The Description Pattern

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# The Description Pattern

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1 Introduction
When describing the elements of a system, there are a number of different aspects of an element's description that need to be considered. As well as the obvious aspects such as the element's properties and behaviours, it is also necessary to understand how an element relates to other elements. Such relationships are generally of three types:

- They may be general in nature, for example a relationship showing that a water supply is supplying water to a tap.
- They may show how the element is broken down into parts, such as a tap being made up of a handle, spindle, valve mechanism etc.
- They may show "type" relationships between elements, for example showing that a mixer tap is a type of tap.

In addition, it is sometimes necessary to "localise" the descriptions of elements into different natural languages. Think, for example, of a set of installation or maintenance instructions for a mixer tap that may contain a description of the tap in multiple languages.

Without considering all of these aspects of an element's description, a full and consistent description may be lacking. The localisation aspect is particularly important in systems that are deployed, operated or maintained in different countries and therefore need multilingual yet consistent descriptions to be produced.

1.1 Pattern Aims
This Pattern is intended to be used as an aid to the description of the elements of a system. The main aims of this Pattern are shown in the Architectural Framework Context View (AFCV) in Figure 1.
The key aim of the Description Pattern is to 'Support description of elements'. This includes the Use Cases:

- 'Support identification of properties' - the Pattern must support the identification of properties of an element, including any type information and initial or default property values.
- 'Support identification of behaviours' - the Pattern must support the identification of any behaviour that the element has. If necessary, parameterised behaviours must be able to be identified. Note that this Pattern is concerned purely with the identification of behaviour and not with its description i.e. it identifies the behaviours that an element has but does not describe how the behaviours are carried out.
- 'Allow breakdown into parts to be shown' - the Pattern must allow the structural breakdown of an element into constituent parts to be shown.
- 'Allow element's position in a type hierarchy to be shown' - the Pattern must allow the element's position in a "type hierarchy" (often called a taxonomy) to be shown, allowing its relationship to more general types and more specialised types of the element to be shown.
- 'Allow relationships with other elements to be shown' - allow more general relationships (i.e. relationships other than through decomposition and taxonomy) to be shown.
- 'Support localisation' - the Pattern must allow extended textual descriptions of the element to be produced in a number of languages.

The Use Case 'Support localisation' is constrained by the need to 'Comply with standards'; it is important that the languages used in localisation are clearly identified in conformance with best practice.
2 Concepts

The main concepts covered by the Description Pattern are shown in the Ontology Definition View (ODV) in Figure 2.

Key to this Pattern is the concept of an 'Element' that, at its most basic, has a 'Name' and a 'Description'. An 'Element' may also be composed of zero or more 'Property' and zero or more 'Behaviour'.

An 'Element' can be related to zero or more other target 'Element', may be broken down into zero or more 'Element' acting as parts of the whole and may be a type of zero or more parent 'Element'.

An 'Element' may be "localised" through further description by zero or more 'Element Description'. Each 'Element Description' has a:

- 'Presentation name' - the name used when referring to the localised 'Element'
- 'Brief description' - a short description of the 'Element'
- 'Full description' - a longer, more detailed, description of the 'Element'
- 'Language code' - a short code that identifies the language used in the 'Presentation name', 'Brief description' and 'Full description'

The localisation of an 'Element' through zero or more 'Element Description' is heavily constrained by the Rules associated with this Pattern. See the RDV for details.

3 Viewpoints

This section describes the Viewpoints that make up the Description Pattern. It begins with an overview of the Viewpoints, defines Rules that apply to the Pattern and then defines each Viewpoint.
3.1 Overview

The Description Pattern defines a number of Viewpoints as shown in the Viewpoint Relationship View (VRV) in Figure 3.

The Description Pattern defines two Viewpoints for the description of Elements:

- The 'Element Structure Viewpoint' is used to describe an Element in terms of its Properties and Behaviours, relationship to other Elements (including relationships in a type taxonomy) and breakdown into parts.
- The 'Element Description Viewpoint' is used to show extended Element Descriptions for an Element on an 'Element Structure View'.

Each of these Viewpoints is described in more detail in the following sections. For each Viewpoint an example is also given.

3.2 Rules

Eight Rules apply to the two Description Viewpoints, as shown in the Rules Definition View (RDV) in Figure 4.
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Figure 4 - Rules Definition View showing Description Pattern Rules

The eight Rules are:

- ‘Rule DP01: When using the Description Pattern, at least one Element Structure View must exist.’ This Rule establishes the minimum set of Views that must be produced for the use of the Pattern to be valid.

- ‘Rule DP02: An Element only has (and must have) a Description if it has no (i.e. zero) associated Element Descriptions.’ An Element’s Description property is only completed (and must be so completed) if it has no associated Element Description. If it does have an Element Description then the Description property is not used.

- ‘Rule DP03: The Language code of an Element Description consists, as a minimum, of a language identifier taken from ISO639.
- For example, if Esperanto is used, then the Language code will be "eo".
- If variants of a language are used, such as British and American English, then the Language code consists of a language identifier taken from ISO639 and a country identifier from ISO3166. It has the form "ll-CC".
- For example, the language code for British English is "en-GB" and that of American English is "en-US".

- ‘Rule DP04: Language code must be different for all Element Descriptions that describe the same Element.’

- ‘Rule DP05: All the properties of an Element Description (Presentation name, Brief description etc.) must be written in the language indicated by that Element Description’s Language code.’

- ‘Rule DP06: All Element Descriptions for a given Element must be translations of each other.

- ‘Rule DP07: The Brief description or Full description of an Element Description may, if necessary, refer to a different Element. If such a reference is needed, then it is done via:
- The Name of the referenced Element if that Element has no Element Descriptions.
- The Presentation name from one of the referenced Element's Element Descriptions if it has any. In this case, the Language code of the referenced Element's Element Description and that of the referencing Element's Element Description must be the same.

- ‘Rule DP08: An Element Structure View can only have one Element that is the focus i.e. only a single Element will have its Description, Properties and Behaviours shown. All other Elements that appear on an ESV are those to which the Element forming the focus are related.'
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- ‘Rule DP05: All the properties of an Element Description (Presentation name, Brief description etc.) must be written in the language indicated by that Element Description’s Language code.’ An Element Description must not be created that uses a mixture of languages for its various properties.
- ‘Rule DP06: All Element Descriptions for a given Element must be translations of each other.’ This Rule says that, as far as translation allows, all Element Descriptions must say the same thing, but in different languages.
- ‘Rule DP07: The Brief description or Full description of an Element Description may, if necessary, refer to a different Element. If such a reference is need, then it is done via:
  - The Name of the referenced Element if that Element has no Element Descriptions.
  - The Presentation name from one of the referenced Element’s Element Descriptions if it has any. In this case, the Language code of the referenced Element’s Element Description and that of the referencing Element’s Element Description must be the same.’ This Rule gives guidance on how different Elements may be referenced in a consistent fashion and in a way that prevents references from one language to another.
- ‘Rule DP08: An Element Structure View can only have one Element that is the focus i.e. only a single Element will have its Description, Properties and Behaviours shown. All other Elements that appear on an ESV are those to which the Element forming the focus are related.’. This Rule simply states that only a single Element can be broken down, described or related on an ESV.

Note that the eight Rules shown in Figure 4 are the minimum that are needed. Others could be added if required.

3.3 Element Structure Viewpoint (ESVp)

The aims of the Element Structure Viewpoint are shown in the Viewpoint Context View in Figure 5.
The main aims of the Element Structure Viewpoint is to ‘Support description of elements’ through the aims of ‘Support identification of properties’, ‘Support identification of behaviours’, ‘Allow breakdown into parts to be shown’, ‘Allow element’s position in a type hierarchy to be shown’ and ‘Allow relationships with other elements to be shown’. That is, its aim is to describe an Element in term of its Properties and Behaviours, relationship to other Elements (including relationships in a type taxonomy) and breakdown into parts.

### 3.3.1 Description

The Viewpoint Definition View (VDV) in Figure 6 shows the Ontology Elements that appear on an Element Structure Viewpoint.
The Element Structure Viewpoint is used to describe an Element in terms of its Properties and Behaviours, relationships to other Elements (including relationships in a type taxonomy) and breakdown into Elements representing its parts.

Although an Element Structure Viewpoint can show multiple Elements, it allows only a single Element to be the focus i.e. only a single Element will have its Description, Properties and Behaviours shown. All other Elements that appear on a View which realises an Element Structure Viewpoint are those to which the Element forming the focus are related. The definition could, of course, be extended to allow multiple Elements to be shown in detail.

### 3.3.2 Example

An example View that conforms to the Element Structure Viewpoint is shown in Figure 7.
The Element Structure View in Figure 7, realised as a SysML block definition diagram, shows the structure of the 'Water Tap' Element (highlighted in light grey for emphasis). Apologies to any plumbers who may be reading!

SysML blocks have been used to realise Elements, with the addition of a stereotype for emphasis. The 'Name' of each Element is represented by the name of the realising block.

The relationships between the 'Water Tap' and the other Elements are shown. Examples of all three types of relationship from the ODV are shown: 'is a type of' is realised using generalisation, 'is broken down into' is realised by composition and 'is related to' through association.

The Properties of the 'Water Tap' Element are shown as SysML properties and the Behaviour of the 'Water Tap' through SysML operations.

This diagram conforms to Rule DP01. Note that 'Water Tap' has no Description; in accordance with Rule DP02 this means that 'Water Tap' must have at least one Element Description associated with it. This has been done and is shown in Figure 10.

### 3.4 Element Description Viewpoint (EDVp)

The aims of the Element Description Viewpoint are shown in the Viewpoint Context View in Figure 8.
The key aim of the Element Description Viewpoint is to 'Support description of elements' through the aim of 'Support localisation' while meeting the constraint of 'Comply with standards'. That is, the Viewpoint is concerned with supporting the production of localised textual descriptions of an Element.

### 3.4.1 Description

The Viewpoint Definition View (VDV) in Figure 9 shows the Ontology Elements that appear on an Element Description Viewpoint.
The Element Description Viewpoint is used to show extended Element Descriptions for a single Element.

As defined, the Element Description Viewpoint allows only a single Element to be the focus i.e. only a single Element will have its extended descriptions in terms of Element Descriptions shown. The definition could, of course, be extended to allow multiple Elements to be shown in detail.

### 3.4.2 Example

An example View that conforms to the Element Description Viewpoint is shown in Figure 10.
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Figure 10 - EDV - Extended descriptions of Water Tap

The Element Description View in Figure 10, realised as a SysML block definition diagram, shows the localisation through extended Element Descriptions of the 'Water Tap' Element (highlighted in light grey for emphasis).

Each Element Description is realised as a SysML block and has a stereotype added for extra emphasis. The 'Presentation name' of each Element Description is represented by the name of the realising block. The 'Brief description' and 'Language code' are realised using tags associated with the stereotype.

The 'Extended description' of each Element Description is realised using the "notes" field of the realising block. Note that while "notes" is not a built-in SysML concept, all SysML modelling tools allow notes or descriptive text to be added against elements in the tool. The 'Extended description' has been omitted for brevity for the Element Description written in Esperanto (the Element Description with 'language code' set to 'eo').

The relationship between the Element Descriptions and the Elements that they describe are realised using stereotyped dependencies.

This diagram conforms to Rules DP02 to DP07.

4 Summary

The Description Pattern defines two Viewpoints for the description of Elements. The Element Structure Viewpoint is used to describe an Element in term of its Properties and Behaviours, relationship to other Elements (including relationships in a type taxonomy) and breakdown into parts. The Element Description Viewpoint is used to show extended Element Descriptions for an Element; this can also be used to support "localisation" of an Element, where consistent descriptions in multiple languages are needed.
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5 Related Patterns
If using the Description Pattern, the following Patterns may also be of use:

- Interface Definition
- Traceability

6 References & Further Reading


