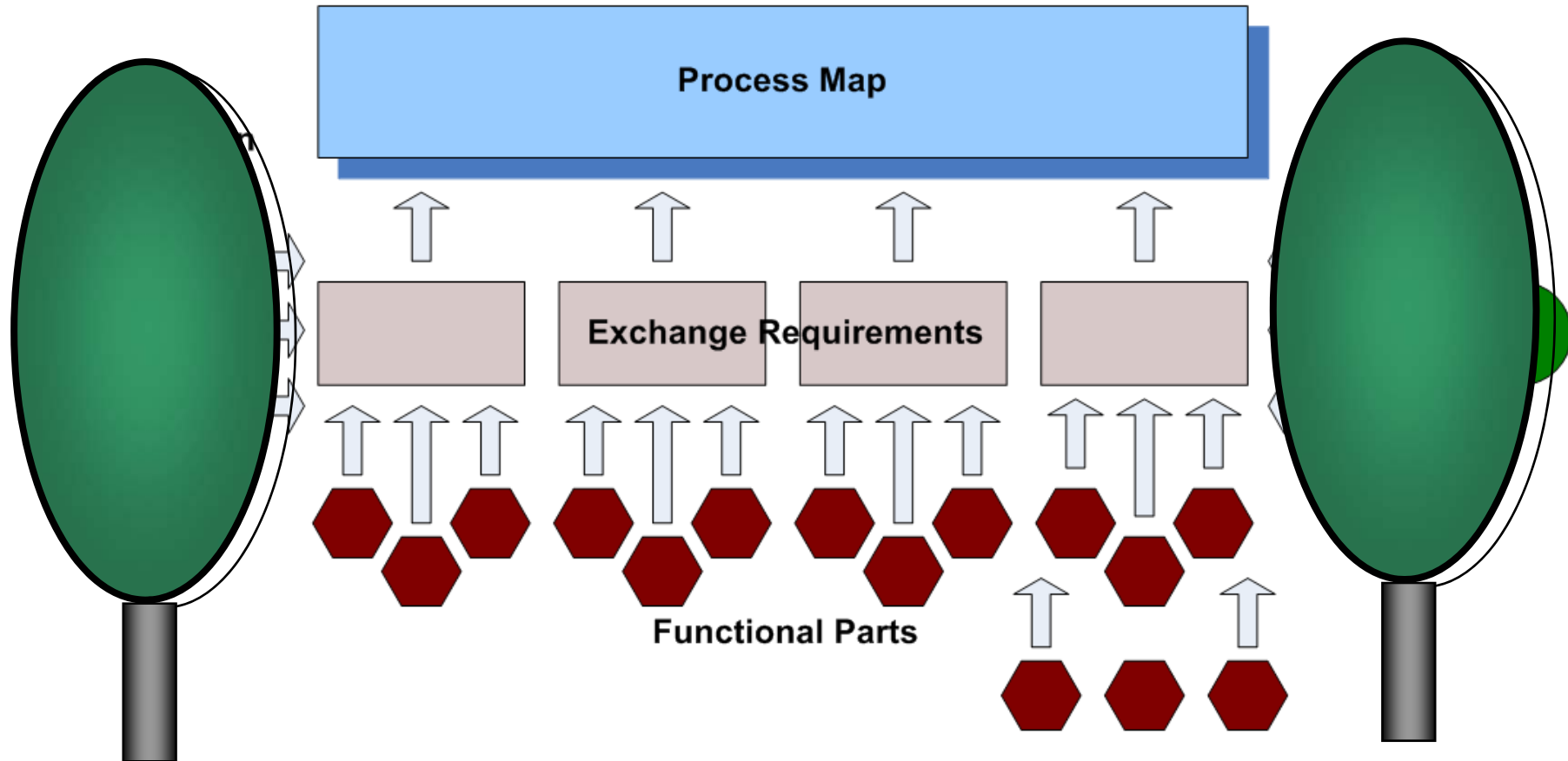




**IDM**  
**Business Rules**

*Nicholas Nisbet*

# IDM Technical Architecture



**Focus on Business Rules and Verification Tests**

# Tests

Tests can be checked  
Tests can be automated

## Verification tests

- build on the validation of the building model
- validate against purpose of exchange

## Business rules

- project standards and processes
- enterprise standards and processes
- national standards and processes

# Tests and non-Tests

What's the difference ?

Test

***Testable***

- '... is an approved vapour barrier'
- '... has a permeability of less than 1 perm'

Non-Test

***Not Testable***

- '... is weather-proof'
- '... is a vapour barrier'

# Boolean and Logical Tests

Contractual Specifications  
must be testable

## Boolean test

*Known*

- yes, true, pass
- no, false, fail

## Logical test

*Knowable*

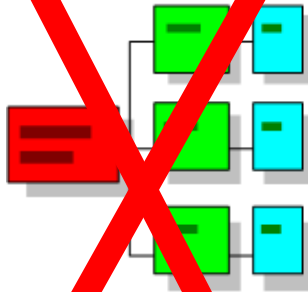
- yes, true, pass
- unsure, unknown, indeterminate
- no, false, fail

# Users

Tests serve a purpose



Executive User



- aware of process and business impacts
- doesn't need technical detail about use of information in the process
- does not need to know about software or format



End Users



- needs to know what information to expect and how to use it in the business process
- does not need to know about software or format



Solution Provider



dSA

- writes software + data exchange interface
- needs to know what users expect from software
- needs to know about the exchange format

# Tests

## Types of test

- objects (including relationships) present or absent
- values present or absent from range or lists

## Examples

- internal spaces present but no external spaces
- naming of spaces to BS 4157 conventions
- layering to BS1192:2007
- take-off classified to RICS BCIS
- materials named as on enterprise approved lists

Compliance tier	Topics covered	Example failure	Detection
Validity	Domain expertise Application requirements	Escape from room with no door.	Domain application rules, results.
<b>IDM</b>	<b>Project process based requirements, Expectations, Fitness for purpose.</b>	<b>Absence of connections on HVAC</b>	<b>?</b>
IFC endorsed property set usage (ie IFC2x4, IFD).	Naming, value types	Incorrect spelling of 'PsetSpace_Common'	Inspection
IFC view definition: Coordination or Code-Checking.	Anticipated entities. Implementation Agreements.	Absence of space boundaries	IAI Certification
IFC schema rules	Cardinality and 'where' rules	Empty list in material relationship	Toolkit validation
IFC schema content	Entities and properties	Incorrect number or type of attributes	Toolkit read/write
ISO-10303 STEP SPF:Part21 or XML:Part28	File layout and syntax	Incomplete comment delimiters	General read/write code



# Technical Concept

Which of these five are Tests?

Description of information required and specification of values to be set

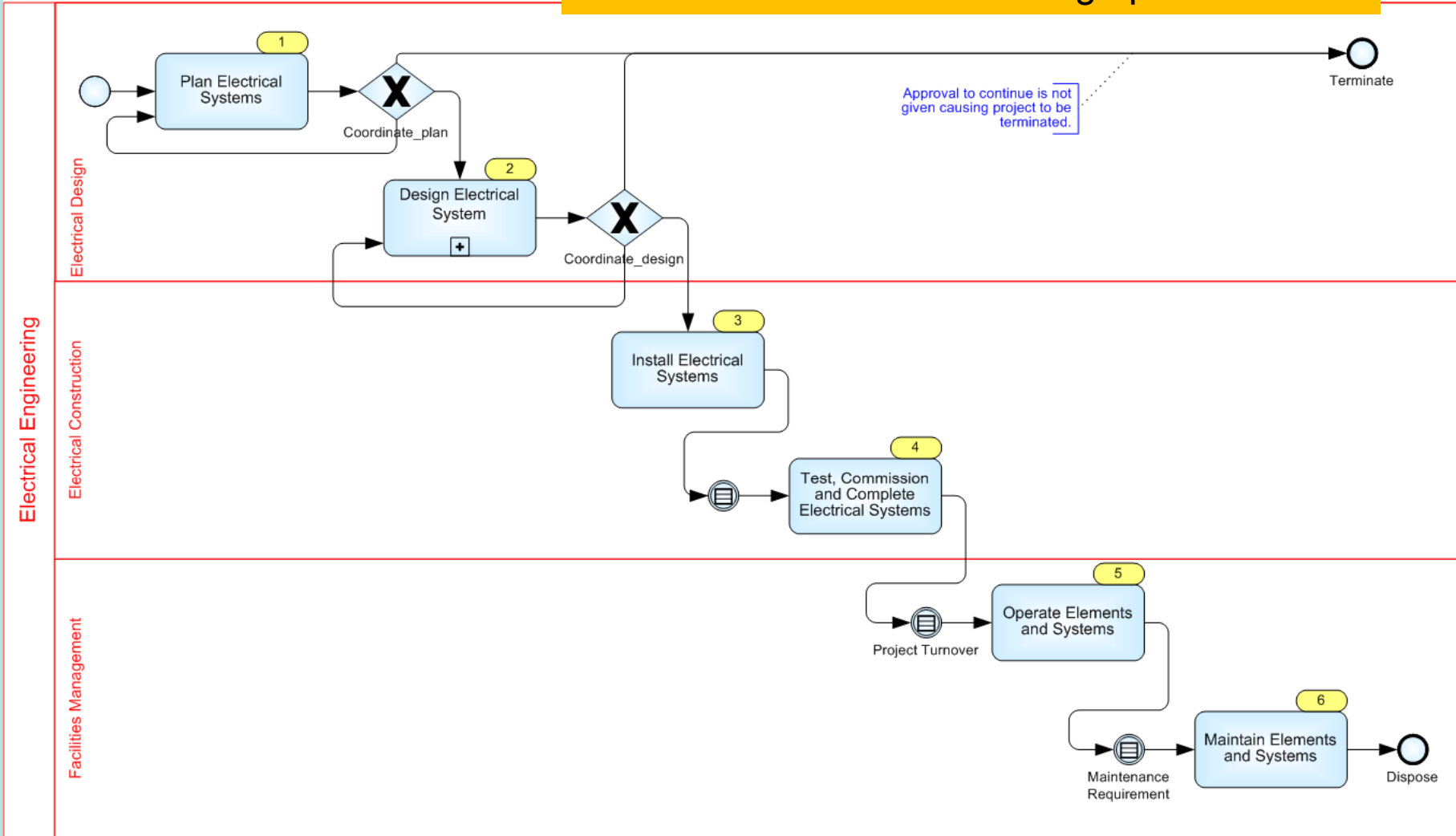
Name of entity/attribute or property set/property to be used

Mandatory (actual/recommended) or Optional to use

Description	Entity/Pset/Functional Part	M A N	R E C	O P T
Specify the system occurrence in which elements will participate  <i>A system opening is directly specified as an occurrence.</i>	IfcSystem OR IfcElectricalCircuit  <b>Testable</b>	✓		
Set the global unique identifier	IfcSystem.GlobalId → IfcGloballyUniqueId OR IfcElectricalCircuit.GlobalId → IfcGloballyUniqueId  <b>Testable</b>	✓		
Assert the owner history of the system	IfcSystem.OwnerHistory → fp_apply_owner_history OR IfcElectricalCircuit.OwnerHistory → fp_apply_owner_history  <b>Testable</b>	✓		
Specify the name of the system.  <i>Although this is an optional attribute within IFC, it must be asserted for system.</i>	IfcSystem.Name → IfcLabel OR IfcElectricalCircuit.Name → IfcLabel  <b>Not Testable</b>		✓	
Specify a description for the system  <i>Whilst the description does not add value to the semantics of the system, it can provide significant information for later project stages.</i>	IfcSystem.Description → IfcText OR IfcElectricalCircuit.Description → IfcText  <b>Not Testable</b>			✓

# Example

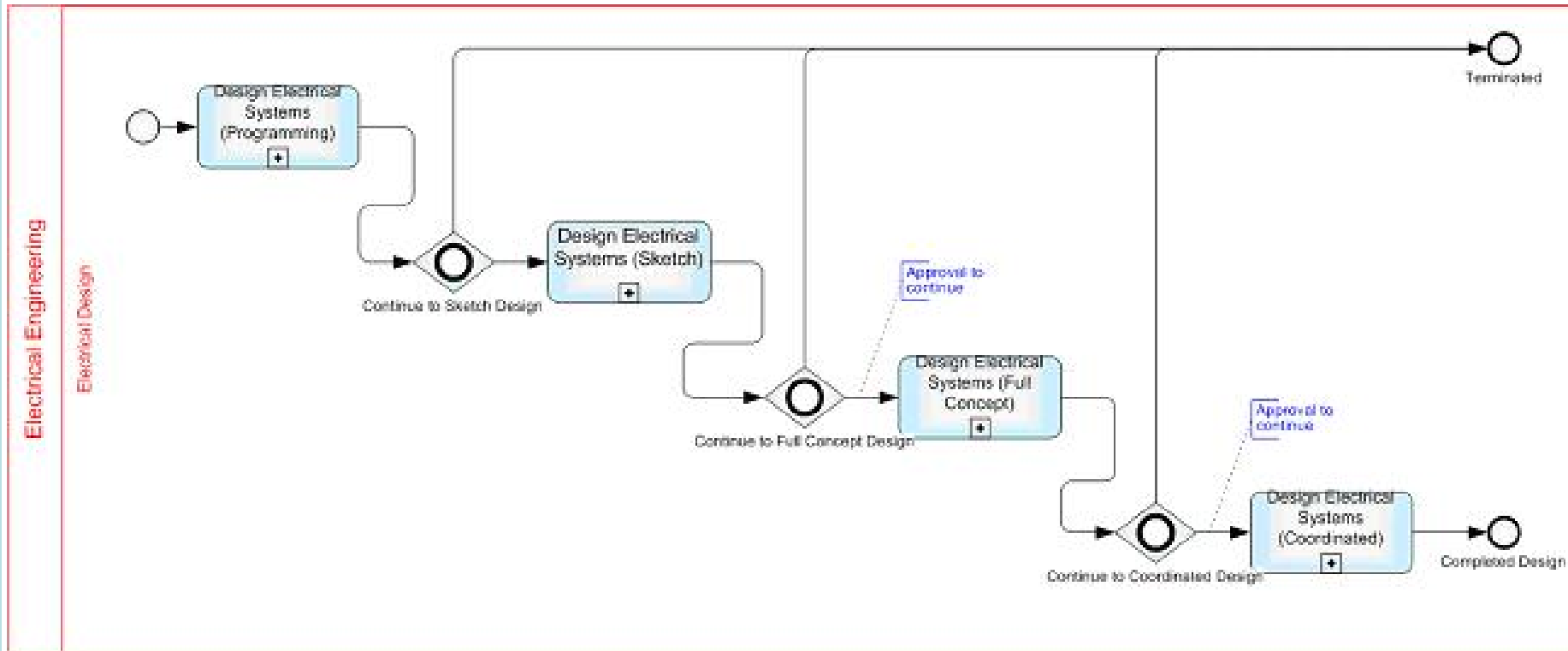
This example is from the HITOS project and focuses on the Electrical design process.



Electrical Engineering	author: Jeffrey Wix	created: 20/12/2005 15:24:35	
Electrical Engineering	version: 0.3	modified: 05/03/2006 14:31:29	
Top level diagram for electrical project electrical engineering	status: created	bpmn_electrical_engineering.vsd	

# Process: electrical design

- Pre-requisites for electrical design
- Criteria for completion of electrical design



# Specific process details

This process includes determining:

- Estimate of load to determine incoming size
- Identify main vertical routes using indicated spaces
- Location, sizing and identification of technical spaces
- Costing for presentation is by high level aggregation element such as lighting overall (1 less digit in classification table!).
- Specification of types of system and principles of operation.
- Sketch design [BIM] showing technical spaces, vertical distribution routes, key horizontal routes using cable carriers to describe principal routing

## Specifics for Norwegian Practice

- NS3451, Building element level of systems (down to level of whole system such as all lighting)
- Costing uses NS3453 (standard table for building categories) likely to be based on sq.m. prices against known previous example buildings.

# er: ready\_for\_electrical\_design

er\_ready\_for\_electrical\_design

er\_model\_building (basic)

fp\_set\_project\_context  
fp\_model\_building  
fp\_model\_building\_storey  
fp\_model\_space  
fp\_model\_wellbeing

fp\_electrical\_requirements ?  
fp\_space\_occupancy ?  
fp\_jurisdiction ?

# er: exchange\_electrical\_design

er\_exchange\_electrical\_system

er\_model\_building (basic)

fp\_set\_project\_context  
fp\_model\_building  
fp model building storev

fp\_set\_project\_context  
fp\_model\_flow\_segment [cable/cablecarrier]  
fp\_model\_flow\_fitting [CableCarrier, predefined\_type]  
fp\_model\_electrical\_equipment [type, predefined\_type]  
fp\_model\_electric\_distribution\_point [function]  
fp\_model\_distribution\_port [cable/cablecarrier]  
fp\_connect\_ports  
fp\_services\_building  
fp\_model\_system  
fp\_define\_electrical\_base\_properties

# Sample tests

Usually applicable to all schema versions  
Frequently tighten IFC schema constraints

- $\{ 1 \leq \text{self.BasePhase} \leq 3 \}$
- `Exists(self.Name)`
- `self.BaseVoltage` in `[110,250,260]`
- `self.BaseFrequency`  $\geq 50$
- `PropertyExists('Graphical','LayerName')`

# Extending the FP with Clauses

Description	Entity	Name and Test Clause
<p>Model the correct number of ports for the element to which the ports are assigned: for example:</p> <p><b>flow terminals terminate a distribution system.</b></p>	<p><i>a subtype of (Ifc) Distribution Element</i></p> <p><b>Ifc Flow Terminal</b></p>	<p><b>flow_terminals_ should_have_ one_port</b></p> <p><b>sizeof (self.hasPorts) = 1</b></p>

```
#75= idmLOGICALTEST(
    '1234567890123456789075',
    'br_flow_terminals_should_have_one_port',
    'flow terminals terminate a distribution system.', $,
    '2005-10-03','2005-11-09',$,.F.,(#50,#51),
    'IfcFlowTerminal',
    'sizeof(self.hasPorts)=1'
);
```

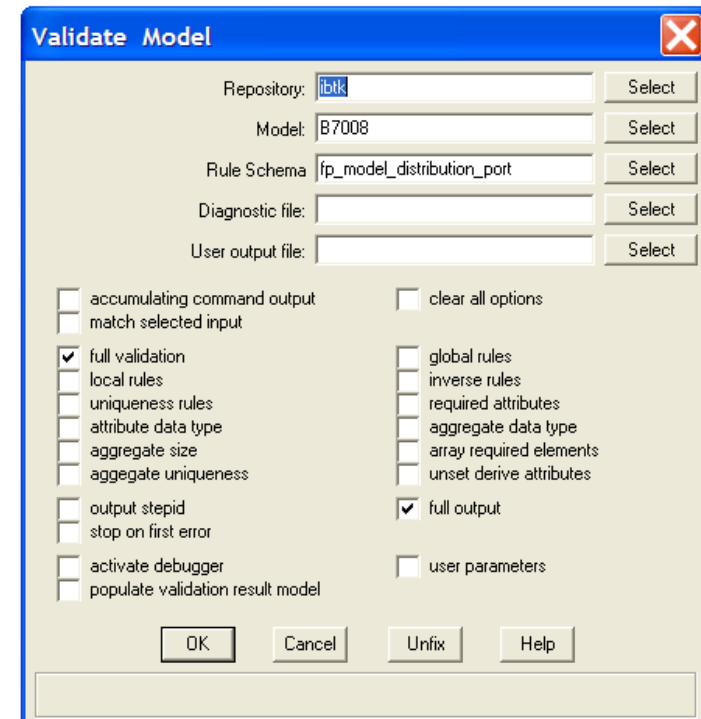


# Formal Validation Test

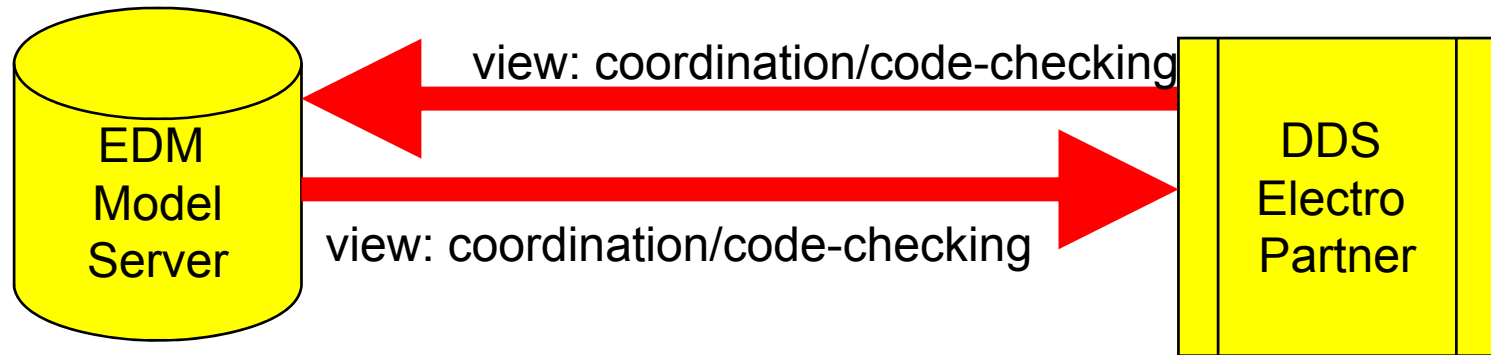
- **RULE\_SCHEMA fp\_model\_flow\_terminal FOR ifc2x2\_final;**
  - **entity ifcFlowTerminal;**
    - where  
**br\_flow\_terminal\_should\_have\_one\_port :**  
**sizeof(self.hasPorts)=1;**
  - **end\_entity;**
- **end\_rule\_schema;**

# Raw result from Validation

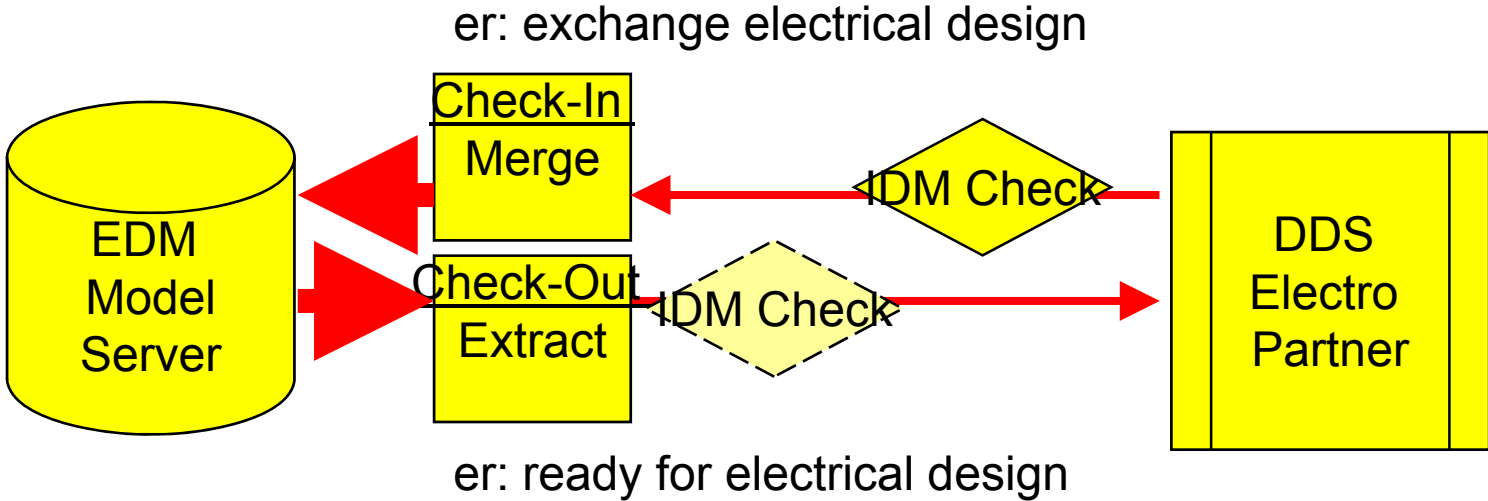
- Validation report by: **EDM Model Checker**
  - Model: DataRepository.**B7009**
  - Rule schema: **fp\_model\_flow\_terminal**
- **FAILED:**  
**br\_flow\_terminal\_should\_have\_one\_port**
  - **IFC FLOW TERMINAL**
  - 0gjMzbm9rCiP0CdYXc4\_ZD
  - Intake1
  - Fan Intake 1
  - at (2.400m 1.500m 2.700m)



# File based design development



# Tromso HITOS Check-Out, Check-In



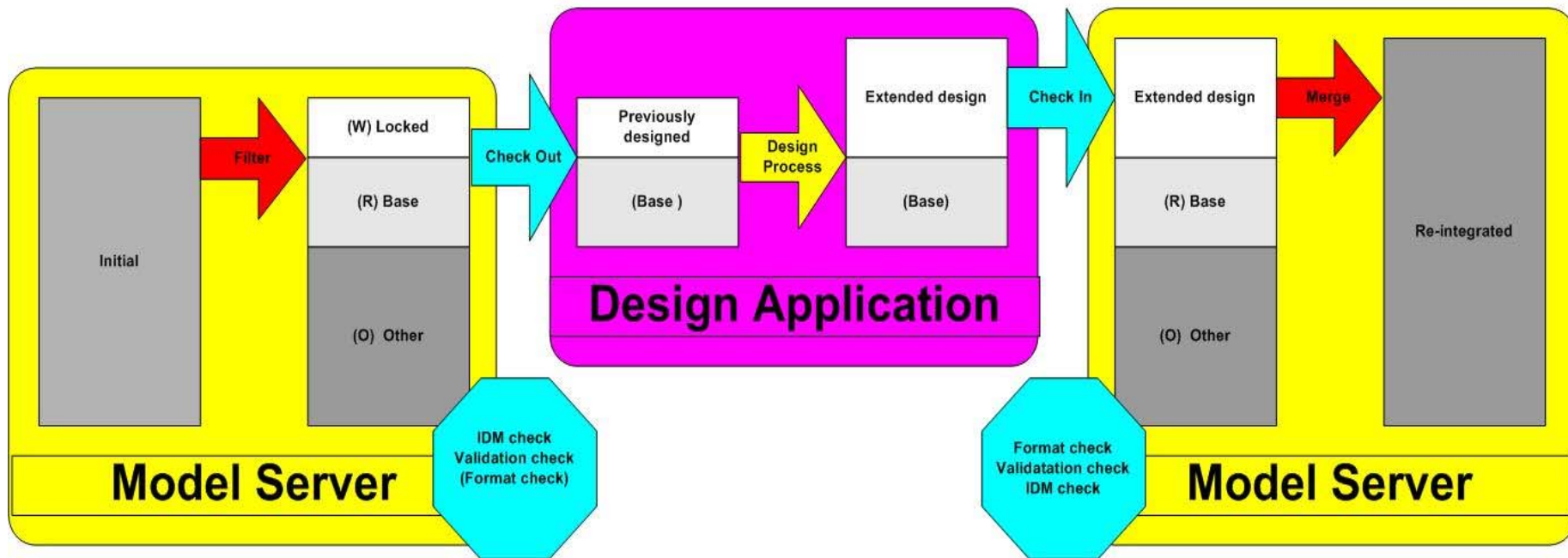
# Full Check-Out and Check-In Processes

Filter Partial Model Extraction
Lock/Read/Omit
Type and subtypes
Filter
Minimum number
Maximum number

Check Out: er_Ready_for_X
Type and subtypes
Filter
Quality rule

Check In er_Done_X
Type and subtypes
Filter
Quality rule

Merge Partial Model Re-integration
Get/Update/Ignore
Type and subtypes
Filter
Minimum number
Maximum number



# Check-in example (1)

- Failed before IDM check

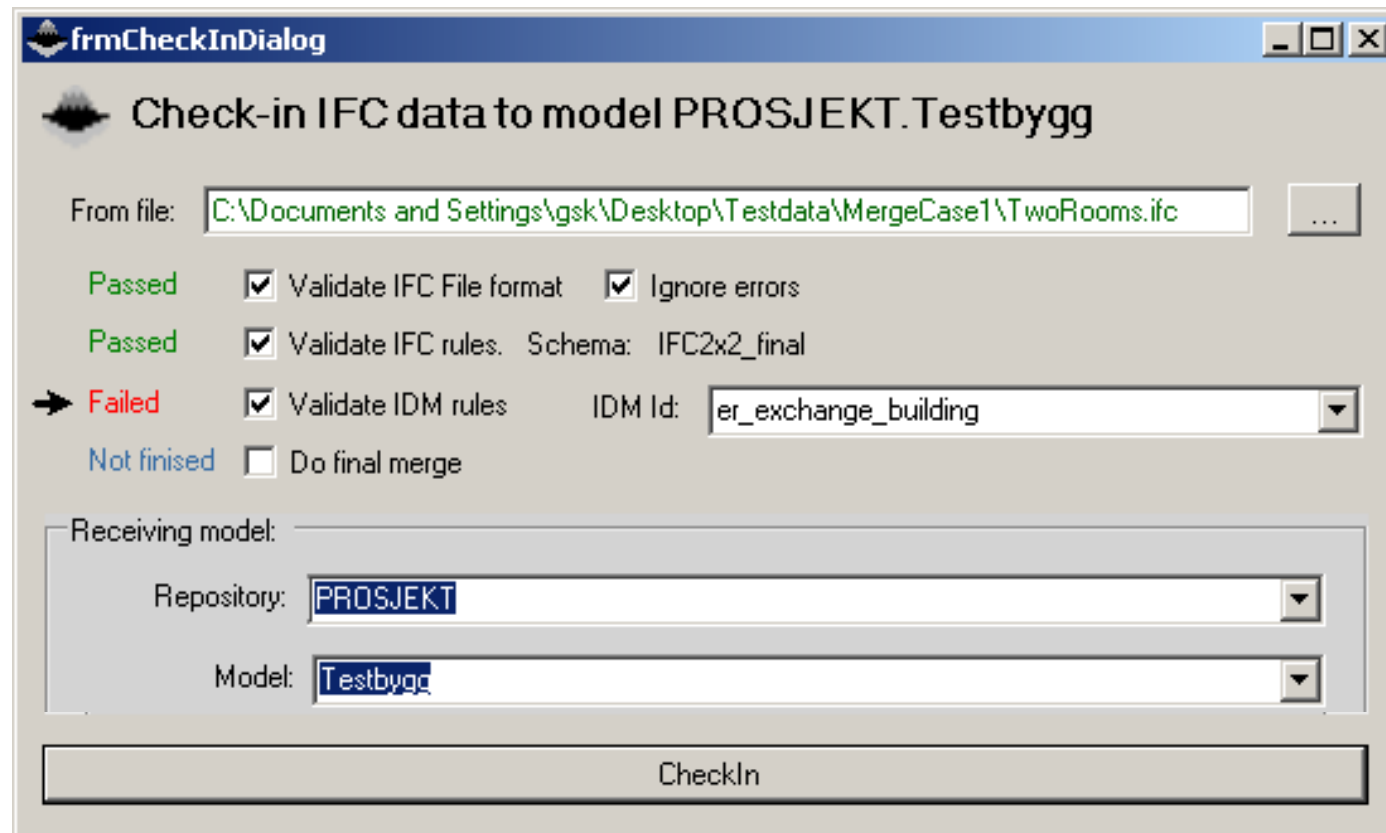
The screenshot shows a 'Check-in dialog' window titled 'Check-in IFC data to model EPM.NN-test1'. The 'From file' field contains the path 'C:\Documents and Settings\All Users\Documents\Shared Projects\idm-coci\models\HITO'. The 'Validate and merge' section shows a 'Failed' status with the following options checked: 'Validate IFC File format', 'Ignore errors', 'Validate IFC rules for schema: IFC2x2\_final', 'Validate IDM rules: Exchange Electrical System', and 'Do final merge'. The 'Receiving model' section shows 'Repository: EPM', 'Model: NN-test1', and 'Merge method: IFCCheckIn\_EDMDefault'. The 'Replace checked out dataset' section shows 'Keep dataset checked out: [unchecked]' and 'Dataset name: HITOS\_SketchDesign\_Electrical\_TEST'. A 'Check-in' button is at the bottom.

Ifc Electrical Circuit  
unrelated to any contents

ISGROUPEDBY =  
Violating INVERSE rule.  
Expected: [1:1];  
Actual: 0

# Check-in example (2)

- Failed during IDM check



# Describe the PA and add ERs

IFC Model Server Manager Connection: statsbygg (Server: edmserver.epmtech.jotne.com:4570)

Server: edmserver.epmtech.jotne.com Port 4570

Repositories (19)

- ARK
- ARKTIS
- BuildingSmart
- DDS
- DataRepository
- DictionaryRepository
- EDMvisualExpress
- EDR
- EPM
- ModelServer
- NESTOR
- NOIS
- NOSKO
- PROSJEKT (4)
  - Demo (IFC2X2\_FINAL)
  - Statsbygg (IFC2X2\_FINAL)
  - Tromso (IFC2X2\_FINAL)

IDM for Tromso College

Name:

Description:

Identifier:

Suspended:

Exchange requirements							
	Name	Description	Identifier	ImageURL	Suspended	Stages	
▶	IDMEXCHANGEREQUIREMENT	Exchange Duct	This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of infor	er_exchange_duct	<input type="checkbox"/>	0	
	IDMEXCHANGEREQUIREMENT	Exchange Basic Building	This exchange requirement describes the information to be provided about the basic building fabric	er_exchange_building	<input type="checkbox"/>	0	
*							

---

IDM for Tromso College

Name:

Description:

Identifier:

Suspended:

Exchange requirements							
	Name	Description	Identifier	ImageURL	Suspended	Stages	
▶	IDMEXCHANGEREQUIREMENT	Exchange Duct	This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of infor	er_exchange_duct	<input type="checkbox"/>	0	
	IDMEXCHANGEREQUIREMENT	Exchange Basic Building	This exchange requirement describes the information to be provided about the basic building fabric	er_exchange_building	<input type="checkbox"/>	0	
*							

IFD\_2004\_02\_14

ISO\_12006\_3\_VERSION\_9

IDM\_SCHEMA

Map Schemata (22)

IDM for Tromso College

- Exchange Basic Building
- Exchange Duct



# Describe the ER and add FPs

IFC Model Server Manager Connection: statsbygg (Server: edmserver.epmtech.jotne.com:4570)

Server: edmserver.epmtech.jotne.com Port 4570

Repositories (19)

- ARK
- ARKTIS
- BuildingSmart
- DDS
- DataRepository
- DictionaryRepository
- EDMvisualExpress
- EDR
- EPM
- ModelServer
- NESTOR
- NOIS
- NOSYK
- PROJEKT (4)
  - Demo (IFC2X2\_FINAL)
  - Testbygg (IFC2X2\_FINAL)
  - Tromsø (IFC2X2\_FINAL)
  - ifc\_20060216 (IFC2X2\_FINAL)

IDM for Tromsø College Exchange Duct

Name: Exchange Duct

Description: This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of information at various stages during the design process including:  
 " Line based representations at early design stages that enable routing, terminal location and main plant location information to be exchanged;  
 " Full 3D shape representations at detailed design stages that enable coordination between different building services systems, between services and structure and between services and the building construction elements.  
 This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of information at various stages during the design process including:

Identifier: er\_exchange\_duct

Suspended:

Functional parts						
		Name	Description	Identifier	ImageURL	Suspended
▶	IDMFUNCTIONALPART	Model Distribution Port		fp_model_distribution_port		<input type="checkbox"/>
	IDMFUNCTIONALPART	Model Distribution Element	This functional part summarises the expectation of distribution elements in general	fp_model_distribution_element		<input type="checkbox"/>
*						

---

IDM for Tromsø College Exchange Duct

Name: Exchange Duct

Description: This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of information at various stages during the design process including:  
 " Line based representations at early design stages that enable routing, terminal location and main plant location information to be exchanged;  
 " Full 3D shape representations at detailed design stages that enable coordination between different building services systems, between services and structure and between services and the building construction elements.  
 This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of information at various stages during the design process including:

Identifier: er\_exchange\_duct

Suspended:

Functional parts						
		Name	Description	Identifier	ImageURL	Suspended
▶	IDMFUNCTIONALPART	Model Distribution Port		fp_model_distribution_port		<input type="checkbox"/>
	IDMFUNCTIONALPART	Model Distribution Element	This functional part summarises the expectation of distribution elements in general	fp_model_distribution_element		<input type="checkbox"/>
*						

IDM\_SCHEMA

Map Schemata (22)

IDM for Tromsø College

- Exchange Basic Building
- Exchange Duct
  - Model Distribution Port
  - Model Distribution Element

# Describe the FP and add Clauses

IFC Model Server Manager Connection: statsbygg (Server: edmserver.epmtech.jotne.com:4570)

Server: edmserver.epmtech.jotne.com Port 4570

Repositories (19)

- ARK
- ARKTIS
- BuildingSmart
- DDS
- DataRepository
- DictionaryRepository
- EDMvisualExpress
- EDR
- EPM
- ModelServer
- NESTOR
- NOIS
- NOSYKO
- PROSJEKT (4)
  - Tromsø (IFC2X2\_FINAL)
  - statsbygg (IFC2X2\_FINAL)
  - Tromsø (IFC2X2\_FINAL)
  - ifc\_20060216 (IFC2X2\_FINAL)

IDM for Tromsø College | Exchange Duct | Model Distribution Element

Name: Model Distribution Element

Description: This functional part summarises the expectation of distribution elements in general

Identifier: fp\_model\_distribution\_element

Suspended:

Clauses											
		Name	Description	Identifier	Optio	Im	Sus	LogicalEx	TargetType	TargetSubt	TargetFilter
	IDMLOGICALCLAUSE	flow segment ports	for the successful exchange of distribution elements, flow segmetns	cl_flow_segments_should_have_two_ports	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowSegment	<input type="checkbox"/>	
	IDMLOGICALCLAUSE	flow terminal port	for the successful exchange of distribution elements, flow terminals t	cl_flow_terminals_should_have_one_port	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowTerminal	<input type="checkbox"/>	
	IDMLOGICALCLAUSE	fan ports	for the successful exchange of distribution elements, fans must be pr	cl_fans_need_at_least_two_ports	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowMovingDevice	<input type="checkbox"/>	

---

IDM for Tromsø College | Exchange Duct | Model Distribution Element

Name: Model Distribution Element

Description: This functional part summarises the expectation of distribution elements in general

Identifier: fp\_model\_distribution\_element

Suspended:

Clauses											
		Name	Description	Identifier	Optio	Im	Sus	LogicalEx	TargetType	TargetSubt	TargetFilter
	IDMLOGICALCLAUSE	flow segment ports	for the successful exchange of distribution elements, flow segmetns	cl_flow_segments_should_have_two_ports	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowSegment	<input type="checkbox"/>	
	IDMLOGICALCLAUSE	flow terminal port	for the successful exchange of distribution elements, flow terminals t	cl_flow_terminals_should_have_one_port	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowTerminal	<input type="checkbox"/>	
	IDMLOGICALCLAUSE	fan ports	for the successful exchange of distribution elements, fans must be pr	cl_fans_need_at_least_two_ports	<input type="checkbox"/>		<input type="checkbox"/>		IfcFlowMovingDevice	<input type="checkbox"/>	

IDM SCHEMATA

- Map Schemata (22)
- IDM for Tromsø College
  - Exchange Basic Building
  - Exchange Duct
    - Model Distribution Port
    - Model Distribution Element
      - flow segment ports
      - flow terminal port
      - fan ports

# Describe and test the Clause

IFC Model Server Manager Connection: statsbygg (Server: edmserver.epmtech.jotne.com:4570)

File

STATSBYGG SystemRepository

- Schemata
  - SDAI\_DICTIONARY\_MODEL
  - SDAI\_SESSION\_MODEL
  - EXPRESS\_DATA\_MANAGER
  - HEADER\_SECTION\_SCHEMA
  - SDAI\_ABSTRACT\_DATA\_TYPE\_SCHEMA
  - EDM\_VALIDATION\_RESULT\_SCHEMA
  - EDM\_DUMMY\_SCHEMA
  - EXPRESS\_G
  - DEX001\_LF
  - DEX004\_LF
  - MODEL\_SERVER\_SCHEMA
  - IFC2X2\_FINAL (Default)
  - IFC2X3\_IF
  - IFC2X3\_ODIN
  - IFC2X3\_RC1
  - IFC2004\_02\_14
  - ISO\_12006\_3\_VERSION\_9
  - IDM\_SCHEMA
  - Query Schemata (2)
  - IDM\_CHECK (5)

IDM for Tromso College Exchange Duct Model Distribution Element Model Distribution Port Exchange Basic Building Model Construction Materials building element constructions

Name: building element constructions

Description: for the successful exchange of building elements, the constructions must be represented.

Identifier: c\_building\_elements\_should\_have\_construction

OptionalClause:

Suspended:

TargetType: ifcBuildingElement

TargetSubtypes:

TargetFilter:

**LogicalExpression:**  
Exists(MySelf.Representation) And Exists(MySelf.ObjectPlacement)

IDM for Tromso College Exchange Duct Model Distribution Element Model Distribution Port Exchange Basic Building Model Construction Materials building element constructions

Name: building element constructions

Description: for the successful exchange of building elements, the constructions must be represented.

Identifier: c\_building\_elements\_should\_have\_construction

OptionalClause:

Suspended:

TargetType: ifcBuildingElement

TargetSubtypes:

TargetFilter:

**LogicalExpression:**  
Exists(MySelf.Representation) And Exists(MySelf.ObjectPlacement)

# Results from the Clause

IFC Model Server Manager Connection: statsbygg (Server: edmsvrer.epmtech.jotne.com:4570)

Validation results

Validation results for IDM chapter: building element constructions on Model: BROS IEKT Testbyg

IDMClause	ObjectNumber	ObjectDesc	
building element constructions	1001	1001	
	1002	1002	
	1003	1003	
	1004	1004	
	1005	1005	
	1006	1006	
	1007	1007	
	1008	1008	
	213 of 894	Type: IFCFLOWFITTING Name: , Description: FAILED	

Information Delivery Manual

- Generic Project Agreement
  - Exchange Basic Building
  - Exchange Ductwork
  - Exchange Electrical System

IDMEXCHANGEREQUIREMENT: Exchange Ductwork

Name: Exchange Ductwork

Description: This exchange requirement describes the information to be provided about ductwork systems. It allows for the provision of information at various stages during the design process including:

Identifier: er\_exchange\_duct

Suspended:

Functional parts

	Name	Description	Identifier	ImageURL	Suspended
▶	IDMFUNC	Model Distr	{\rtf1\ansi\la	fp_model_	<input type="checkbox"/>
*					

Element version number  
 Exchange Duct  
 Model Distribution Port
 

- distribution elements have ports
- distribution port names
- distribution port descriptions

 Model Distribution Element
 

- flow segment ports
- flow terminal port
- fan ports

# IDM coverage

