . . . . . es_A
    DestinationEntity . . . . . re_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_A.dp.dfmp_A0
    SourceEntity . . . . . re_A
    DestinationEntity . . . . . dfmp_A0
    SequenceNumber 1

Meta-entity . . . . . FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fd_A
    Name . . . . . "A_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A.r.fd_A
    SourceEntity . . . . . f_A
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fip_Aa.r.fd_A
    SourceEntity . . . . . fip_Aa
    DestinationEntity . . . . . fd_A

/* Process Decomposition: the next level of abstraction. */

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A01
    Name . . . . . "A01"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.dfmp_A01
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . dfmp_A01

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_A01
Name . . . . . "A01_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A01.r.pd_A01
SourceEntity . . . . . dfmp_A01
DestinationEntity . . . . . pd_A01

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A02
Name . . . . . "A02"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.dfmp_A02
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . dfmp_A02

Meta-entity . . . . . DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . pd_A02
Name . . . . . "A02_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A02.r.pd_A02
SourceEntity . . . . . dfmp_A02
DestinationEntity . . . . . pd_A02

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A03
Name . . . . . "A03"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.dfmp_A03
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . dfmp_A03

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A03
    Name . . . . . "A03_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A03.r.pd_A03
    SourceEntity . . . . . dfmp_A03
    DestinationEntity . . . . . pd_A03

Meta-entity . . . . . FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . fip_Af
    IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.fip_Af
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . fip_Af

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fip_Af.r.fd_A
    SourceEntity . . . . . fip_Af
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_A.dp.fip_Af
    SourceEntity . . . . . re_A
    DestinationEntity . . . . . fip_Af
    SequenceNumber 2

/* Flow A' */

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'
    Name . . . . . "A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.f_A'
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A'.r.fd_A
SourceEntity . . . . . f_A'
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_Af.c.fip_Af
SourceEntity . . . . . f_A'
DestinationEntity . . . . . fip_Af

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_Af.p.f_A'
SourceEntity . . . . . fip_Af
DestinationEntity . . . . . f_A'

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A'a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.cp_fip_A'a
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fip_A'a

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A'a.c.fd_A
SourceEntity . . . . . fip_A'a
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_A'a.c.f_A'
SourceEntity . . . . . fip_A'a
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . FlowProducerConsumer.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A'.p.fip_A'a
SourceEntity . . . . . f_A'
DestinationEntity . . . . . fip_A'a

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A'

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.es_A'
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . es_A'

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A'.hm.fip_A'a
SourceEntity . . . . . es_A'
DestinationEntity . . . . . fip_A'a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A'

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.re_A'
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . re_A'

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_A'.hm.re_A'
SourceEntity . . . . . es_A'
DestinationEntity . . . . . re_A'

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A'.dp.dfmp_A01
SourceEntity . . . . . re_A'
DestinationEntity . . . . . dfmp_A01
SequenceNumber 1

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A'f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A01.c.fip_A'f
SourceEntity . . . . . pd_A01
DestinationEntity . . . . . fip_A'f

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A'f.r.fd_A
SourceEntity . . . . . fip_A'f
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A'.dp.fip_A'f
SourceEntity . . . . . re_A'
DestinationEntity . . . . . fip_A'f
SequenceNumber 2

/* Flow A" */

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_A"
Name . . . . . "A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.f_A"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . f_A"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A".r.fd_A
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A".c.fip_Af
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fip_Af

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_Af.p.f_A"
SourceEntity . . . . . fip_Af
DestinationEntity . . . . . f_A"

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A"a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.cp_fip_A"a
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fip_A"a

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A"a.c.fd_A
SourceEntity . . . . . fip_A"a
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_A"a.c.f_A"
SourceEntity . . . . . fip_A"a
DestinationEntity . . . . . f_A"

Meta-relationship . . . . . FlowProducerConsumer.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A".p.fip_A"a
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fip_A"a

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.es_A"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . es_A"

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A".hm.fip_A"a
SourceEntity . . . . . es_A"
DestinationEntity . . . . . fip_A"a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.re_A"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . re_A"

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_A".hm.re_A"
SourceEntity . . . . . es_A"
DestinationEntity . . . . . re_A"

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A".dp.dfmp_A02
SourceEntity . . . . . re_A"
DestinationEntity . . . . . dfmp_A02
SequenceNumber 1

Meta-entity . . . . . FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . fip_A"f
    IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . pd_A02.c.fip_A"f
    SourceEntity . . . . . pd_A02
    DestinationEntity . . . . . fip_A"f

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fip_A"f.r.fd_A
    SourceEntity . . . . . fip_A"f
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_A".dp.fip_A"f
    SourceEntity . . . . . re_A"
    DestinationEntity . . . . . fip_A"f
    SequenceNumber 2

4.3.2 "A Copy" Flow Decomposition

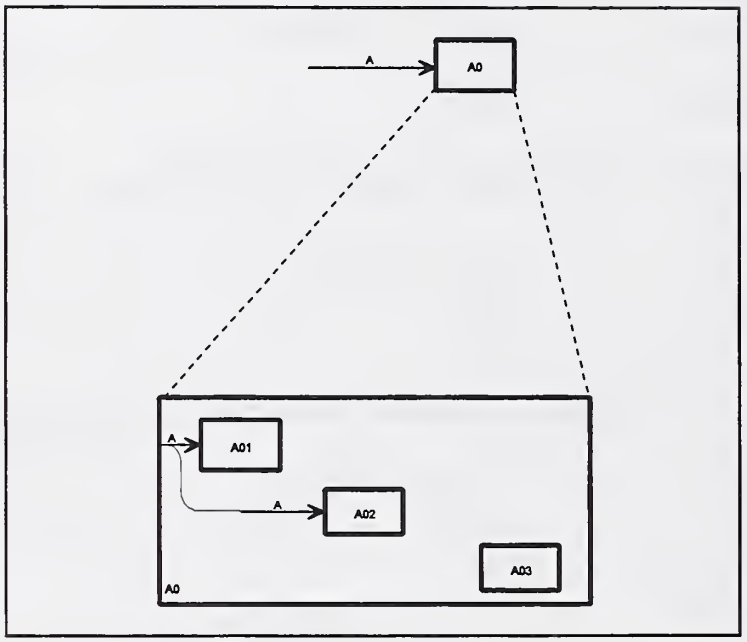

Figure 16. "A Copy" Decomposition

The only difference between a "Blind Copy" and "A Copy" decomposition is that in the "Copy" decomposition we can "see" the flow split. So, in this case, *FlowInputPort* Af produces *Flow* A', which then produces flows A" and A'".

The following is the CDIF mapping of the above decomposition. A graphical representation of the mapping can be found in the Appendix A.

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A0
    Name . . . . . "A0"

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0
    Name . . . . . "A0_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
Meta-attributes
CDIFIdentifier . . . . . dfmp_A0.r.pd_A0
SourceEntity . . . . . dfmp_A0
DestinationEntity . . . . . pd_A0

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_A
Name . . . . . "A"

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_Aa
IsFormal . . . . . FALSE

Meta-relationship . . . . . FlowInputPort.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_Aa.c.f_A
SourceEntity . . . . . fip_Aa
DestinationEntity . . . . . f_A

Meta-relationship . . . . . Flow.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A.p.fip_Aa
SourceEntity . . . . . f_A
DestinationEntity . . . . . fip_Aa

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A.hm.fip_Aa
SourceEntity . . . . . es_A
DestinationEntity . . . . . fip_Aa

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_A.hm.re_A
SourceEntity . . . . . es_A
DestinationEntity . . . . . re_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A.dp.dfmp_A0
SourceEntity . . . . . re_A
DestinationEntity . . . . . dfmp_A0
SequenceNumber 1

Meta-entity . . . . . FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fd_A
Name . . . . . "A_def"

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A.r.fd_A
SourceEntity . . . . . f_A
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_Aa.r.fd_A
SourceEntity . . . . . fip_Aa
DestinationEntity . . . . . fd_A

/* Process Decomposition: the next level of abstraction. */

Meta-entity . . . . . DFMProcess
Meta-attributes
CDIFIdentifier . . . . . dfmp_A01
Name . . . . . "A01"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.dfmp_A01
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . dfmp_A01

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A01
    Name . . . . . "A01_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A01.r.pd_A01
    SourceEntity . . . . . dfmp_A01
    DestinationEntity . . . . . pd_A01

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A02
    Name . . . . . "A02"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.dfmp_A02
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . dfmp_A02

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A02
    Name . . . . . "A02_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A02.r.pd_A02
    SourceEntity . . . . . dfmp_A02
    DestinationEntity . . . . . pd_A02

Meta-entity . . . . . DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A03
    Name . . . . . "A03"

Meta-entity . . . . . DFMProcessDefinition.Contains.DFMProcess
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.dfmp_A03
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . dfmp_A03

Meta-entity . . . . . DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . pd_A03
    Name . . . . . "A03_def"

Meta-relationship . . . . . DFMProcess.References.DFMProcessDefinition
    Meta-attributes
    CDIFIdentifier . . . . . dfmp_A03.r.pd_A03
    SourceEntity . . . . . dfmp_A03
    DestinationEntity . . . . . pd_A03

Meta-entity . . . . . FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . fip_Af
    IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.fip_Af
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . fip_Af

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . fip_Af.r.fd_A
    SourceEntity . . . . . fip_Af
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
    Meta-attributes
    CDIFIdentifier . . . . . re_A.dp.fip_Af
    SourceEntity . . . . . re_A
    DestinationEntity . . . . . fip_Af
    SequenceNumber 2

/* Flow A' */

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A'
    Name . . . . . "A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.f_A'
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . f_A'

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.r.fd_A
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.FlowInputPort
    Meta-attributes
    CDIFIdentifier . . . . . f_A'.c.fip_Af
    SourceEntity . . . . . f_A'
    DestinationEntity . . . . . fip_Af

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
    Meta-attributes
    CDIFIdentifier . . . . . fip_Af.p.f_A'
    SourceEntity . . . . . fip_Af
    DestinationEntity . . . . . f_A'

/* Flow A" */

Meta-entity . . . . . Flow
    Meta-attributes
    CDIFIdentifier . . . . . f_A"
    Name . . . . . "A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
    Meta-attributes
    CDIFIdentifier . . . . . pd_A0.c.f_A"
    SourceEntity . . . . . pd_A0
    DestinationEntity . . . . . f_A"

Meta-relationship . . . . . Flow.References.FlowDefinition
    Meta-attributes
    CDIFIdentifier . . . . . f_A".r.fd_A
    SourceEntity . . . . . f_A"
    DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A".c.f_A'
SourceEntity . . . . . f_A"
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A'.p.f_A"
SourceEntity . . . . . f_A'
DestinationEntity . . . . . f_A"

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A"a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.cp_fip_A"a
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fip_A"a

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A"a.c.fd_A
SourceEntity . . . . . fip_A"a
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_A"a.c.f_A"
SourceEntity . . . . . fip_A"a
DestinationEntity . . . . . f_A"

Meta-relationship . . . . . FlowProducerConsumer.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A".p.fip_A"a
SourceEntity . . . . . f_A"
DestinationEntity . . . . . fip_A"a

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.es_A"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . es_A"

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A".hm.fip_A"a
SourceEntity . . . . . es_A"
DestinationEntity . . . . . fip_A"a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.re_A"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . re_A"

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_A".hm.re_A"
SourceEntity . . . . . es_A"
DestinationEntity . . . . . re_A"

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A".dp.dfmp_A01
SourceEntity . . . . . re_A"
DestinationEntity . . . . . dfmp_A01
SequenceNumber 1

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A"f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A01.c.fip_A"f
SourceEntity . . . . . pd_A01
DestinationEntity . . . . . fip_A"f

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A"f.r.fd_A
SourceEntity . . . . . fip_A"f
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A".dp.fip_A"f
SourceEntity . . . . . re_A"
DestinationEntity . . . . . fip_A"f
SequenceNumber 2

/* Flow A"'*/

Meta-entity . . . . . Flow
Meta-attributes
CDIFIdentifier . . . . . f_A"'
Name . . . . . "A"

Meta-relationship . . . . . DFMProcessDefinition.Contains.Flow
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.f_A"'
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . f_A"'

Meta-relationship . . . . . Flow.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . f_A"'.r.fd_A
SourceEntity . . . . . f_A"'
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A"'.c.f_A'
SourceEntity . . . . . f_A"'
DestinationEntity . . . . . f_A'

Meta-relationship . . . . . FlowProducerConsumer.Produces.Flow
Meta-attributes
CDIFIdentifier . . . . . f_A'.p.f_A'''
SourceEntity . . . . . f_A'
DestinationEntity . . . . . f_A'''

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A'''a
IsFormal . . . . . FALSE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.cp_fip_A'''a
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . fip_A'''a

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A'''a.c.fd_A
SourceEntity . . . . . fip_A'''a
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . FlowProducerConsumer.Consumes.Flow
Meta-attributes
CDIFIdentifier . . . . . fip_A'''a.c.f_A'''
SourceEntity . . . . . fip_A'''a
DestinationEntity . . . . . f_A'''

Meta-relationship . . . . . FlowProducerConsumer.Produces.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . f_A'''.p.fip_A'''a
SourceEntity . . . . . f_A'''
DestinationEntity . . . . . fip_A'''a

Meta-entity . . . . . EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . es_A'''

Meta-relationship . . . . . DFMProcessDefinition.Contains.EquivalenceSet
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.es_A'''
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . es_A'''

Meta-relationship . . . . . EquivalenceSet.HasMember.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . es_A'".hm.fip_A'"a
SourceEntity . . . . . es_A'"
DestinationEntity . . . . . fip_A'"a

Meta-entity . . . . . ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . re_A'"

Meta-relationship . . . . . DFMProcessDefinition.Contains.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . pd_A0.c.re_A'"
SourceEntity . . . . . pd_A0
DestinationEntity . . . . . re_A'"

Meta-relationship . . . . . EquivalenceSet.HasMember.ReferencedElement
Meta-attributes
CDIFIdentifier . . . . . es_A'".hm.re_A'"
SourceEntity . . . . . es_A'"
DestinationEntity . . . . . re_A'"

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A'".dp.dfmp_A02
SourceEntity . . . . . re_A'"
DestinationEntity . . . . . dfmp_A02
SequenceNumber 1

Meta-entity . . . . . FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . fip_A'"f
IsFormal . . . . . TRUE

Meta-relationship . . . . . DFMProcessDefinition.Contains.FlowInputPort
Meta-attributes
CDIFIdentifier . . . . . pd_A02.c.fip_A'"f
SourceEntity . . . . . pd_A02
DestinationEntity . . . . . fip_A'"f

Meta-relationship . . . . . FlowInputPort.References.FlowDefinition
Meta-attributes
CDIFIdentifier . . . . . fip_A'"f.r.fd_A
SourceEntity . . . . . fip_A'"f
DestinationEntity . . . . . fd_A

Meta-relationship . . . . . ReferencedElement.DefinesPath.ComponentObject
Meta-attributes
CDIFIdentifier . . . . . re_A'".dp.fip_A'"f
SourceEntity . . . . . re_A'"
DestinationEntity . . . . . fip_A'"f
SequenceNumber 2

4.3.3 "Blind Portion" Flow Decomposition

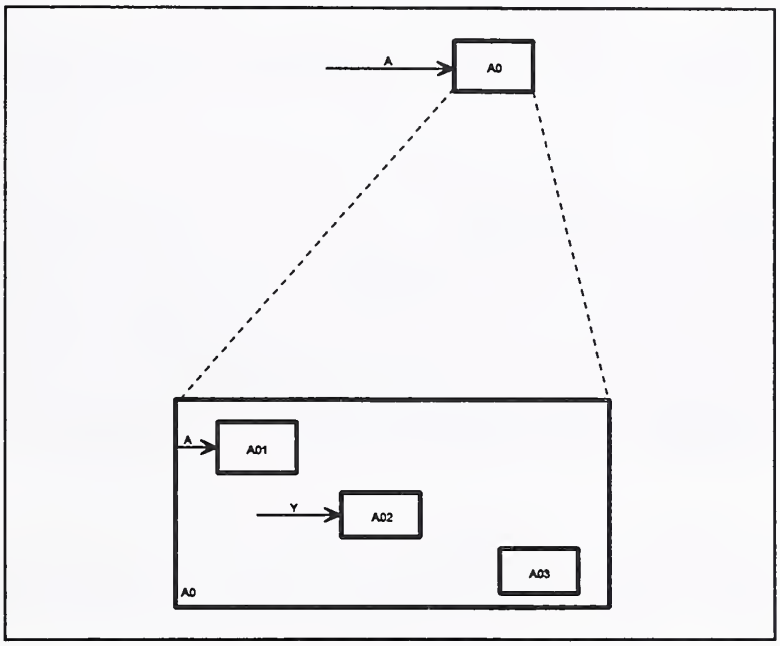

Figure 17. "Blind Portion" Decomposition

Like in the "Blind Copy" decomposition, we do not "see" the split of the flow, but we assume it occurred. In this case, *Flow* A contains *Flow* Y in its structure. We need to have a separate *FlowDefinition* for Y. Also, we have to define the structure of the flow A by creating an extra instance A_Y of flow Y and showing that A_Y is in the structure of

A through the means of meta-relationship *FlowDefinition.Contains.Flow* (see Appendix A).
We also need to link that A_Y with the actual flow Y to define Y. This is done through the *EquivalenceSet* and *ReferencedElement.*

A graphical representation of the mapping can be found in the Appendix A.

4.3.4 "A Portion" Flow Decomposition

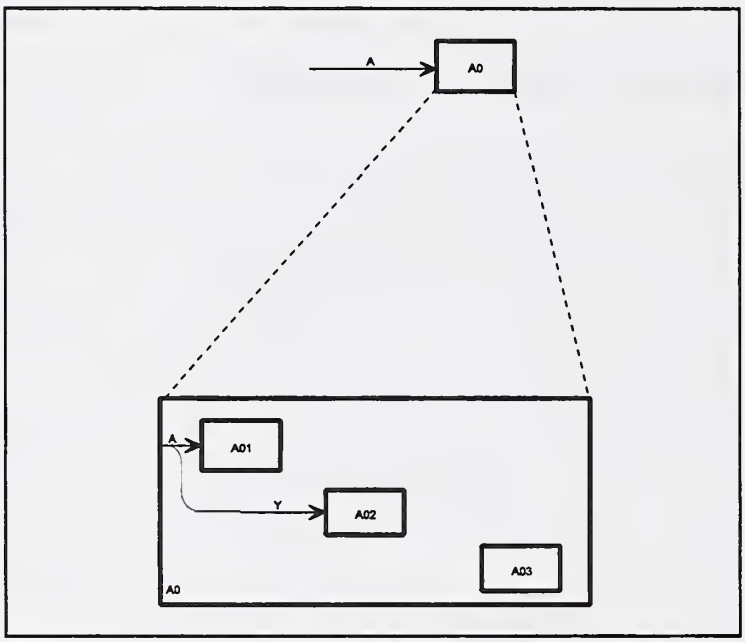

Figure 18. "A Portion" Decomposition

The only difference between a "Blind Portion" and "A Portion" decomposition is that in the "Portion" decomposition we can "see" the flow split. So, in this case, *FlowInputPort* Af produces *Flow* A', which then produces flows A" and Y.

A graphical representation of the mapping can be found in the Appendix A.

4.3.5 "Blind Sum" Flow Decomposition

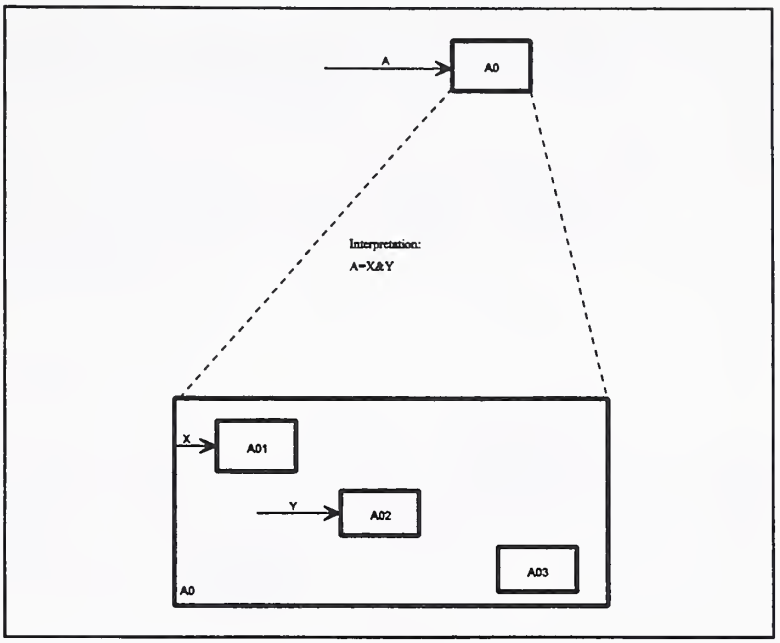

Figure 19. "Blind Sum" Decomposition

Like in the "Blind Copy" and "Blind Portion" decompositions, we do not "see" the split of the flow, but we assume it occured. In this case, *Flow* A contains *Flow* X and *Flow* Y in its structure. We need to have a separate *FlowDefinition* for A, X, and Y. Also, we have to define the structure of the flow A by creating an extra instance A_X and A_Y of flow X and Y, respectively, and showing that A_X and A_Y are in the structure of A through the means of meta-relationship *FlowDefinition.Contains.Flow* (see Appendix A).
We also need to link that A_X and A_Y with the actual flows X and Y to define these flows. This is done through the *EquivalenceSet* and *ReferencedElement* for X and Y.

A graphical representation of the mapping can be found in the Appendix A.

4.3.6 "The Sum" Flow Decomposition

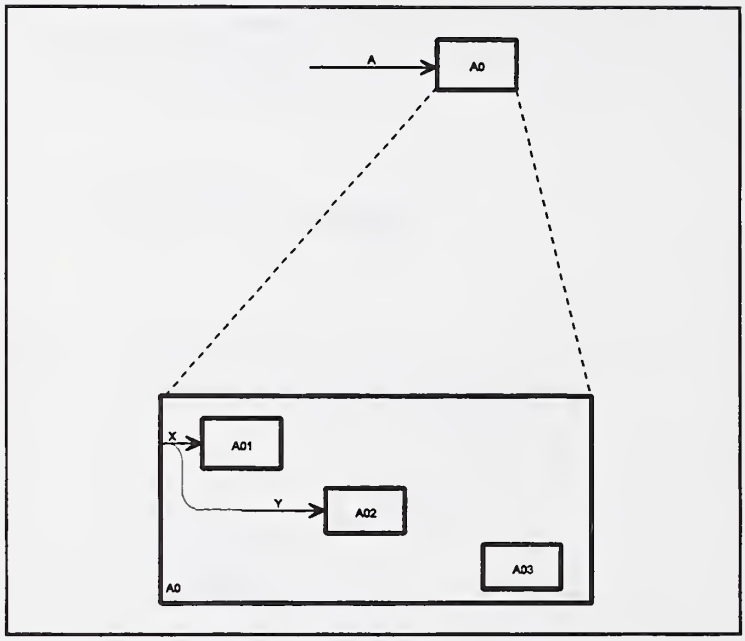

Figure 20. "The Sum" Decomposition

The only difference between a "Blind Sum" and "The Sum" decomposition is that in the "Sum" decomposition we can "see" the flow split. So, in this case, *FlowInputPort* Af produces *Flow* A', which then produces flows X and Y.

A graphical representation of the mapping can be found in the Appendix A.

5.0 SYNTACTICAL MAPPING

5.1 CDIF vs. IDL

The following pages are compliant with the CDIF Presentation Location and Connectivity (PlaC) Subject Area, CDIF-JE-N15-DRAFT and the IDL language, Version 1.2.8.

In the CDIF PlaC, any subtype of the meta-entity *GraphicalElement* can be associated with its semantical representation through the meta-relationship *GraphicalElement.Represents.RootObject*. This would be the way, for example, to link a box to its process definition.

5.1.1 Coordinate Frame

The CDIF Transfer Coordinate Frame is a three dimensional system with the origin at (0,0,0), assumed to be at the top left front corner, with X, Y, and Z coordinate limits of minimum to the maximum of a CDIF integer. The positive X-axis extends to the right, the positive Y-axis extends downwards, and the positive Z-axis extends to the back.

At this time most existing CASE tools are only two dimensional; however, to permit upward compatibility, a three demensional coordinate system was introduced. The Z coordinate shall have a value of 0 in all transfers that use two dimensional system[4].

IDL uses two dimensional coordinate system. The origin of the IDL coordinate system is the upper left corner of the diagram message area. The point (0.9999,0.9999) is the lower right corner of the message area.

5.1.2 Kit

Each separate page of IDEF0 KIT would be a *Diagram*. These pages can be "stapled" into a kit using *Derivation* meta-entity from the CDIF Common Subject Area.

5.1.3 Diagram

The CDIF PlaC Subject Area does not differentiate between different types of diagrams (IDL: d-type ::= 'GRAPHIC' | 'TEXT' | 'GLOSSARY' | 'FEO'). Also, it does not have

---

[4] Throughout this document examples will be provided in two dimensions only.

separate meta-attributes for IDL diag-head data which is AUTHOR, PROJECT, CREATION DATE, etc. However, the PlaC Subject Area has the meta-entity *Annotation*, which is a subtype of the *GraphicalElement*. An *Annotation* has the meta-attributes *TextBlock*, *BitMap*,and *ExtentX* and *Extent Y*. The meta-attribute *TextBlock* may contain text (AUTHOR, PROJECT, CREATION DATE, etc), while *BitMap* may contain a bitmap for the grid of the text. The meta-attributes *ExtentX* and *ExtentY* represent the location of the *TextBlock* or the *BitMap*. Either *TextBlock*, or *BitMap* may be given, but no combination of them is allowed.

Similar can be done about IDL status ('WORKING' | 'DRAFT' | etc.) and diag-body (IDL, pg. 8).

5.1.4 Box

The IDEF0 Box (Function) is represented through the CDIF meta-entity *Node* - the subtype of *PositionedElement*. A *Node* does not describe any attributes of the shape of the object. Instead, it captures the location and representation of the object.

All the text in a box can be put in the description of the *ProcessDefinition* or the *DFMProcess*, which then can be linked with the *Node* via the means of the meta-relationship *GraphicalElement.Represents.RootObject*.

5.1.5 Arrow

A line on an IDEF0 diagram is represented using meta-entity *Edge*, which provides the connectivity information, and *EdgeElement*, which represents one line segment with one source and one destination point. Through the means of the meta-relationship *Edge.ConsistsOf.EdgeElement*, an *Edge* can be built up from many *EdgeElement*s. An *EdgeElement* can have only one single start and end point, and it has a local meta-attribute ArrowOrientation[5], which can be attached to the line segment.

---

[5] There is an error in the PlaC Subject Area: the meta-attribute ArrowOrientation is not listed in the attribute list of the meta-entity EdgeElement.

APPENDIX A: Figures

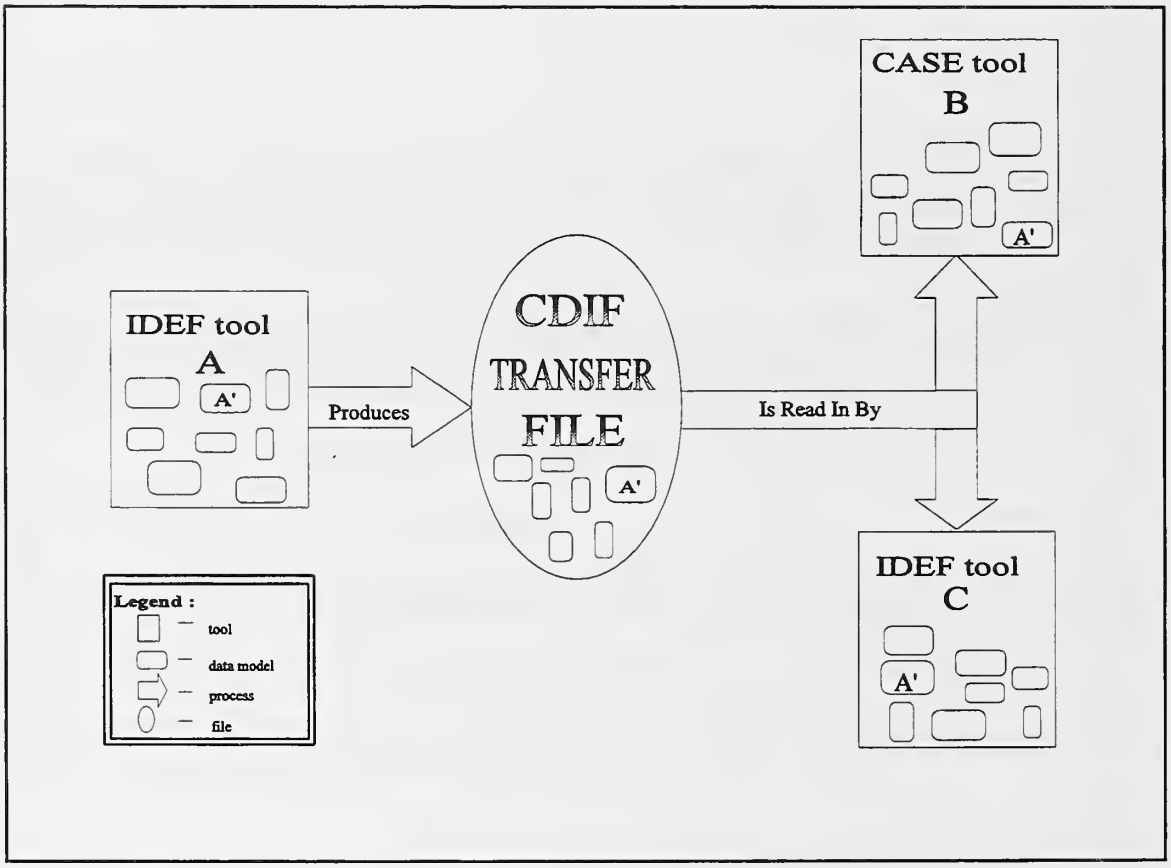

Figure 1: Mapping IDEF Models Using CDIF

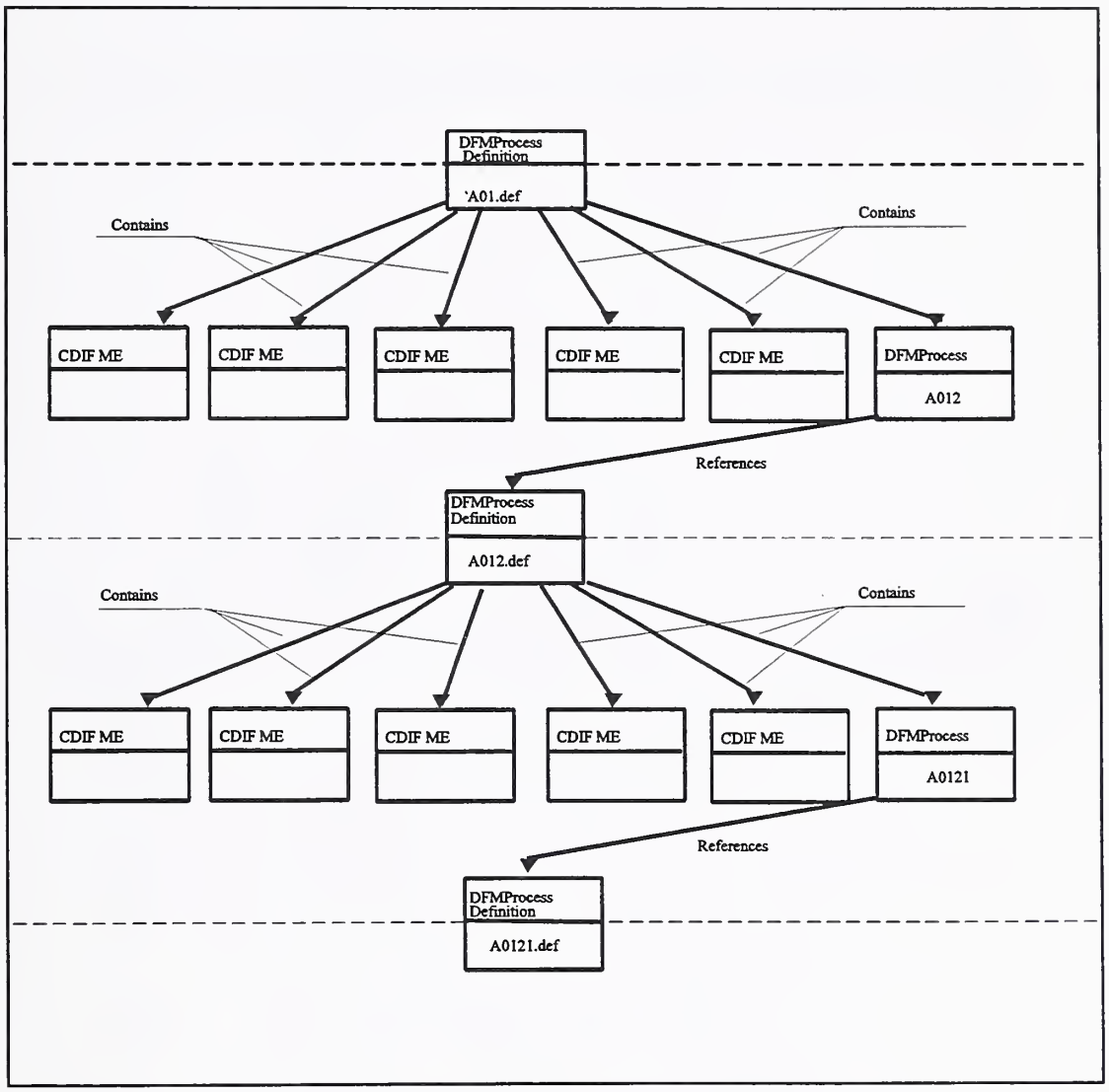

Figure 2: Crossing an Abstraction Level

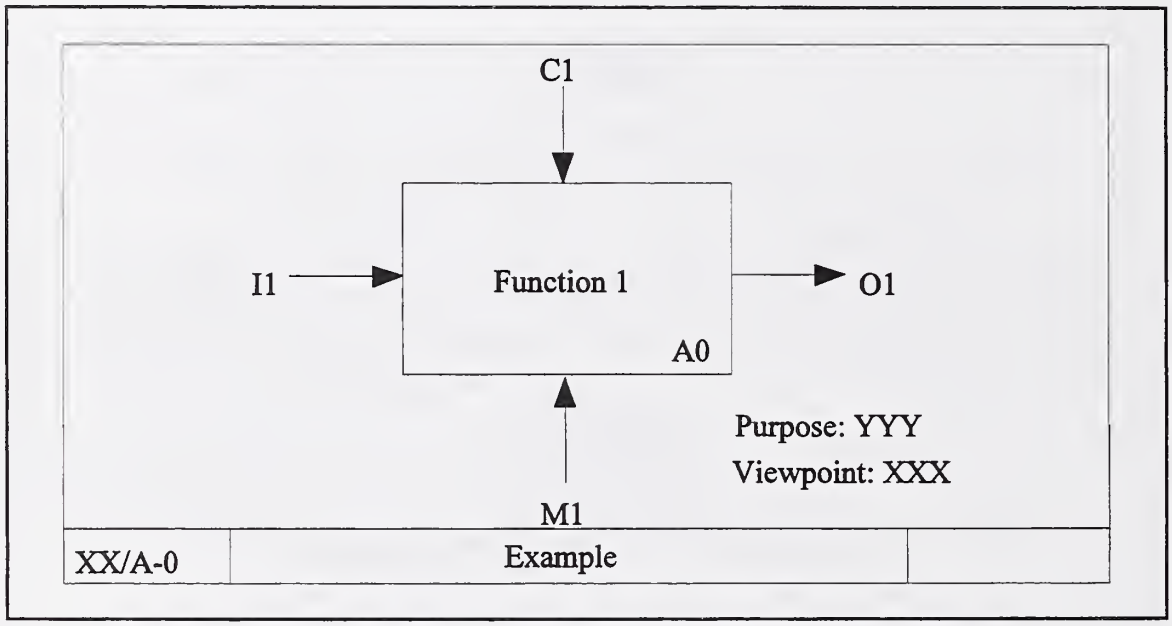

Figure 3: IDEF0 A-0 Diagram

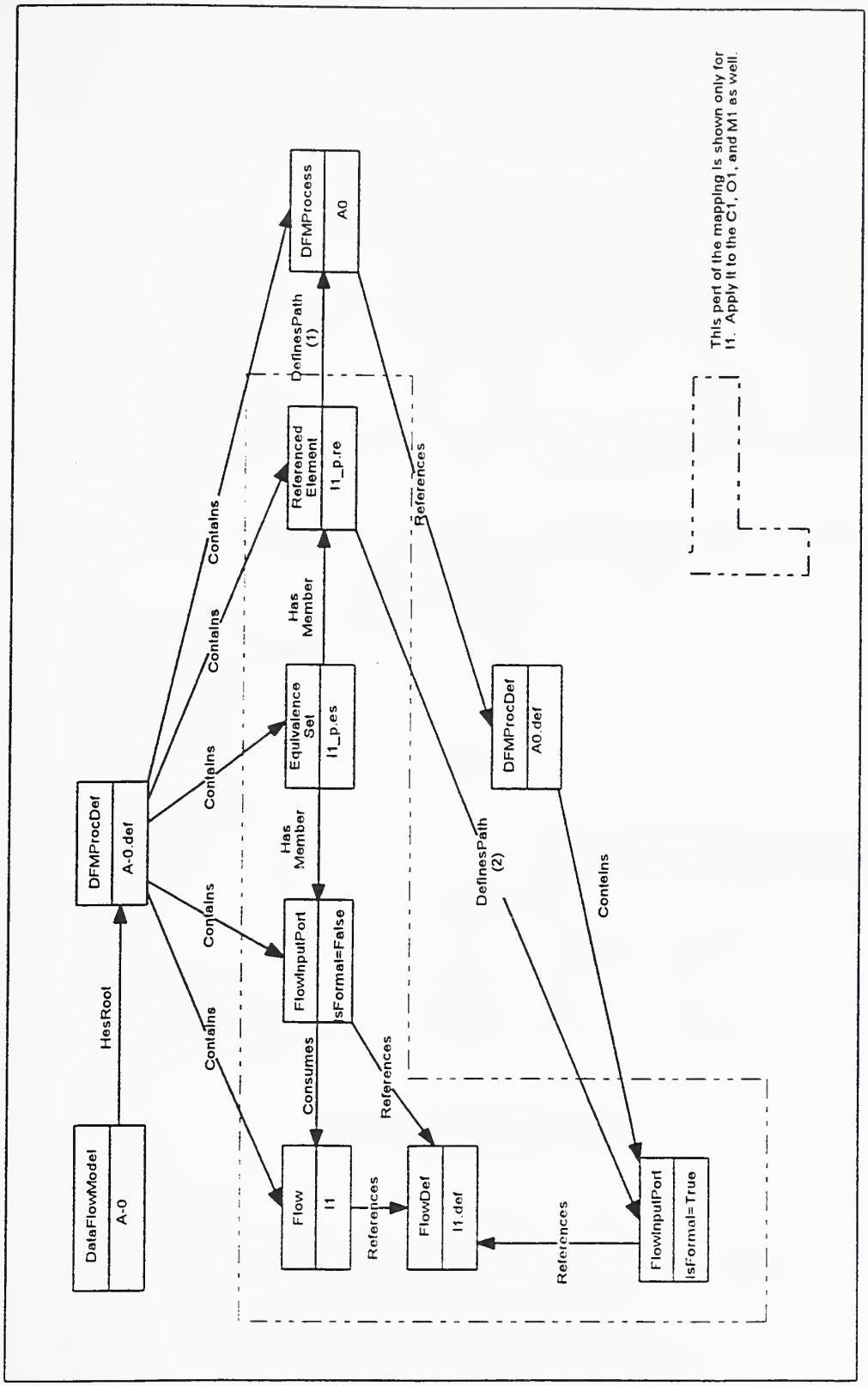

Figure 3-2: CDIF Mapping of A-O Diagram

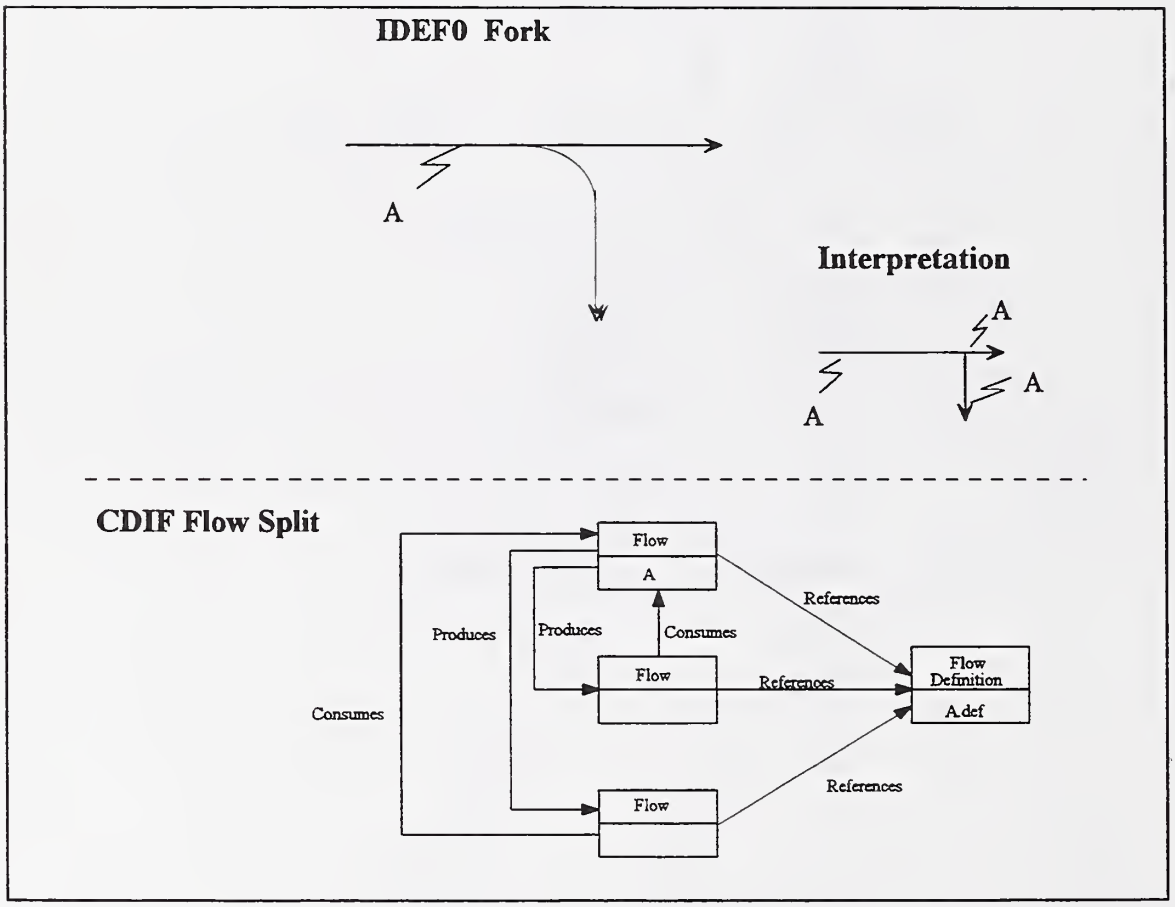

Figure 4: "A Copy" Fork and its CDIF Mapping

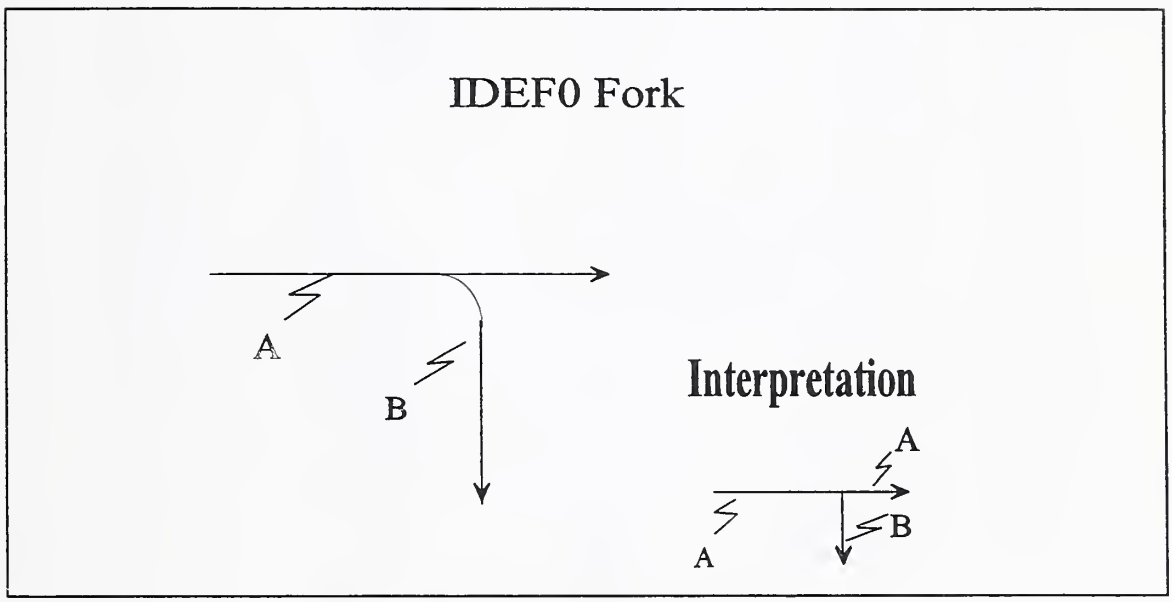

Figure 5: "A Portion" Fork

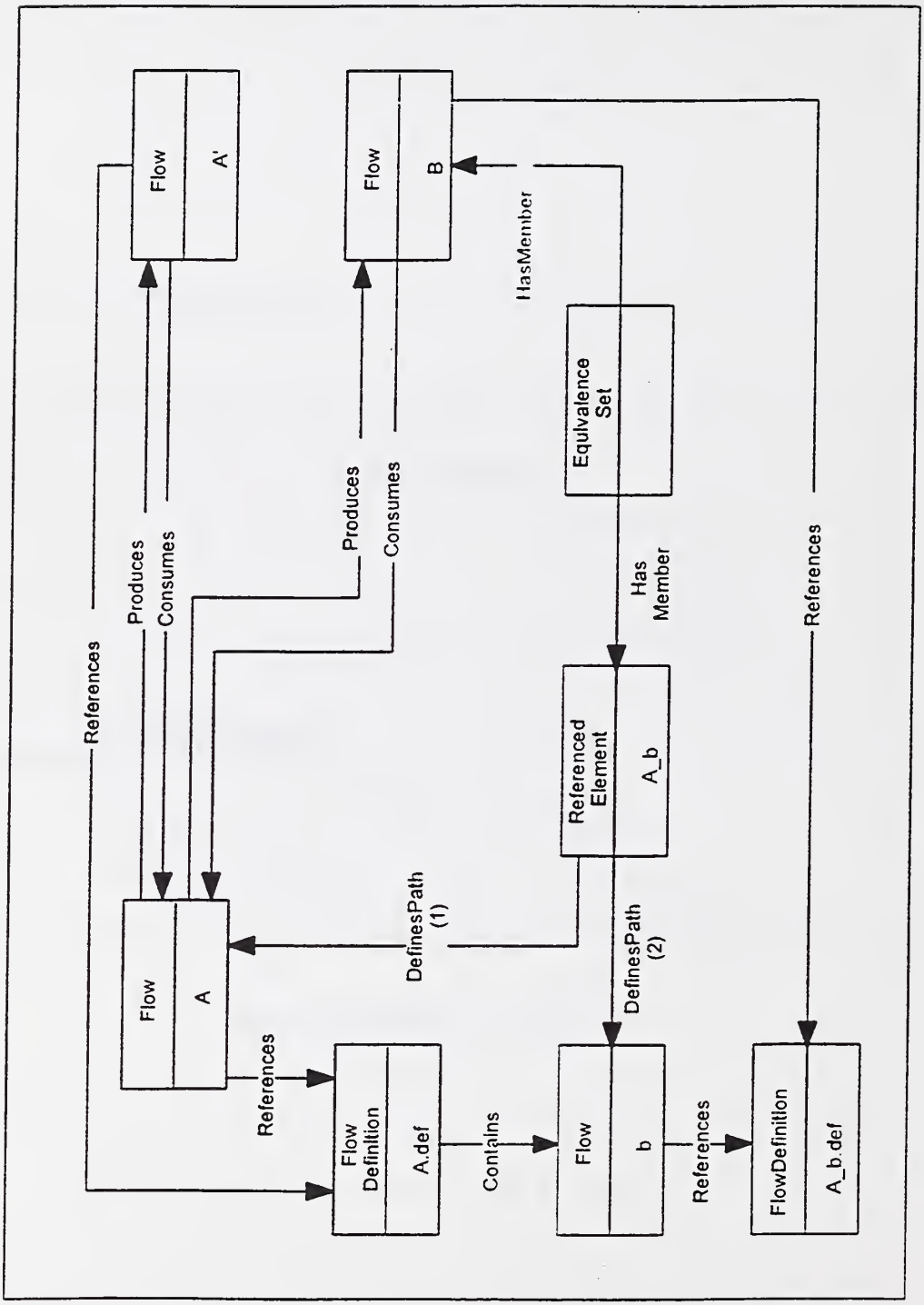

Figure 5-2: CDIF Mapping of "A Portion" Fork

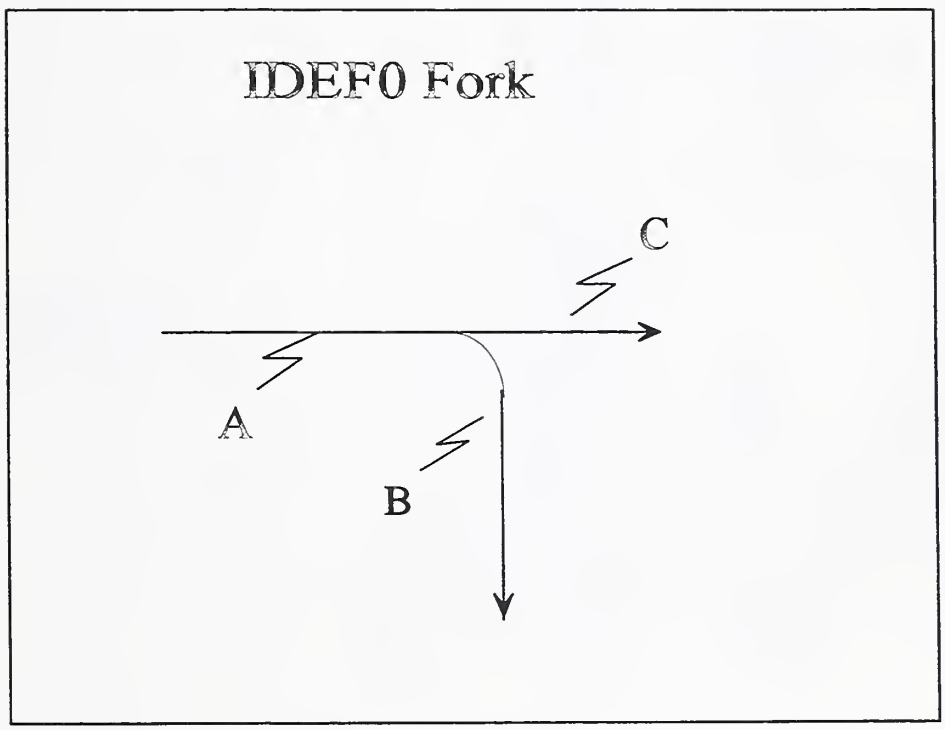

Figure 6: "The Sum" Fork

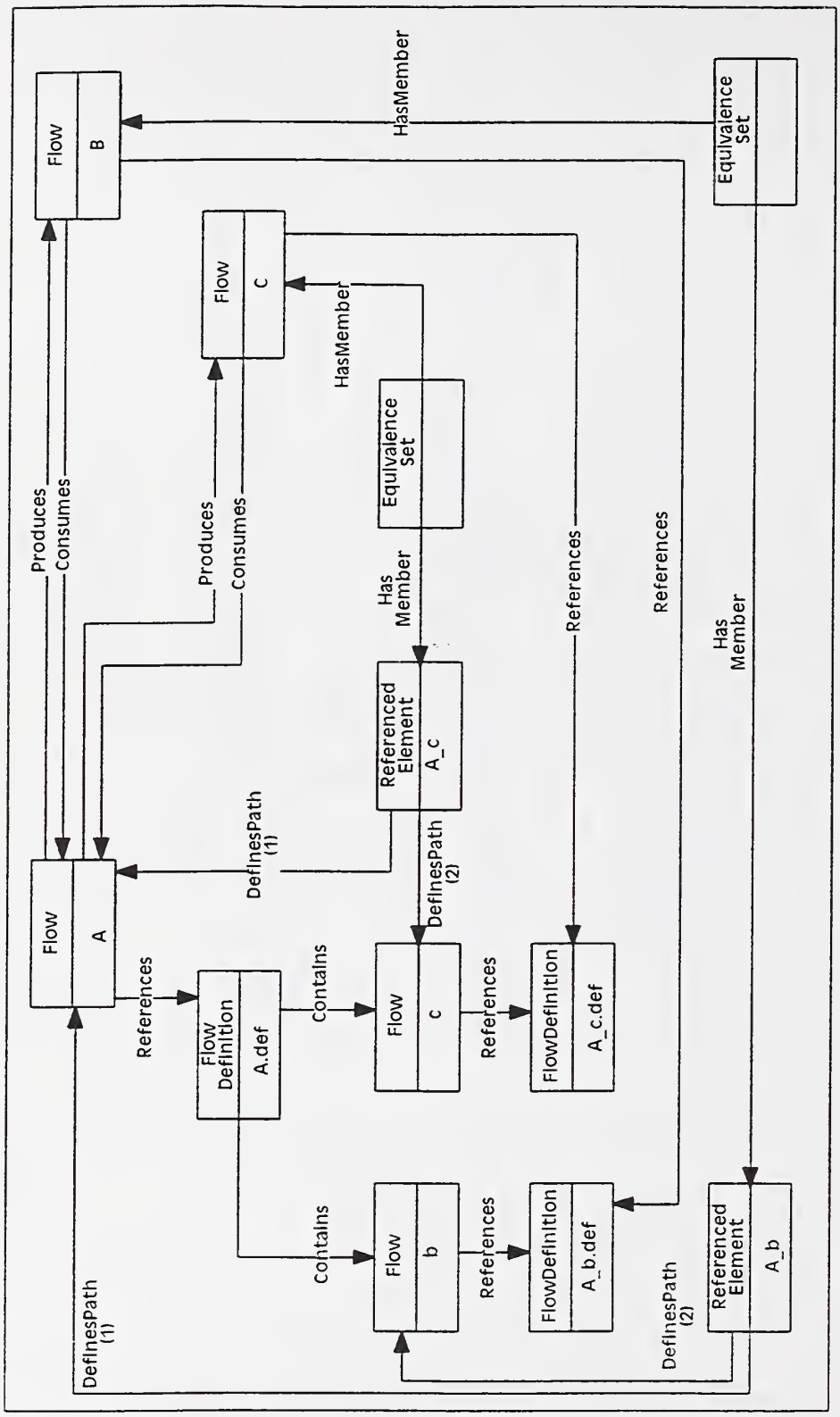

Figure 6-2: CDIF Mapping of "The Sum" Fork

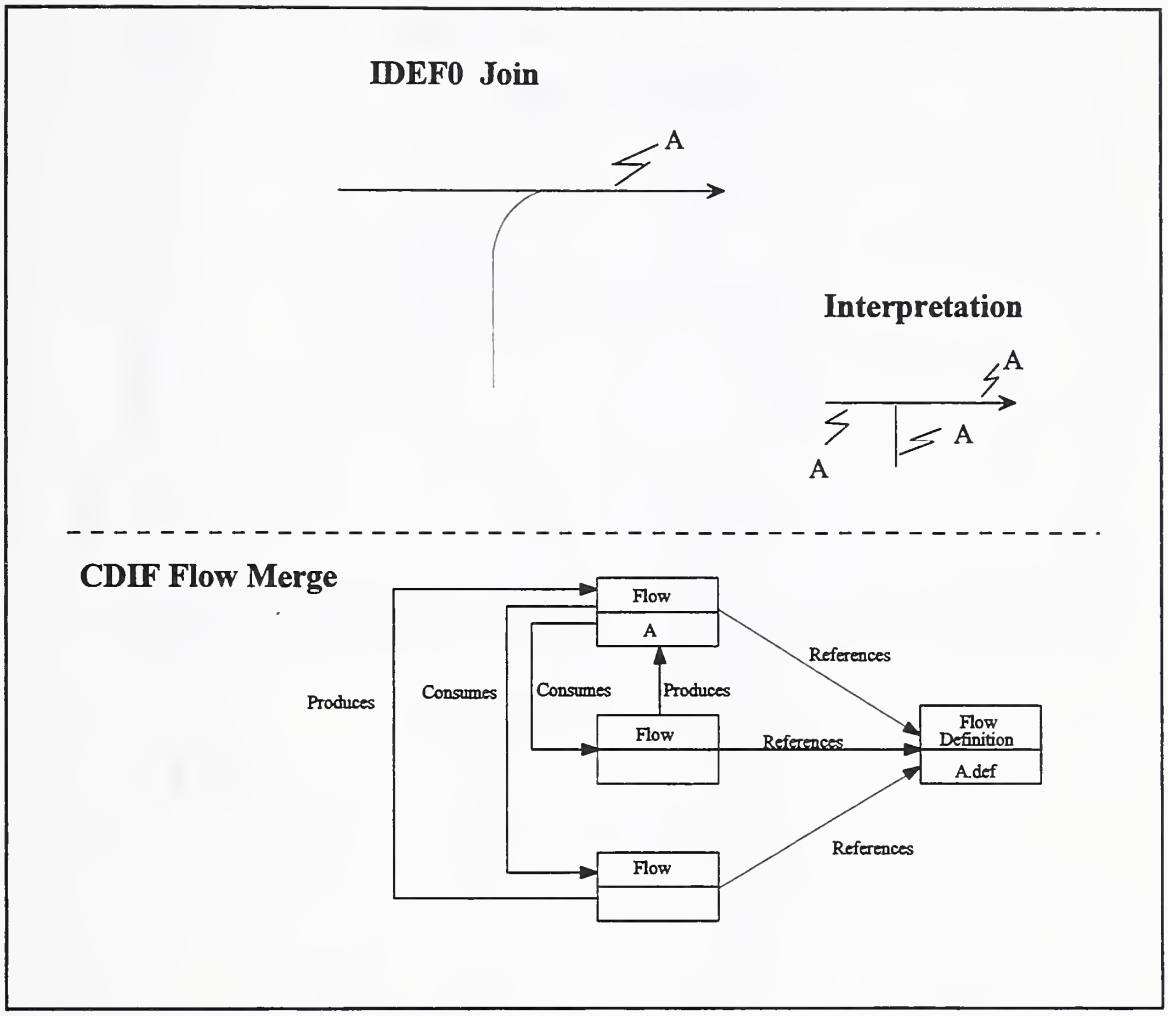

Figure 7: "A Copy" Join and its CDIF Mapping

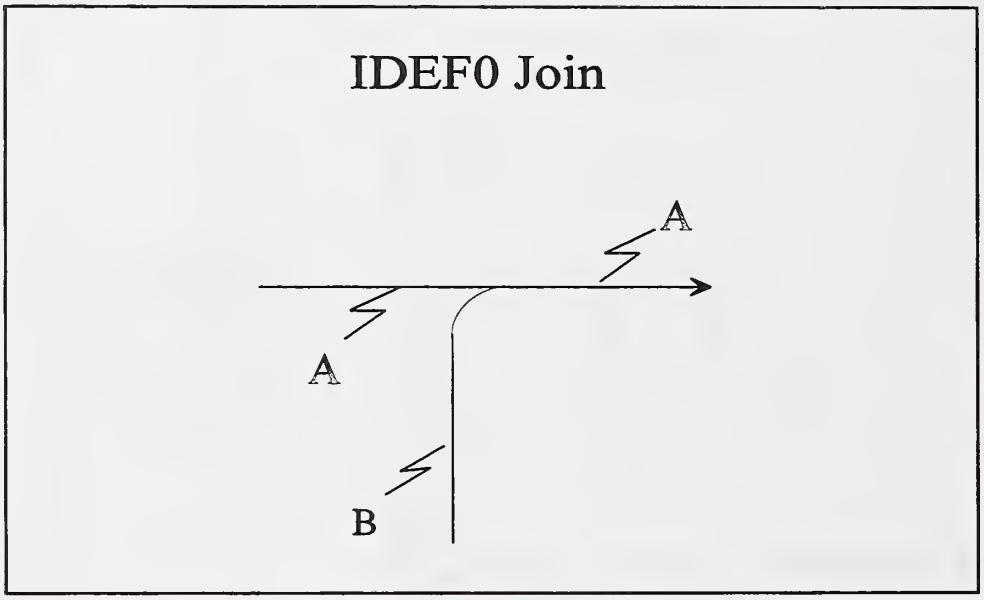

Figure 8: "A Portion" Join

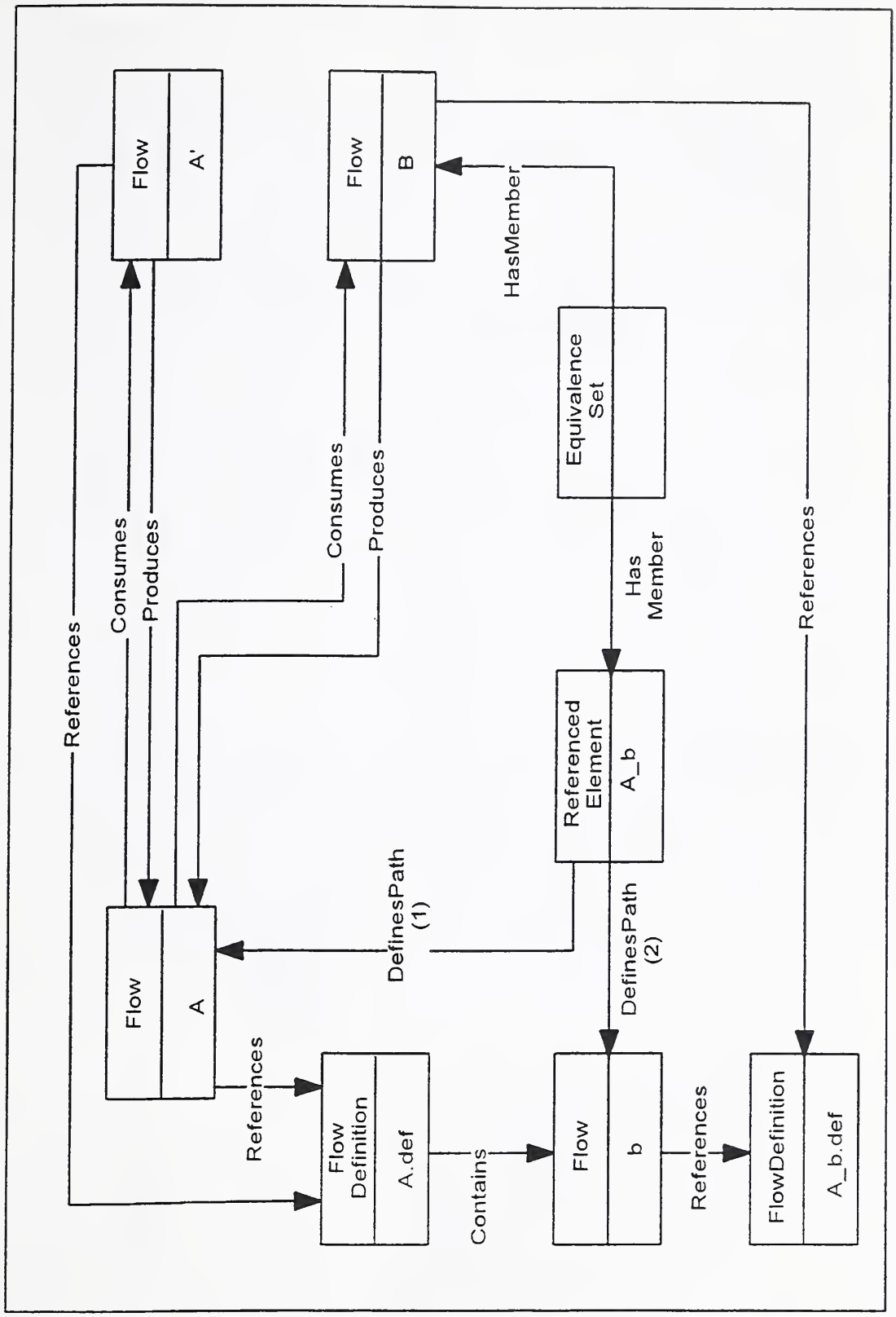

Figure 8-2: CDIF Mapping of "A Portion" Join

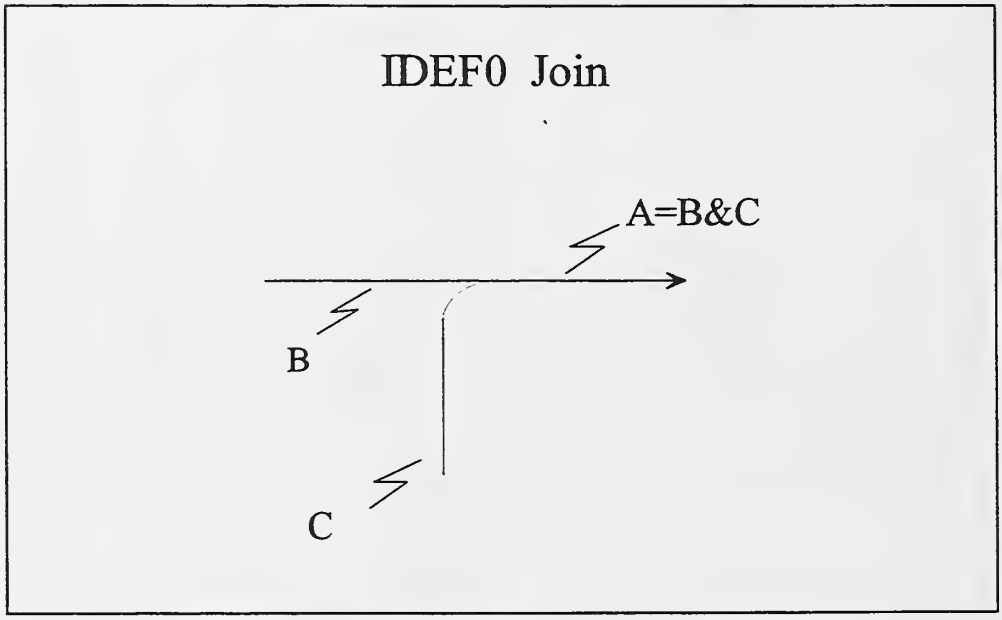

Figure 9: "The Sum" Join

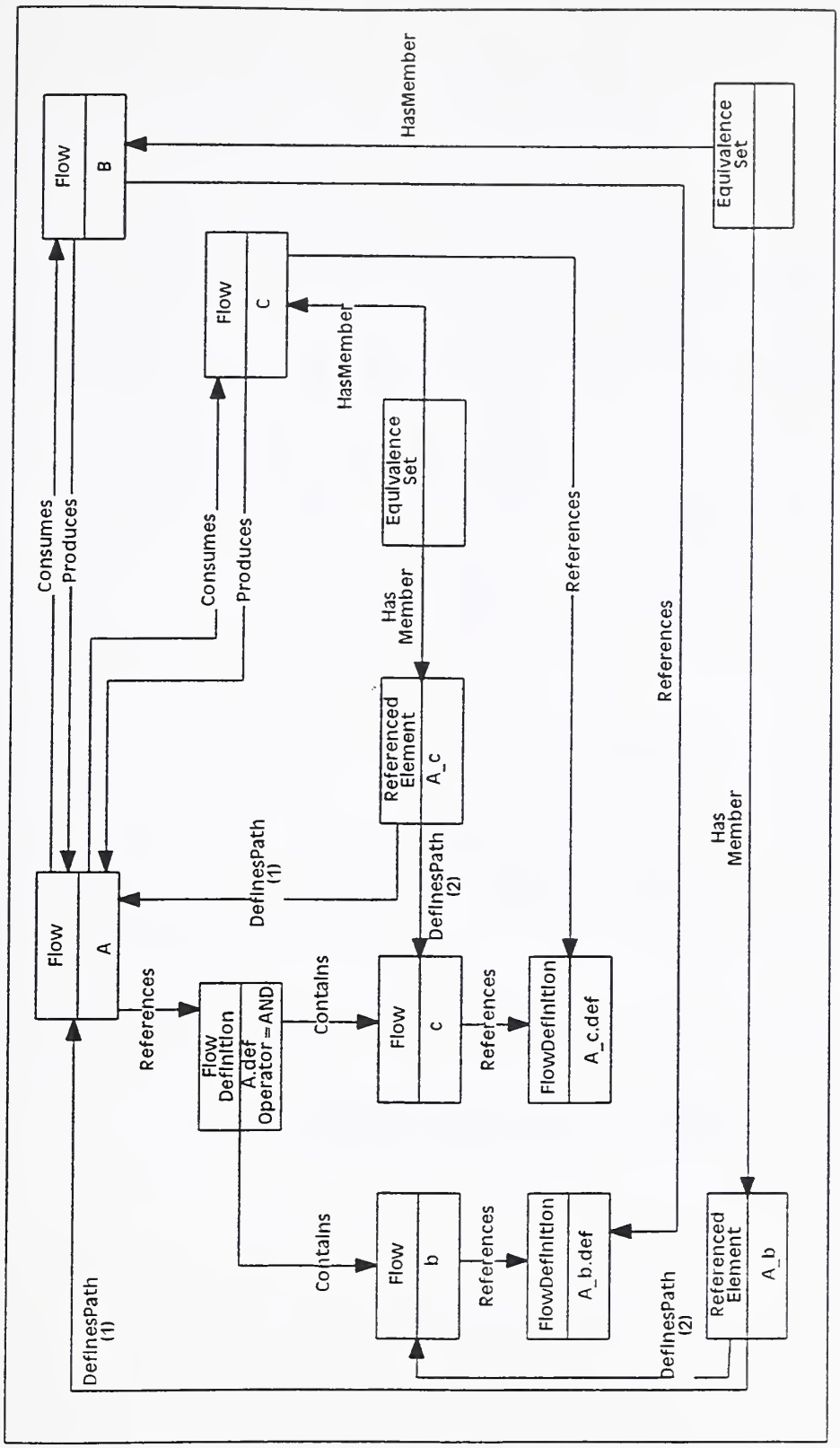

Figure 9-2: CDIF Mapping of "The Sum" Join

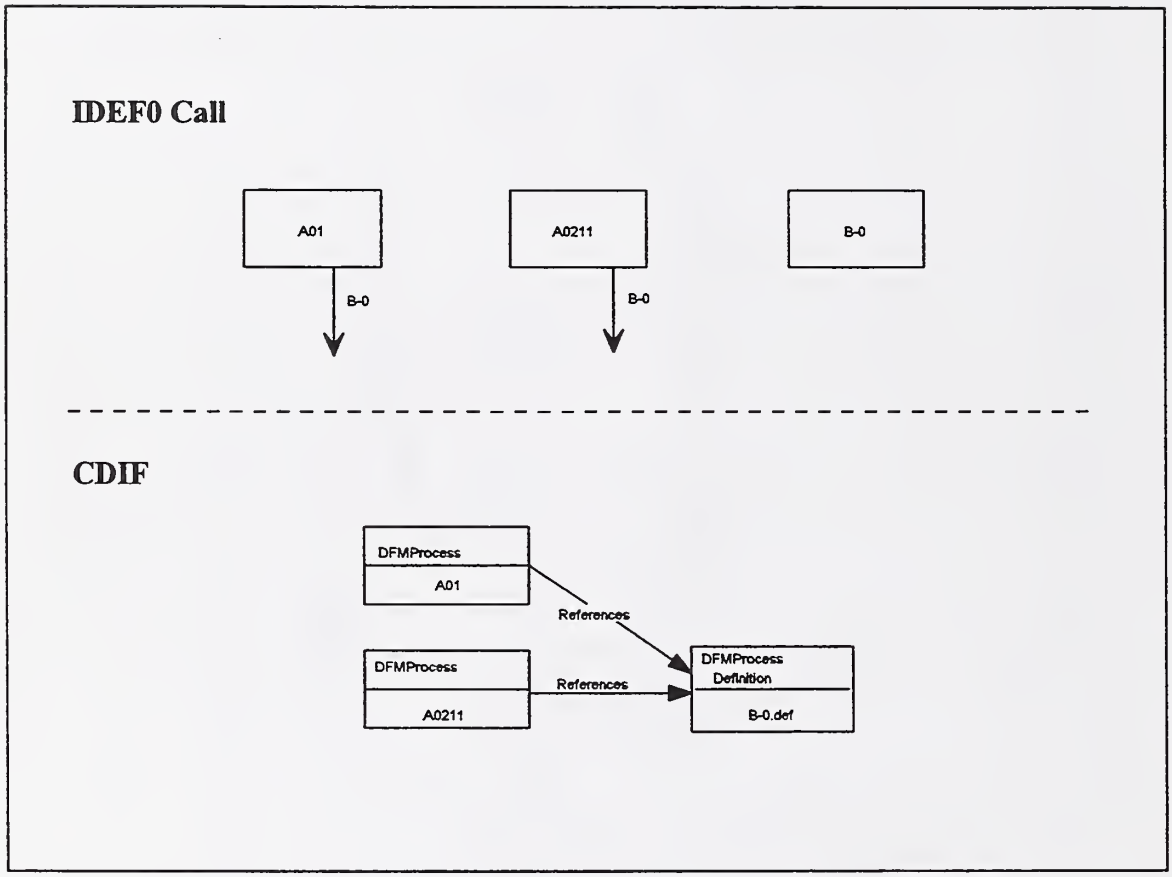

Figure 10: "Another Data Model" Call

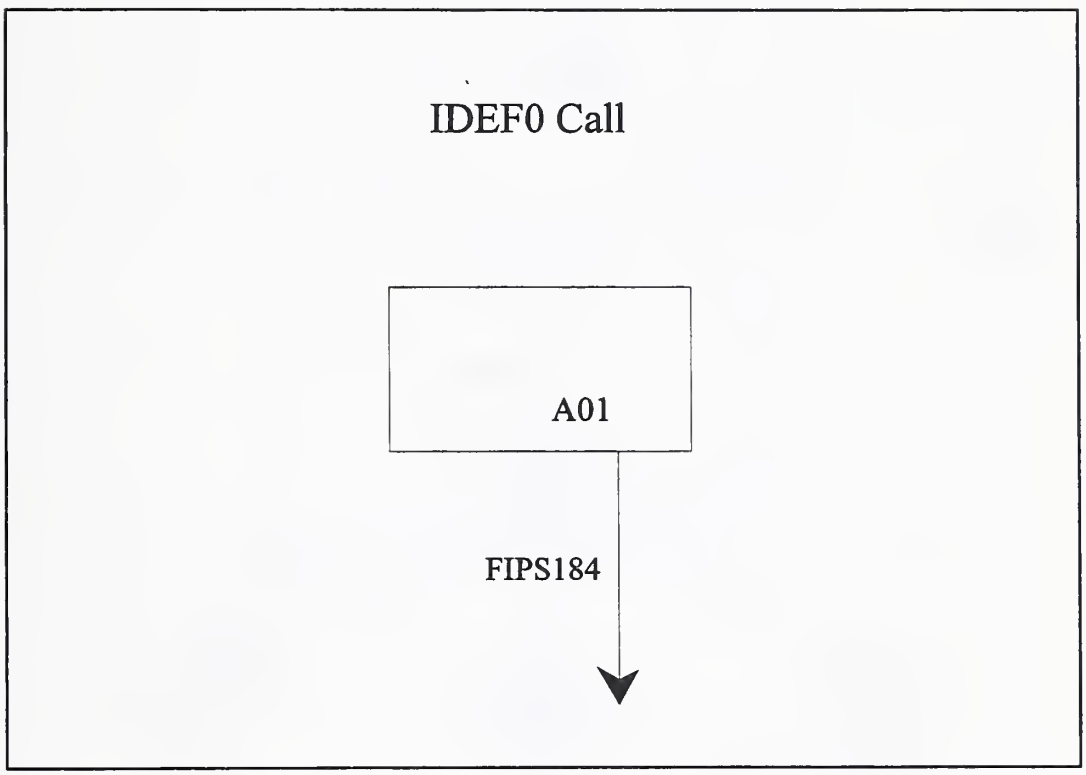

Figure 11: "A Document" Call

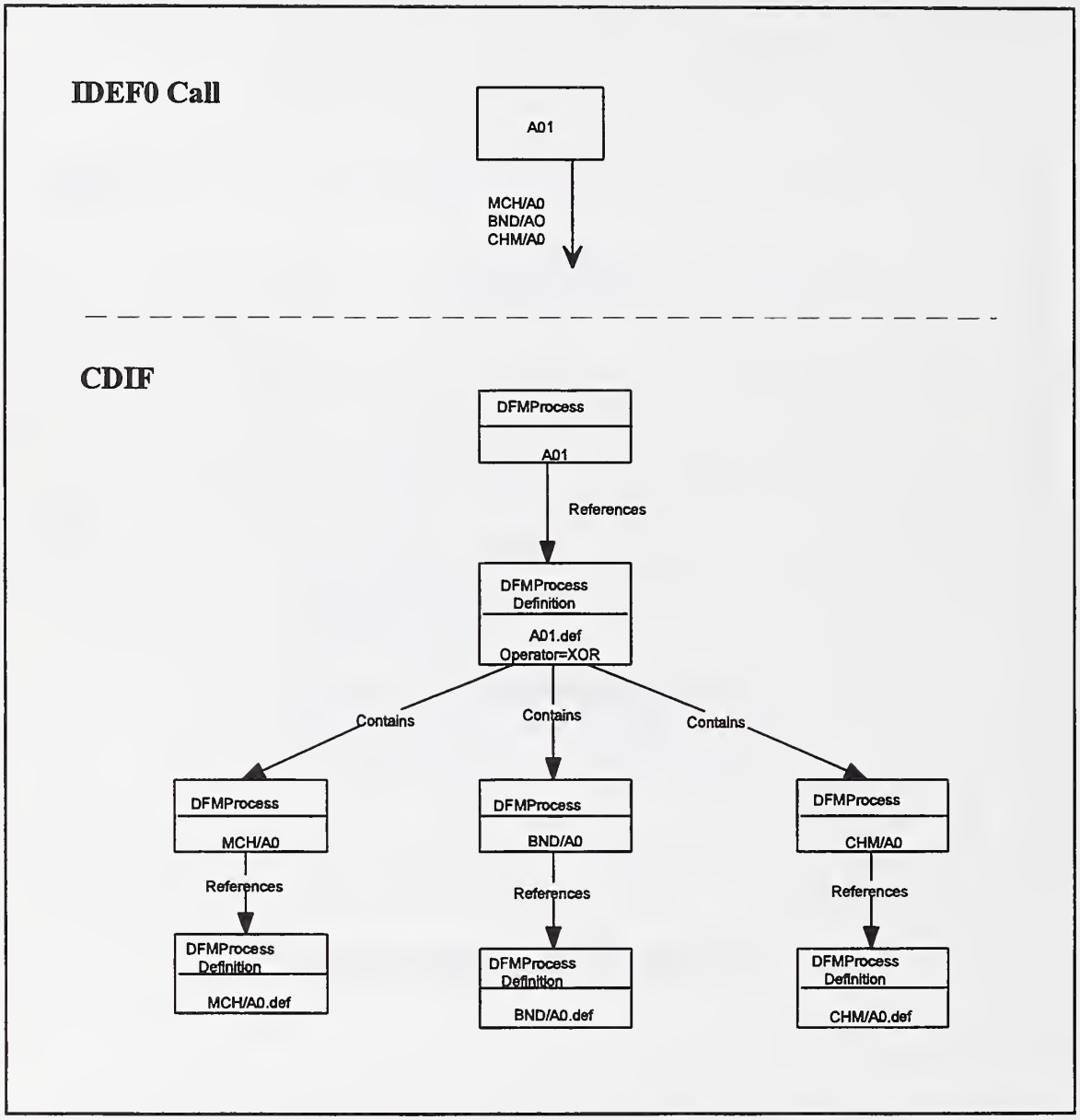

Figure 12: SBT Call

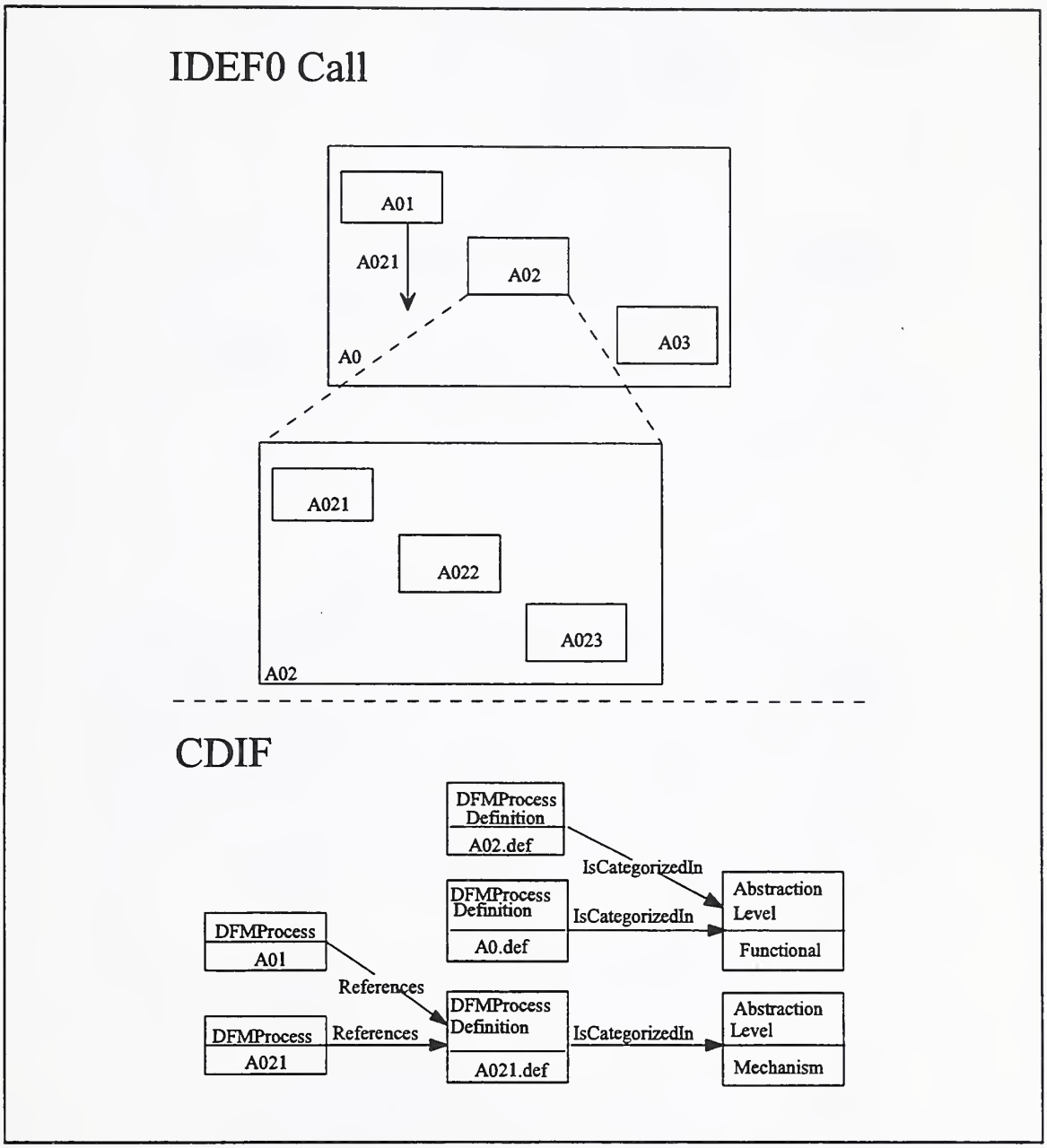

Figure 13: A Drop in the Level of Abstraction Call

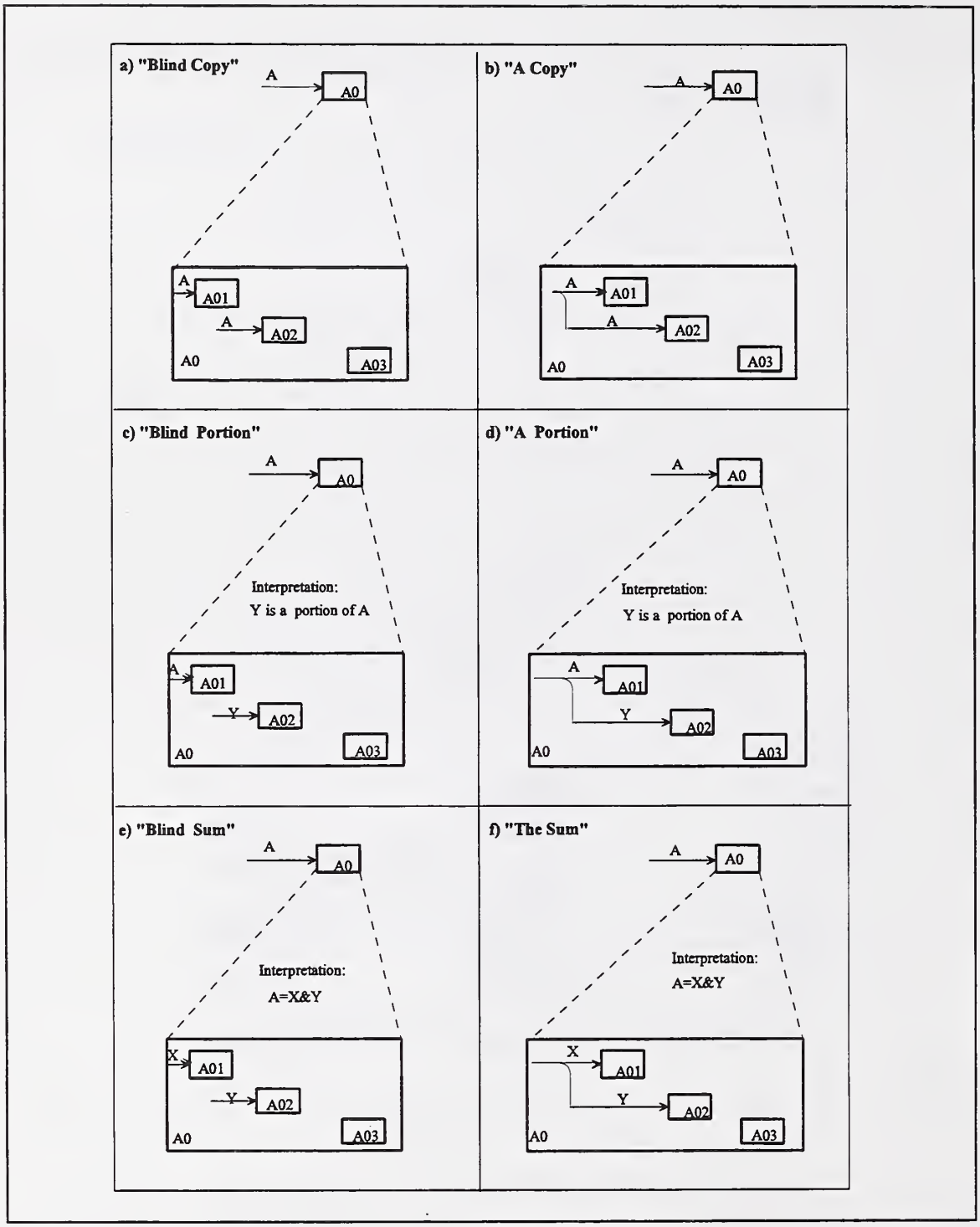

Figure 14: Types of Flow Decomposition

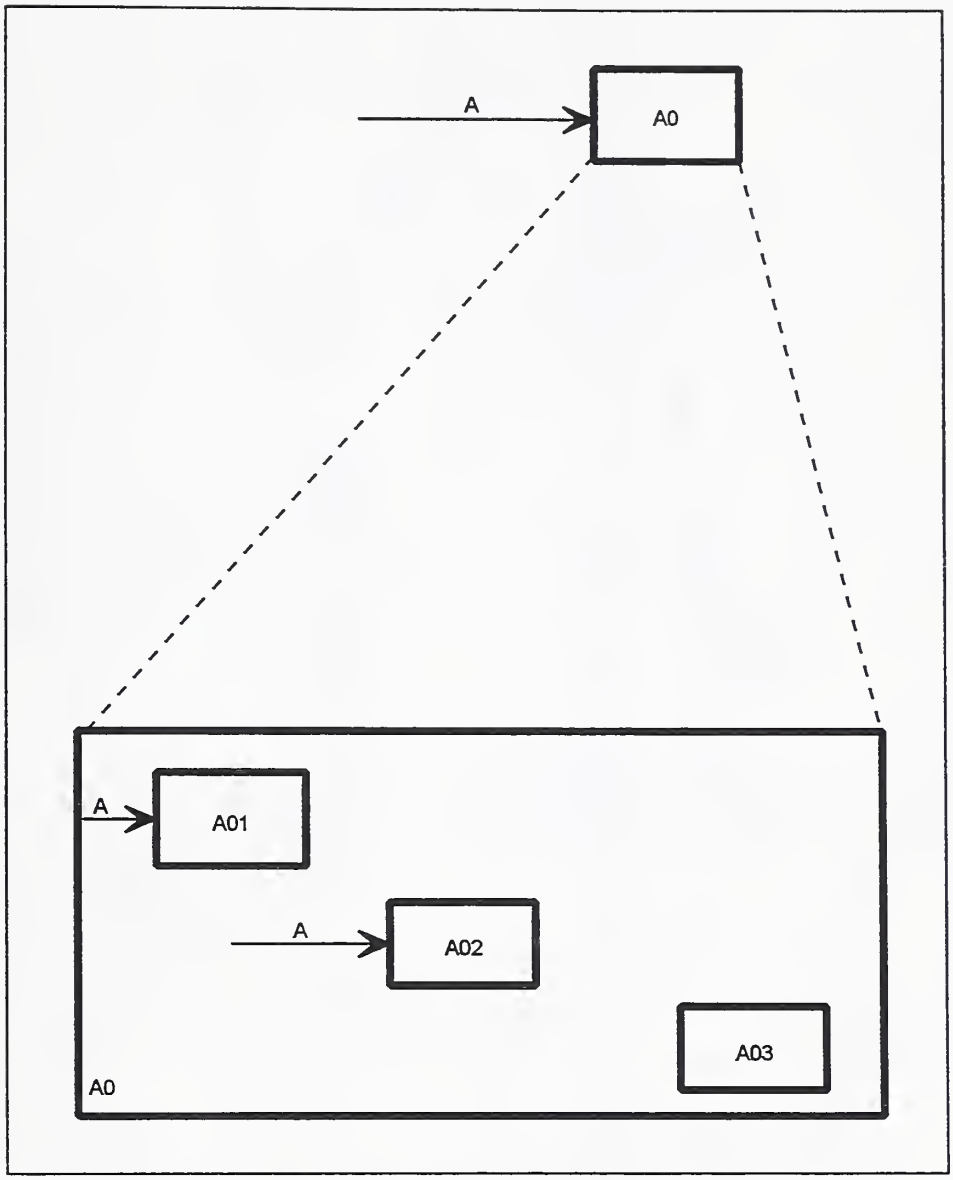

Figure 15: "Blind Copy" Decomposition

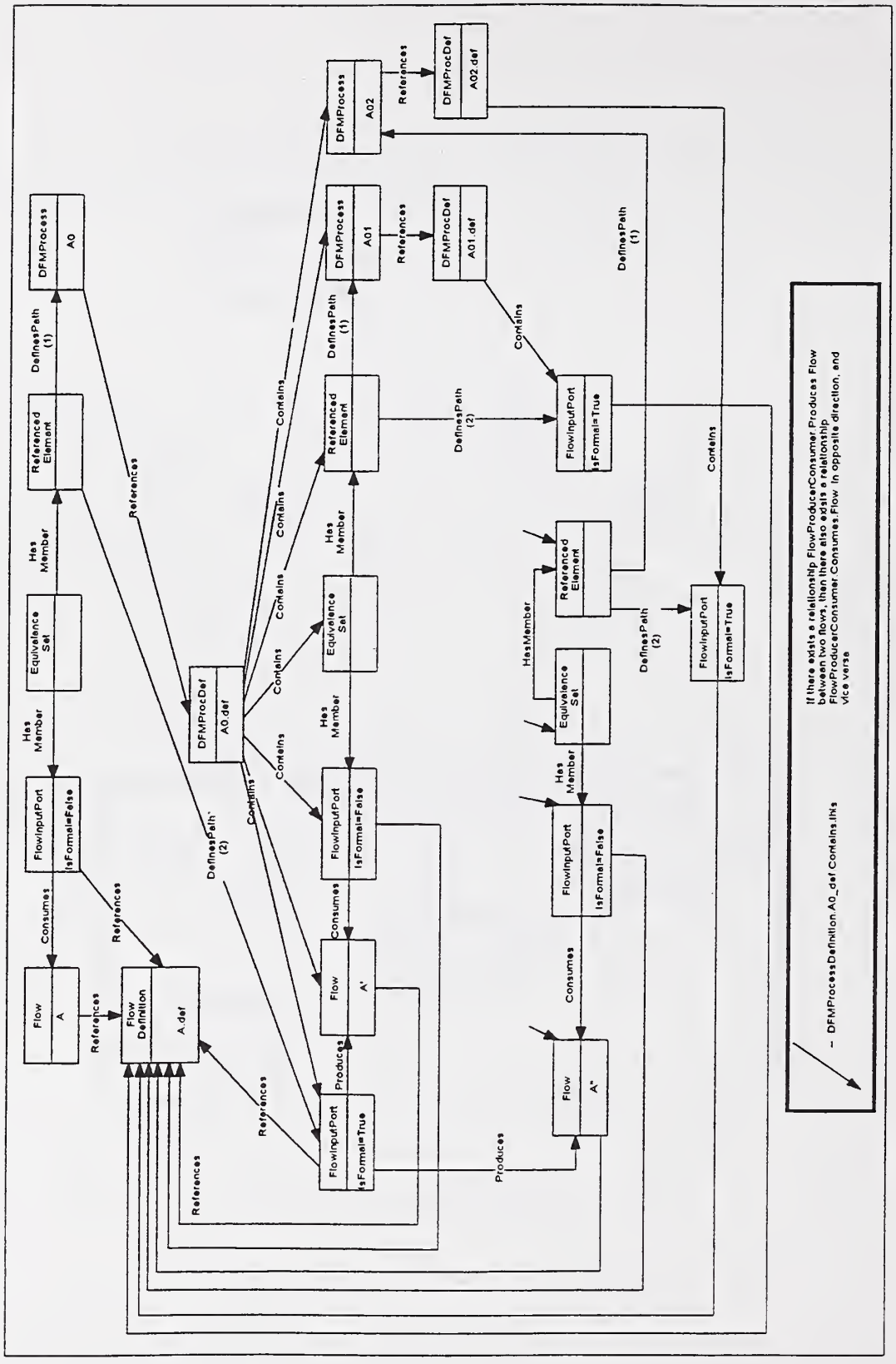

Figure 15-2: CDIF Mapping of the "Blind Copy" Decomposition

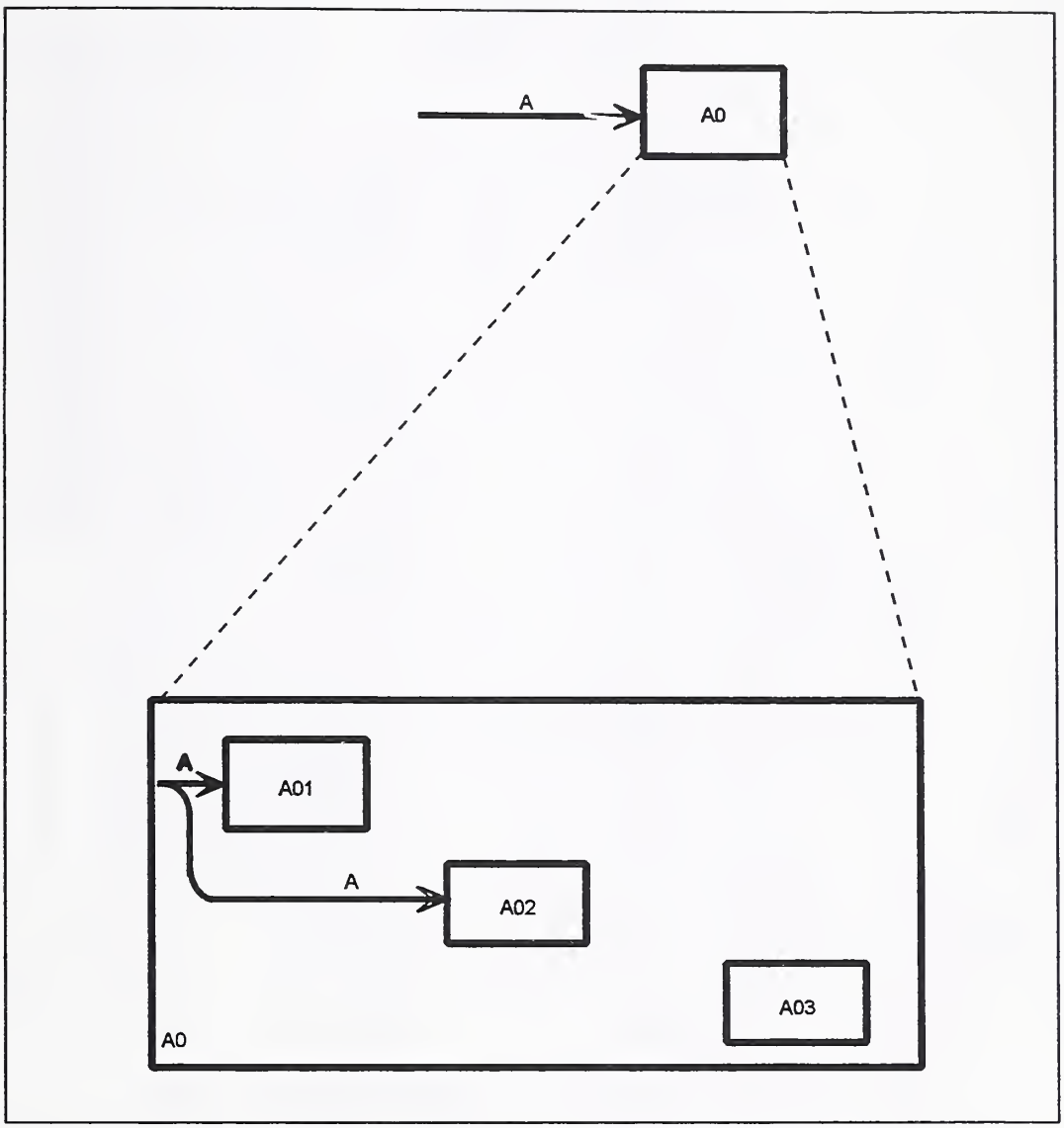

Figure 16: "A Copy" Decomposition

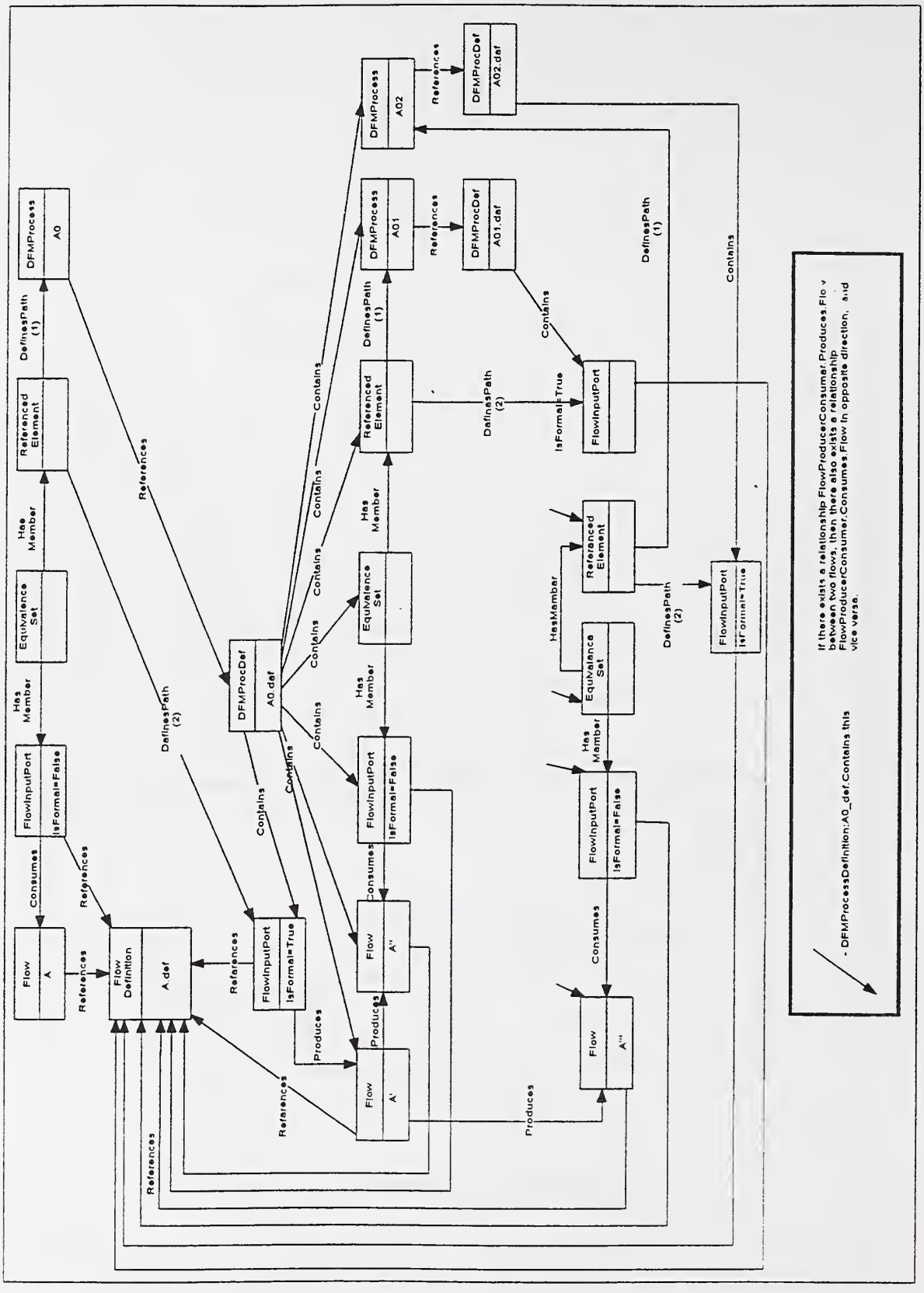

Figure 16-2: CDIF Mapping of the "Copy" Decomposition

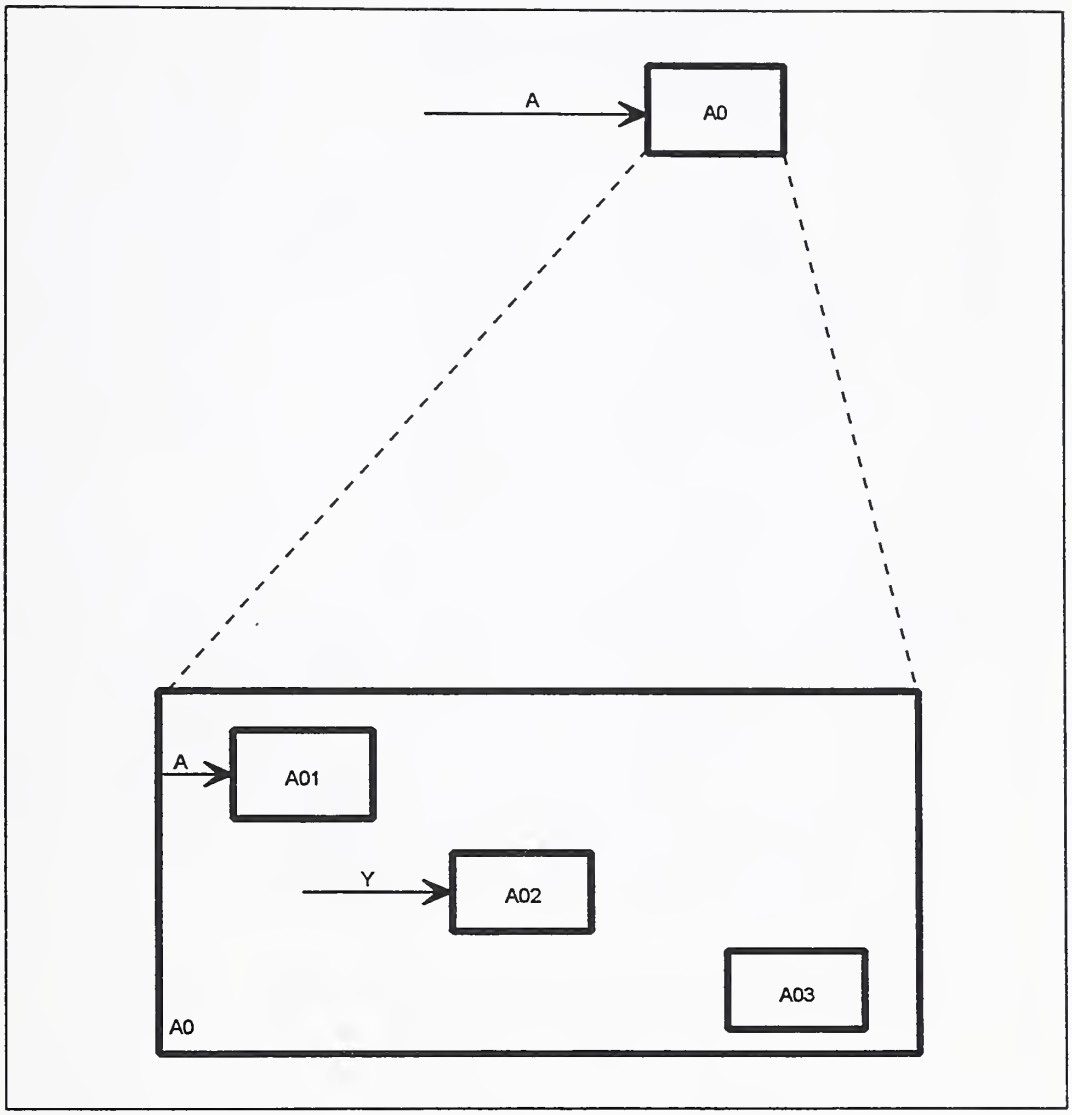

Figure 17: "Blind Portion" Decomposition

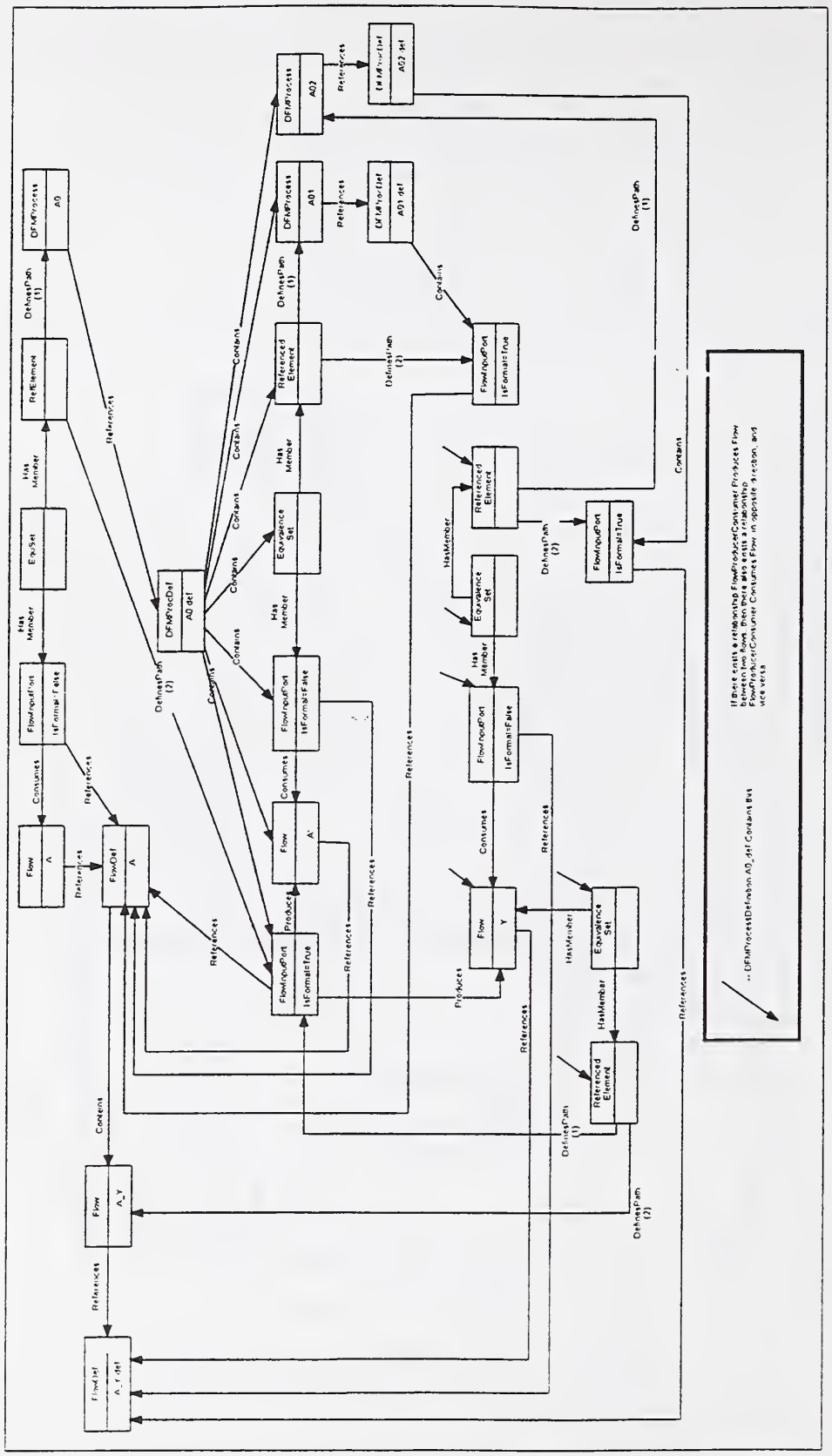

Figure 17-2: CDIF Mapping of the "Blind Portion" Decomposition

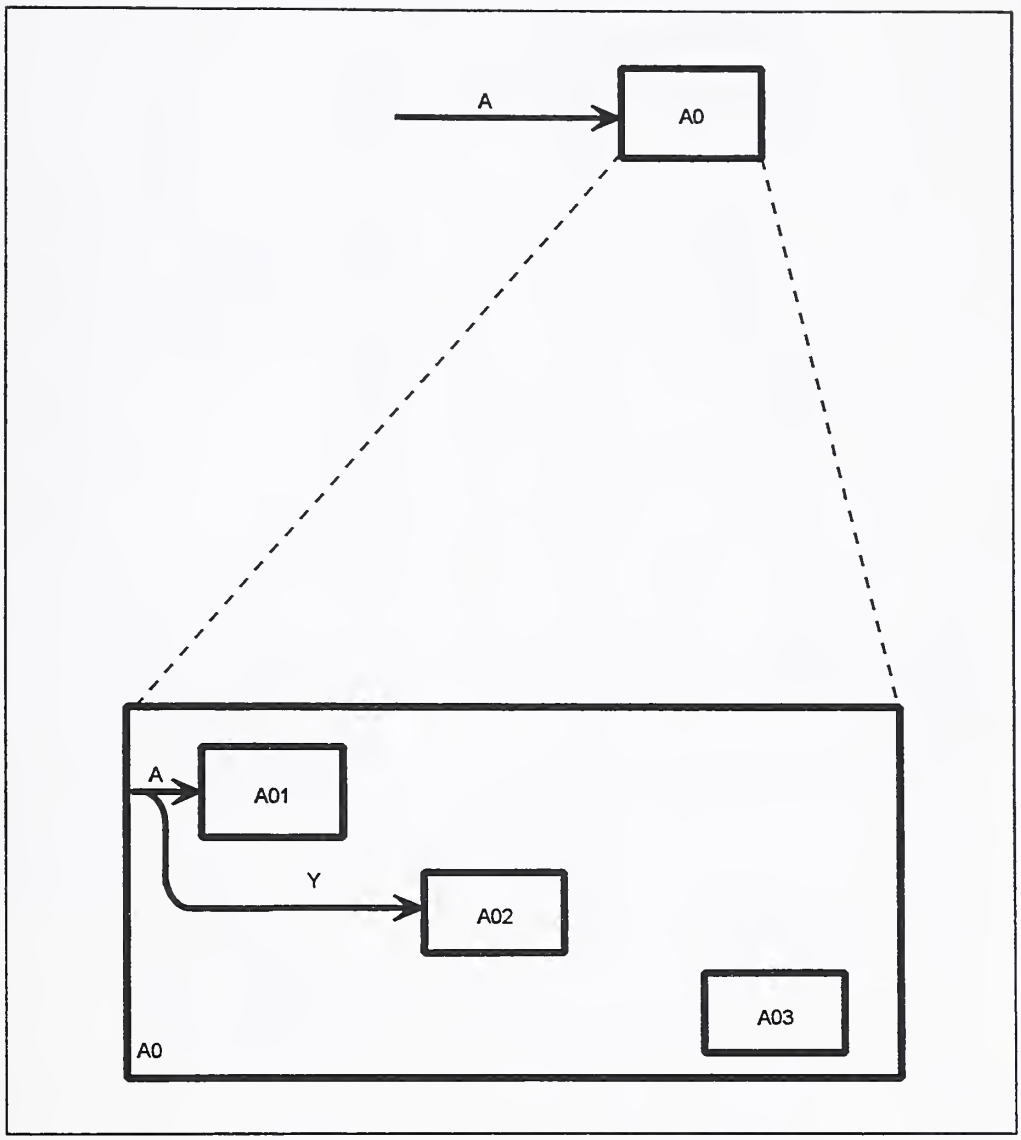

Figure 18: "A Portion" Decomposition

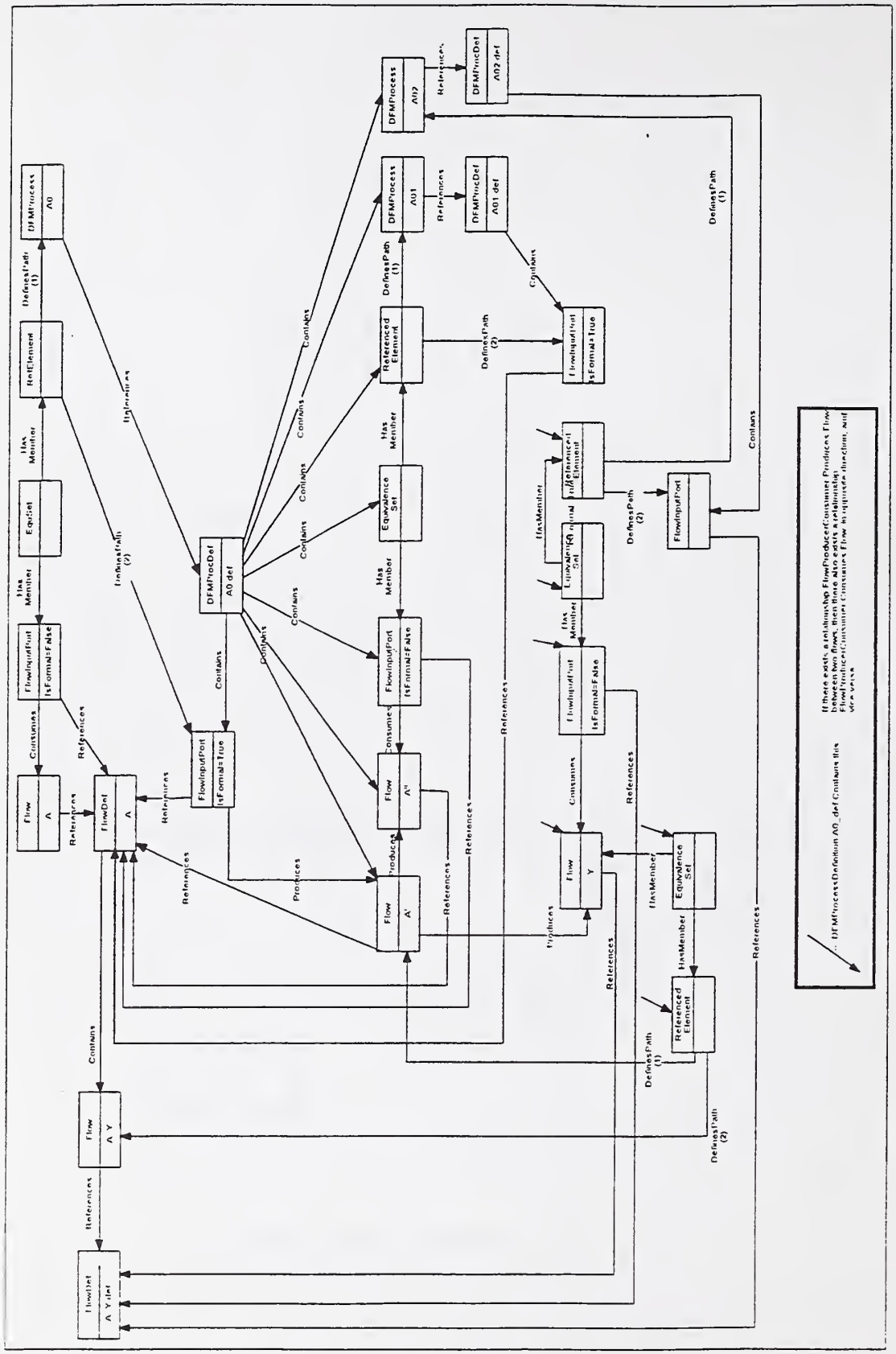

Figure 18-2: CDIF Mapping of the"Portion" Decomposition

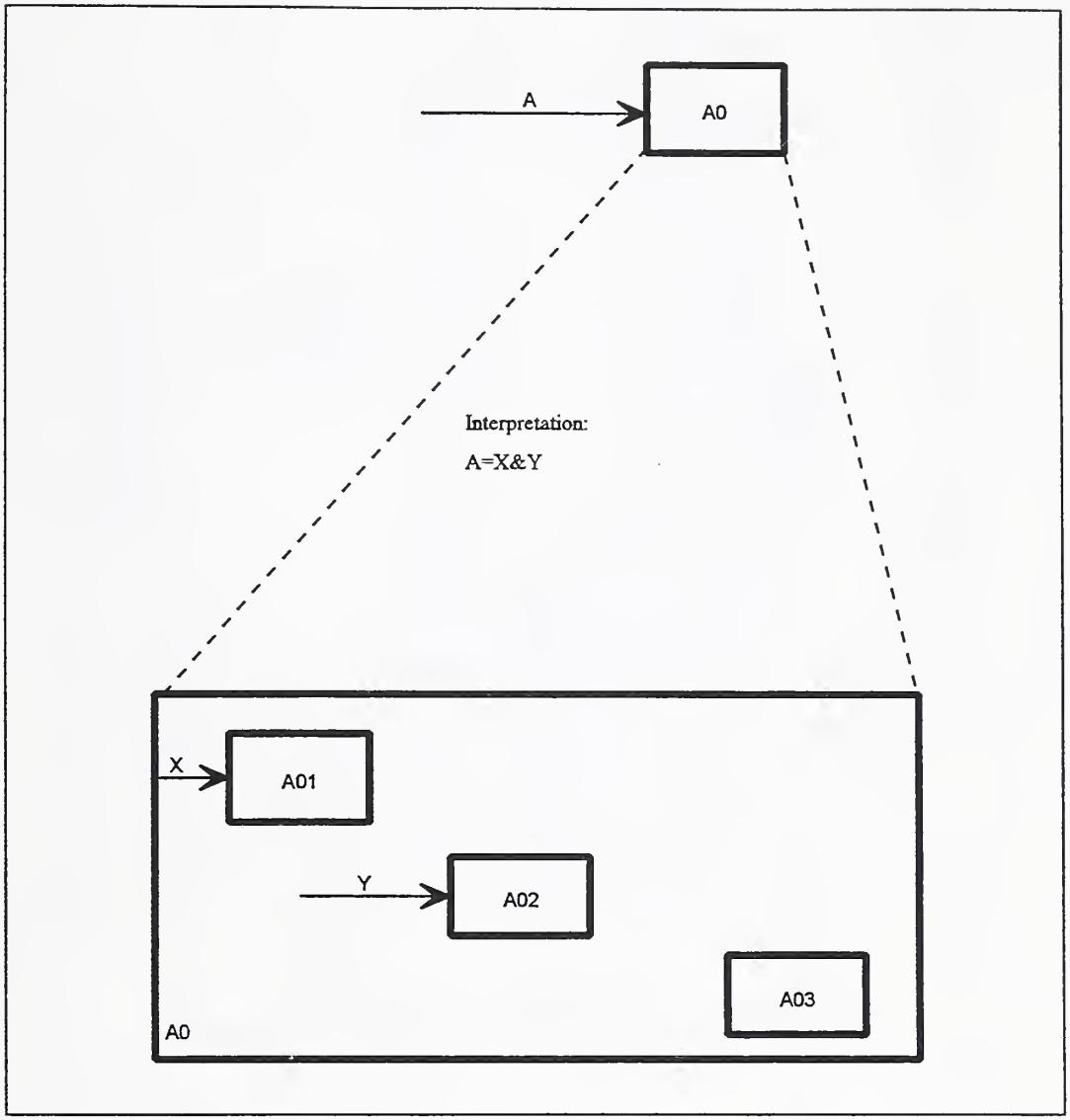

Figure 19: "Blind Sum" Decomposition

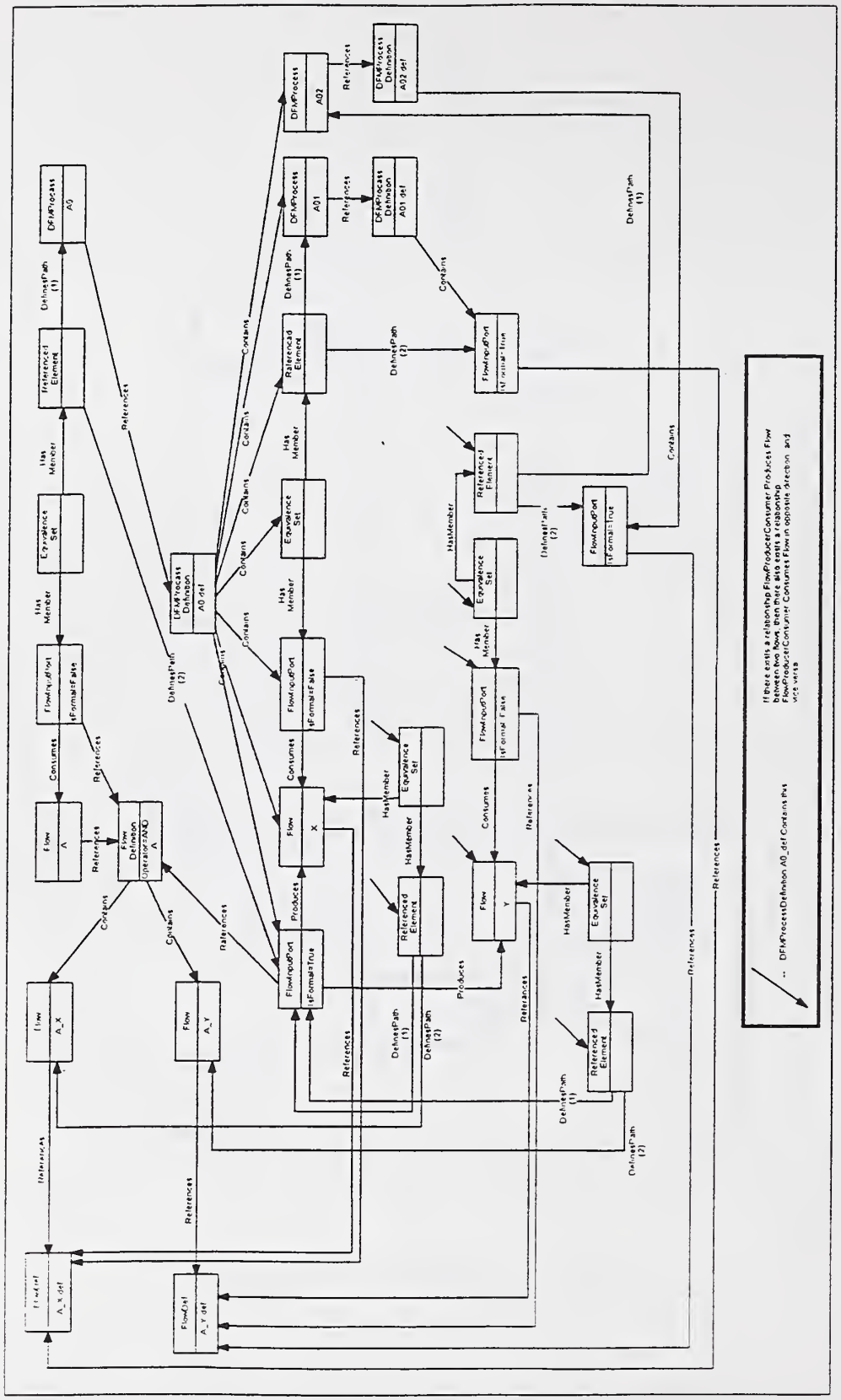

Figure 19-2: CDIF Mapping of the "Blind Sum" Decomposition

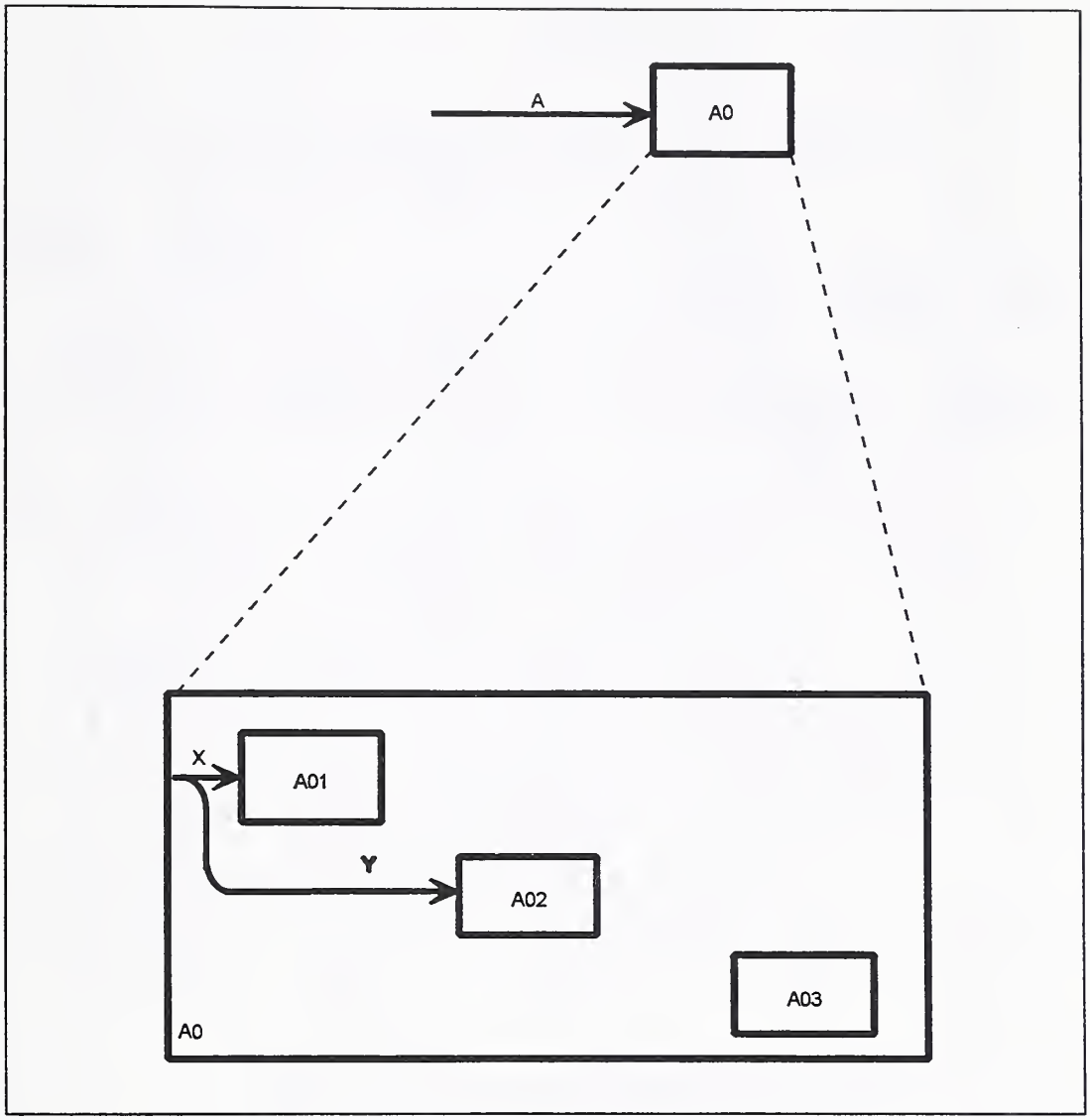

Figure 20: "The Sum" Decomposition

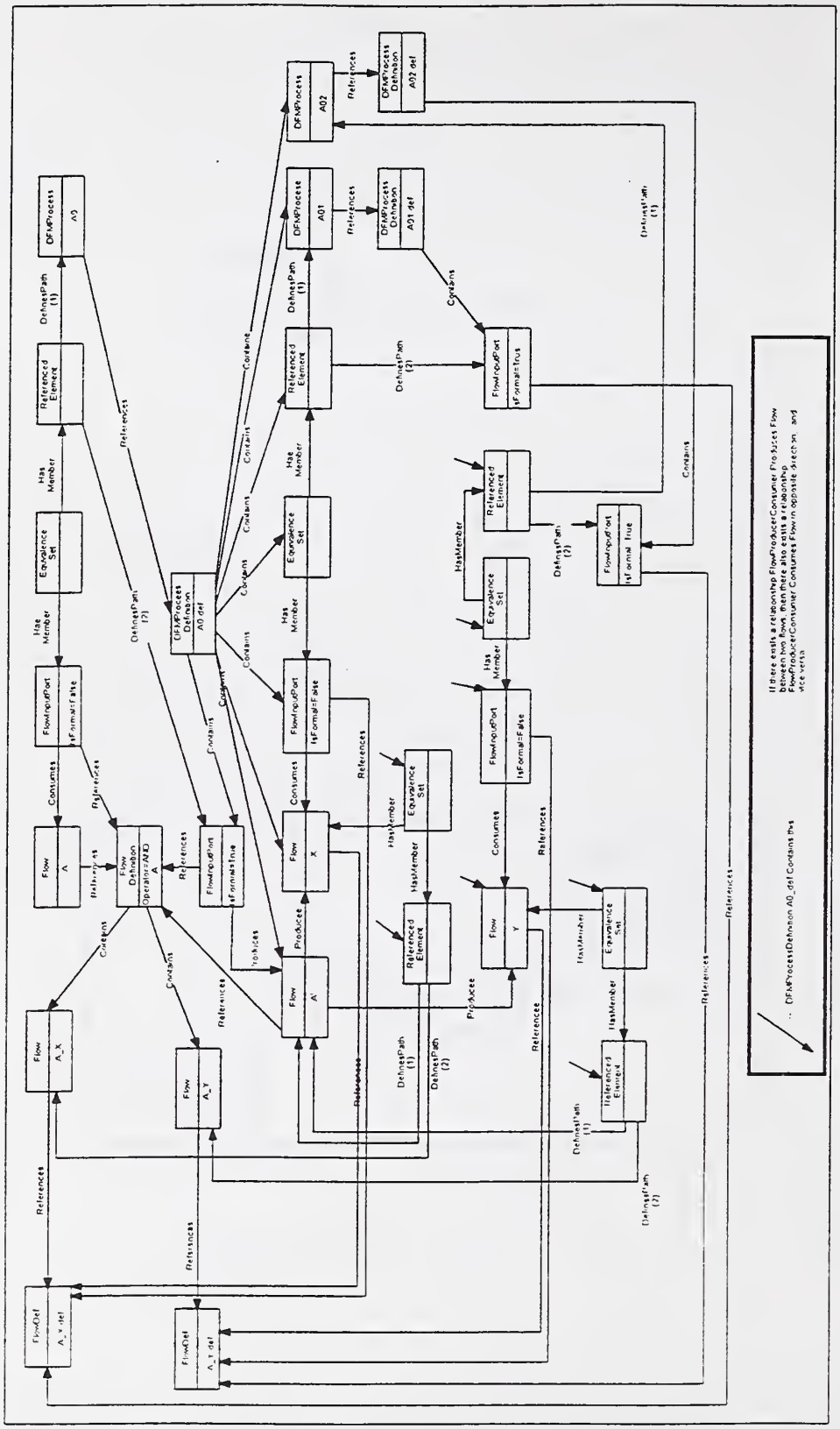

Figure 20-2: CDIF Mapping of the "Sum" Decomposition

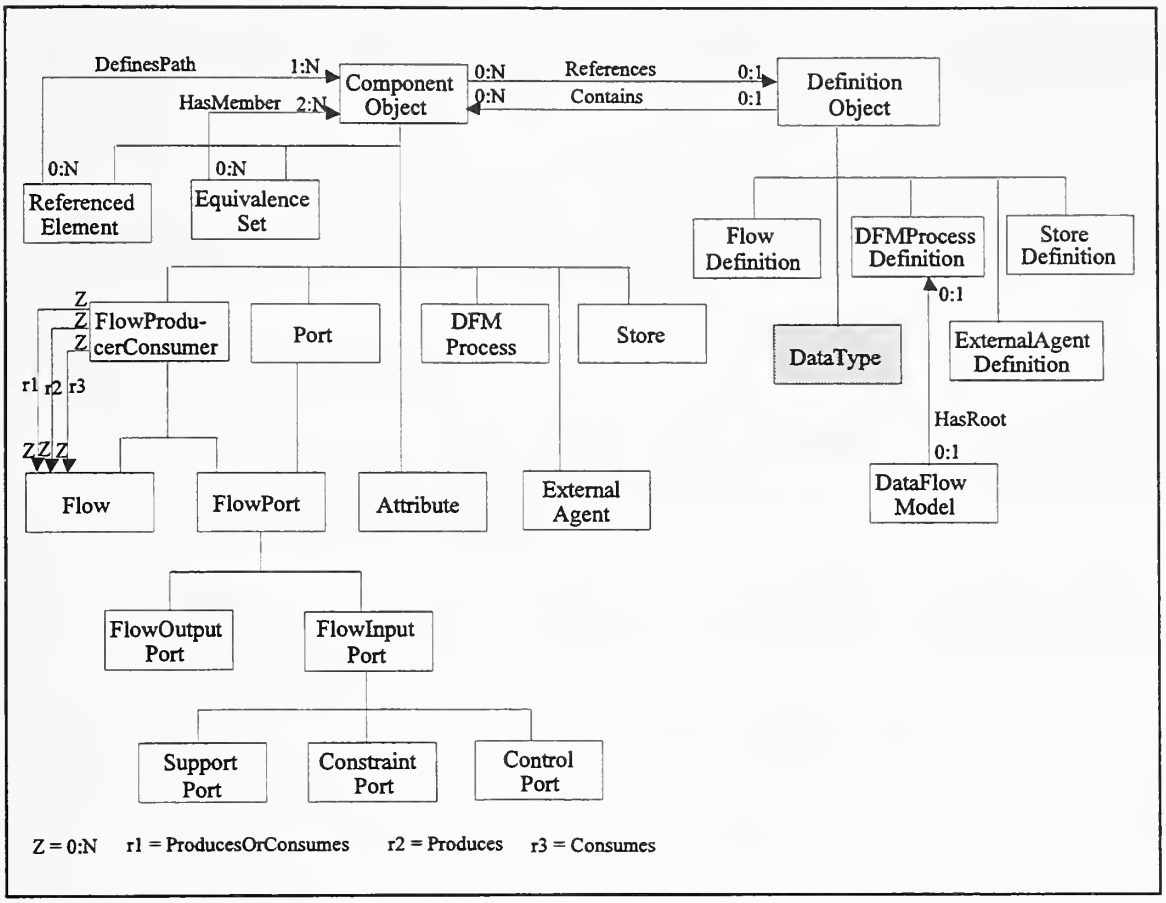

Figure 21: CDIF Data Flow Model Subject Area

APPENDIX B: Alternative Solutions

Node References can be captured using the meta-attribute *ContextIdentifier* of the *DFMProcess*.

Process Names can be captured using the meta-attribute *ContextDescription* or *Name* of the *DFMProcess*.

APPENDIX C: Transfer Summary

Any model can be transferred using CDIF Family of Standards. Even if there exists a construct in this model that is not "built in" into the CDIF Integrated Meta-Model, it can be transferred using the CDIF Framework for Modeling and Extensibility.

This research shows that 99% of IDEF0 semantics CAN be transferred using CDIF Family of Standards, and it is built in into the Integrated Meta-Model. The only major syntactical elements of IDEF0 that CANNOT map one-to-one to the CDIF Integrated Meta-Model are KIT, MODEL, and DIAGRAM.

The following CDIF Meta-meta-entities are needed to be added (or modified) to the specified subject areas to meet the requirements of the 100% mapping of IDEF0 into a CDIF transfer file.

Semantics (CDIF DFM Subject Area)

1. A local meta-attribute "Sequence Number" (type: INTEGER) for the meta-relationship "ReferencedElement.DefinesPath.ComponentObject". It is needed to specify the correct order of objects in the path.

2. A local meta-attribute "ReferenceDescription" (type: TEXT) for the meta-entity "DFMProcess". It is needed for "A Document" IDEF0 Call -- a type of a call which references a document (book, standard, etc.)

Syntax (CDIF Presentation Location and Connectivity Subject Area)

3. A meta-entity "Kit" (with all the required meta-attributes to be mapped to the KIT IDL).

4. A meta-entity "Model" (with all the required meta-attributes to be mapped to the MODEL IDL)

5. A meta-entity "Diagram" (with all the required meta-attributes to be mapped to the DIAGRAM IDL)

6. CDIF error: the meta-attribute "ExtentX" is of type Integer, while the meta-attribute "ExtentY" is BitMap. Correction: make the meta-attribute "ExtentY" also be an Int.

7. Local meta-attributes for the meta-entity "Node", which will match to BOX IDL.

8. CDIF error: no presence of the meta-attribute "ArrowOrientation" for the meta-entity "EdgeElement". Correction: list this meta-attribute in the "fat/thin" CDIF pages.

9. Local meta-attribute "Tunnel" (type: BOOLEAN) for the meta-entity "EdgeElement".

REFERENCES

1. FIPS, Integration Definition for Function Modeling (IDEF0), FIPS PUB 183, National Institute of Standards and Technology, Gaithersburg, MD, December 1993.

2. EIA, CDIF - CASE Data Interchange Format - Overview, EIA/IS-106, January 1994.

3. EIA, CDIF - Integrated Meta-model -- Common Subject Area, EIA/PN-3070, CDIF-DRAFT-CMMN-V15, Editor: Bob Matthews, May 1994.

4. EIA, CDIF - Integrated Meta-model -- Data Flow Model Subject Area, EIA/PN-3073, CDIF-DRAFT-DFM-V9, Editor: Bob Matthews, March 1995.

5. EIA, CDIF - Integrated Meta-model -- Data Definition Subject Area, EIA/PN-3071, CDIF-DRAFT-DDEF-V11, Editor: Adrian Blakey, November 1994.

6. EIA, CDIF - Framework for Modeling and Extensibility, EIA/IS-107, January 1994.