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Principal Consultant Information Management

Shell Global Solutions

Consultancy & Services for
Data Exchange and Data Integration
The Gellish Language
a structured subset of natural languages

- Gellish English
- Gellish Nederlands
- Gellish Deutsch
- Etc.
- Gellish numeric
The Business Issue: Communication on Product Data

Suppliers perspective

- Plant life time
- Discipline experts
- Part-Suppliers
- Sales
- Plant owners
- Maintenance contractors
- Operations & Maintenance
- Equipment & Systems
- Detailed Engineering
- Conceptual design
- Procure & Fabricate
- Construct & Commission
- Hand-over
- Verification and testing
- Authorities
- Standards institutes

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The Data Exchange & Data Integration issue

1. **Standard engineering terminology is needed**
   - There is no standard electronic Business/Engineering dictionary available
     - Ecl@ss, Rosettanet, Trade Ranger, UNSPSC, …, STEPlib / ISO 15926-4
     - All proprietary data and based on proprietary data models

2. **Data structures are problematic**
   - Data models are different and proprietary: communication barriers
   - Data models are domain specific: e.g. ISO 10303 (STEP), ISO 13584 (PLIB)
   - Data models are inflexible, fixed patterns rather than a full language

3. **Generic standard data models are difficult to implement**
   - E.g. ISO 10303-221 (AP221), ISO 15926-2

4. **XML does not provide standardization of application data**
   - Neither data modeling languages nor data models define application terms
     - E.g. UML, XML-schema, EXPRESS

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1. Open Source language definition
   - Open Source Licensed
     [http://www.opensource.org/docs/definition.php](http://www.opensource.org/docs/definition.php)
     [https://sourceforge.net/projects/gellish](https://sourceforge.net/projects/gellish)
     contains the Gellish English language definition with Dictionary / Taxonomy / Knowledge base with engineering terminology

2. Gellish Forum
   - Quality assurance
   - Application support

3. Based on and including concepts from
   - ISO 10303, 15926, 13584, 12006.
   and various other sources.
An individual Plant Model

Decomposition shall be compliant with classification SGP CG facil. HP System-1 S5 K-1301 syst U-1300 K-1301 CH4 Dongting Power Gen.

Legend
- is part of
- is input/output/subject/performer/hold up in
- is connected to
- contains info about

Standard document types
Equipment models & Process models
Standard Specifications

Knowledge base

Processes Streams Equipment Documents

Computation by K-1301

Gasification-1

Proj. Spec.

PFS P&ID of U-1300 CG facil. HP System-1

K-1301 syst

S5 P-13001 K-1301 S1323 CV-1321

CH4 Seg-13A LO-100

Bend-1 Spool-1

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Data Consistency through Data Integration

- PFS
- P&ID
- Data sheet
- Control diagram
- Etc.

Views on Plant Model

Plant Model

Unit 1300

P-1301

S-1

E-1302

bearing-1

CH4

T-12345
Three main distinctions:
1. Individual things – Kinds of things
2. Real things – Imaginary things
3. Single things – Plural things
Relate a Design to the Knowledge Base

Product Model (of a Plant)
(relations between individuals)

Knowledge Model
(relations between classes)

Dongting

Coal gasification facility

SGP

System-1

U-1300

K-1301 system

P-13501-3

K-1301

S-1323

CV-1321

Segm-13

LubOil-100

Reduc-123

Spool-12

Compression by K-1301

S1-Carbon

Power Gen.

Document-X

is classified as a

(relations between individuals and classes)

is classified as a

is classified as a

is classified as a

site

HP steam system

pump

ball control valve

Manufact. model A2

International Standards product models

Industry Standard product models

Proprietary standard product models

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Gellish English

Grammar / Expressions

- relation
- has aspect
- can have as aspect a

Dictionary / Taxonomy

- concept
- aspect
- individual object

Gellish definition of relation types

- can have as aspect a
- shall have as aspect a

Knowledge base written in Gellish English

- shall have as aspect a
- has aspect

Proprietary models

e.g. SHELLlib standard specifications & product requirements written in Gellish English (extended)

Gellish English language definition

- has aspect

Proprietary Gellish English dictionary extensions

e.g. SHELLlib dictionary / taxonomy (subtypes of Gellish English dictionary concepts)

Gellish English dictionary / taxonomy

- compressor
- capacity

STEPlib (open source)

- capacity of K-1301
- MESC 1124.34.1
- K-1301

Gellish English language usage
Meta languages

- UML
- EXPRESS
- XML Schema
- OWL

Possessor
Possessed
Individual thing

Relationship

Pipe
Diameter

Entity
Subtype

Language usage for language definition

Language usage for product description

Product models written in EXPRESS or XMLS
- ISO 15926-2 product modelling language
- AP221 product modelling language

Product models written in AP227, or in AP221 or ISO 15926-2
- AP227 product modelling language
- ISO 15926-4 reference data

Gellish English

- Anything
- Entity
- Is a subtype of
- Has aspect
- Is related to
- Individual thing
- Possessor
- Possessed
- Pipe
- Diameter

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**Standard Product models & Knowledge models expressed in Gellish English**

- **Gellish English**
  - Concepts (classes)
  - Standards product models
    - Textbook product models
    - Open standards product models: ISO, IEC, ASME, DIN, BSI, API, etc.
  - Industry Standard product models
    - Uneto, Cimis, MESC templates, etc.
  - Proprietary product models
    - Company specific
      - Catalogue items, product portfolio (suppliers)
      - Standard buying specifications (e.g. MESC items)
      - Piping classes, etc.

- **Definitions**

- **ISO 10303 & 15926 Concepts (classes)**

- **Decomposition & Possession of aspect relations**

- **Specialization / Inheritance**

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Relate your Company Dictionary to ISO standards

Company specific Dictionary & Mappings

ISO 13584
ISO 10303-221
ISO 15926
(ERDL)

Gellish English
(STEPlib)

Equipment type data
Data about Best Practices
Hand-over data & document requirements

Standard buying specs
Piping class data
Standard forms data

Standard forms
Piping design system

Product Catalogue System

ERP system (SAP)

Document Management System

Project data systems
Top view: SHELLlib and ISO standards

SHELLlib

- ISO 13584
- ISO 10303-221
- ISO15926 (ERDL)

Gellish English (STEPlib)

- MESC buying specs
- Piping class data
- DEP Standard forms data
- Project hand-over data & document requirements
- SAP - GAME equipment type data
- Data about DEP’s

- CMT
- CAPS
- Project systems
- DEP standard forms
- DEP docs
- Project systems
- SAP GAME Blueprint

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### The Gellish language

**Gellish Language definition: Dictionary / Taxonomy**
- Object types, incl. document types, activity types, etc.
- Aspect types,
- Relation types
  - Relations between concepts
  - Relations between individual objects
  - Relations between individual objects and concepts

**Language usage: Gellish Table (syntax)**

<table>
<thead>
<tr>
<th>Left hand object</th>
<th>Relation type</th>
<th>Right hand object</th>
<th>UoM</th>
</tr>
</thead>
<tbody>
<tr>
<td>K-1301</td>
<td>is part of</td>
<td>U-1300</td>
<td></td>
</tr>
<tr>
<td>K-1301</td>
<td>is classified as a</td>
<td>compressor</td>
<td></td>
</tr>
<tr>
<td>K-1301</td>
<td>has as aspect</td>
<td>capacity of K-1301</td>
<td></td>
</tr>
<tr>
<td>capacity of K-1301</td>
<td>is classified as a</td>
<td>capacity (mass flow rate)</td>
<td></td>
</tr>
<tr>
<td>capacity of K-1301</td>
<td>is quantified as</td>
<td>46</td>
<td>kg/s</td>
</tr>
</tbody>
</table>

**Language usage: STEPlib Knowledge base:**

<table>
<thead>
<tr>
<th>Left hand object</th>
<th>Relation type</th>
<th>Right hand object</th>
</tr>
</thead>
<tbody>
<tr>
<td>compressor</td>
<td>can have as aspect a</td>
<td>capacity (mass flow rate)</td>
</tr>
<tr>
<td>is part of</td>
<td>is a specialization of</td>
<td>relation between individuals</td>
</tr>
</tbody>
</table>
Private extensions of the Gellish language

Requirements e.g. Hand-over requirements

<table>
<thead>
<tr>
<th>Left hand object</th>
<th>Relation type</th>
<th>Right hand object</th>
</tr>
</thead>
<tbody>
<tr>
<td>compressor</td>
<td>shall have as aspect a</td>
<td>capacity (mass flow rate)</td>
</tr>
<tr>
<td>equipment</td>
<td>shall be part of a</td>
<td>system</td>
</tr>
<tr>
<td>equipment</td>
<td>shall be element of a</td>
<td>maintenance unit</td>
</tr>
</tbody>
</table>

- Company Standards e.g. Standard product models
  - Mappings to/from system e.g. SAP
  - Standard Buying descriptions (e.g. MESC)
  - Piping classes

- Catalogue items e.g. Vendor catalogues

E.g. Your company specific Private Extension
Knowledge expressed in Gellish

Subsets of Gellish Knowledge Base (STEPlib):

1. List of concepts with their names
   - English 70073 coriolis mass flow meter
   - English 70073 coriolis flow meter

2. Dictionary
   - English 70073 coriolis mass flow meter is a specialization of 70590 mass flow meter
   - intended to apply the Coriolis principle to measure a mass flow rate.

3. Taxonomy
   - English 70073 coriolis mass flow meter is a specialization of 70590 mass flow meter
   - English 70590 mass flow meter is a specialization of 70143 flow meter

4. Ontology or Knowledge models (‘smart dictionary’)
   - English 70143 flow meter can have as part a 10131 straightener
   - English 10131 straightener can have as aspect a 551353 length
## Representation in a Gellish Table

A universal single table (summary)

![Gellish Table Diagram](image)

<table>
<thead>
<tr>
<th>Language</th>
<th>Context</th>
<th>Left hand object ID</th>
<th>Left hand object name</th>
<th>Fact ID</th>
<th>Relation type ID</th>
<th>Relation type name</th>
<th>Right hand object ID</th>
<th>Right hand object name</th>
<th>Status</th>
</tr>
</thead>
<tbody>
<tr>
<td>english</td>
<td>proj A</td>
<td>101</td>
<td>P-1</td>
<td>201</td>
<td>1225</td>
<td>is classified as a</td>
<td>130058</td>
<td>centrifugal pump</td>
<td>accepted</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Left hand role ID</th>
<th>Left hand role name</th>
</tr>
</thead>
<tbody>
<tr>
<td>501</td>
<td>classified P-1</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Right hand role ID</th>
<th>Right hand role name</th>
</tr>
</thead>
<tbody>
<tr>
<td>601</td>
<td>classifier centrifugal pump</td>
</tr>
</tbody>
</table>
# Gellish Table

**Knowledge model of a Business Process**

according to the ‘DEMO’ methodology

<table>
<thead>
<tr>
<th>Request</th>
<th>Promise</th>
<th>Production</th>
<th>Declaration</th>
<th>Acceptance</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>request</strong></td>
<td>can precede a</td>
<td>promise</td>
<td>production act</td>
<td>declaration</td>
</tr>
<tr>
<td><strong>promise</strong></td>
<td>can precede a</td>
<td>production act</td>
<td>declaration</td>
<td>acceptance</td>
</tr>
<tr>
<td><strong>production act</strong></td>
<td>can precede a</td>
<td>declaration</td>
<td>acceptance</td>
<td></td>
</tr>
<tr>
<td><strong>declaration</strong></td>
<td>can precede a</td>
<td>acceptance</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

- **Person** can request to perform a production act
- **Person** can be requested to perform a production act
- **Person** can promise to perform a production act

- **Request** can result in a fact of type A has requested to perform Xi
- **Request** can result in a fact of type B is requested to perform Xi
- **Promise** can result in a fact of type B has promised to perform Xi
- **Production act** can result in a fact of type B has produced Xr

- **Production act** can have as output a product

*blue text = Gellish standard relation type
purple text = Gellish standard concept*
### Gellish Table

**Knowledge model of a Vessel**

<table>
<thead>
<tr>
<th>Blue Text</th>
<th>Purple Text</th>
<th>Red Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>520243 vessel can be a part of a</td>
<td>160104 process unit</td>
<td></td>
</tr>
<tr>
<td>160177 material can have as aspect a</td>
<td>550020 mass</td>
<td></td>
</tr>
<tr>
<td>550020 mass can be expressed on scale</td>
<td>570039 kg</td>
<td></td>
</tr>
<tr>
<td>520243 vessel can have as aspect a</td>
<td>550102 design pressure</td>
<td></td>
</tr>
<tr>
<td>550031 pressure can be expressed on scale</td>
<td>570393 barg</td>
<td></td>
</tr>
<tr>
<td>520204 shell can be a part of a</td>
<td>520243 vessel</td>
<td></td>
</tr>
<tr>
<td>520204 shell can have as aspect a</td>
<td>550206 outside diameter</td>
<td></td>
</tr>
<tr>
<td>550188 diameter can be expressed on scale</td>
<td>570423 mm</td>
<td></td>
</tr>
</tbody>
</table>

*blue text = Gellish standard relation type
purple text = Gellish standard concept
red text = Gellish standard unique identifiers*
<table>
<thead>
<tr>
<th>Gellish Standard Unique Identifiers</th>
<th>Gellish Standard Concept</th>
<th>Gellish Standard Relation Type</th>
</tr>
</thead>
<tbody>
<tr>
<td>520243 vessel</td>
<td>160104 process unit</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>520243 vessel</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>910171 description</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>490040 construction drawing</td>
<td></td>
</tr>
<tr>
<td>490196 drawing</td>
<td>490196 drawing</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>550020 mass</td>
<td></td>
</tr>
<tr>
<td>550020 mass</td>
<td>570039 kg</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>550102 design pressure</td>
<td></td>
</tr>
<tr>
<td>550031 pressure</td>
<td>570393 barga</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>552856 material of construction</td>
<td></td>
</tr>
<tr>
<td>520243 vessel</td>
<td>910174 design rule</td>
<td></td>
</tr>
<tr>
<td>520204 shell</td>
<td>520204 shell</td>
<td></td>
</tr>
<tr>
<td>520204 shell</td>
<td>520243 vessel</td>
<td></td>
</tr>
<tr>
<td>520204 shell</td>
<td>550206 outside diameter</td>
<td></td>
</tr>
<tr>
<td>550188 diameter</td>
<td>570423 mm</td>
<td></td>
</tr>
</tbody>
</table>

- **blue text** = Gellish standard relation type
- **purple text** = Gellish standard concept
- **red text** = Gellish standard unique identifiers
### Gellish Table

**Product model of a Vessel**

<table>
<thead>
<tr>
<th></th>
<th>2</th>
<th>V-6060</th>
<th><strong>is part of</strong></th>
<th>1</th>
<th>Blow Down Unit 6050</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>is classified as a</strong></td>
<td>520121</td>
<td>horizontal vessel</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>is described by</strong></td>
<td>5</td>
<td>flare knock out drum</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>is referenced on</strong></td>
<td>4</td>
<td>FPS120/22/31 SRP</td>
</tr>
<tr>
<td></td>
<td>4</td>
<td>FSP120/22/31..</td>
<td><strong>is classified as a</strong></td>
<td>490040</td>
<td>construction drawing</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>has as aspect</strong></td>
<td>6</td>
<td>m of V-6060</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>m of V-6060</td>
<td><strong>is classified as a</strong></td>
<td>550020</td>
<td>mass</td>
</tr>
<tr>
<td></td>
<td>6</td>
<td>m of V-6060</td>
<td><strong>is quantified as</strong></td>
<td>924238</td>
<td>19000</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V6060</td>
<td><strong>has as aspect</strong></td>
<td>7</td>
<td>dp of V-6060</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>dp of V-6060</td>
<td><strong>is classified as a</strong></td>
<td>550102</td>
<td>design pressure</td>
</tr>
<tr>
<td></td>
<td>7</td>
<td>dp of V-6060</td>
<td><strong>is quantified as</strong></td>
<td>920104</td>
<td>4</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>is made of</strong></td>
<td>8</td>
<td>280043 carbon steel</td>
</tr>
<tr>
<td></td>
<td>2</td>
<td>V-6060</td>
<td><strong>shall be compliant with</strong></td>
<td>8</td>
<td>R-550352</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>shell-1</td>
<td><strong>is classified as a</strong></td>
<td>910174</td>
<td>design rule</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>shell-1</td>
<td><strong>is part of</strong></td>
<td>520204</td>
<td>shell</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>shell-1</td>
<td><strong>has as aspect</strong></td>
<td>2</td>
<td>V-6060</td>
</tr>
<tr>
<td></td>
<td>3</td>
<td>shell-1</td>
<td><strong>is part of</strong></td>
<td>9</td>
<td>OD of shell-1</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>OD of shell-1</td>
<td><strong>is classified as a</strong></td>
<td>550206</td>
<td>outside diameter</td>
</tr>
<tr>
<td></td>
<td>9</td>
<td>OD of shell-1</td>
<td><strong>is quantified as</strong></td>
<td>10</td>
<td>4124</td>
</tr>
</tbody>
</table>

- **black text** = user supplied
- **blue text** = Gellish types of relations
- **purple text** = Gellish standard concepts
- **red text** = Gellish unique identifier (standard & user defined)
### Example of standard Gellish English

**types of relations**

<table>
<thead>
<tr>
<th>Type of Relation</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>... is identified by ...</td>
<td>... is approved for ...</td>
</tr>
<tr>
<td>... is classified as ...</td>
<td>... is created / terminated at ..</td>
</tr>
<tr>
<td>... is a part of ...</td>
<td>... is valid since / until ...</td>
</tr>
<tr>
<td>... has as property ...</td>
<td>... is involved in ...</td>
</tr>
<tr>
<td>... has as quality ...</td>
<td>... is owned by ...</td>
</tr>
<tr>
<td>... is described by ...</td>
<td>... is operated by ...</td>
</tr>
<tr>
<td>... is connected to ...</td>
<td>... is maintained by ...</td>
</tr>
<tr>
<td>... is placed relative to ...</td>
<td>... happened at ...</td>
</tr>
<tr>
<td>... is a version of ...</td>
<td>... is cause of ...</td>
</tr>
<tr>
<td>... is derived from ...</td>
<td>... is included in ...</td>
</tr>
<tr>
<td>... is spare for ...</td>
<td>... is required as input for / as output for ...</td>
</tr>
<tr>
<td>... is defined in/on ...</td>
<td>... is presented by ...</td>
</tr>
<tr>
<td>... is referenced in/on ...</td>
<td>... is carrier of ...</td>
</tr>
<tr>
<td>... is made of ...</td>
<td>... is a realisation of ...</td>
</tr>
</tbody>
</table>
Demonstration topics

1. Plant objects have classifications
2. Classes have ‘knowledge models’, hierarchy, inheritance of aspects
3. Classes relate to DEPs and/or external standards
4. Equipment ‘shall be compliant to’ a DEP, because of its classification
5. Generate and fill-in a ‘data sheet view’ based on a knowledge model
6. Generate a ‘summary sheet view’ of objects of a type, with/without subtypes
7. Asset breakdown
8. Project breakdown related to Asset breakdown and Organizations
9. View documents about process units (PFS, PEFS), incl. versions
10. Equipment is related as performer to process
11. Processes operate on input / output streams
12. Stream data form a material balance
13. Stream data is not duplicated when shown as process data for equipment

K-1301

compressor knowledge

DEPs on compressors

View DEP on compressors

Create compressor K-1302

List of compressors

Dongting site / browser

Shell CGF project

U-1300 > T-..v E, view F

K-1301 > gas compression

gas compression > S5, S13

S5 properties, S13 props

K-1301 properties

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The Gellish Website

http://sourceforge.net/project/showfiles.php?group_id=28333
Later: gellish.sourceforge.net

Gellish
- Language definition (TOPini + Domain ontologies)
- Knowledge Base

Documentation:
- Gellish Table definition
- Gellish English Application Manual
- Gellish Dictionary Extension Manual (GUIDE on STEPlib)
- Example: Lubrication Oil System

- Gellish Browser: www.STEPlib.com

Gellish Forum contact: Andries.vanRenssen@Shell.com
### Scope of the Gellish Smart Dictionary

<table>
<thead>
<tr>
<th>Category</th>
<th>Subcategories</th>
</tr>
</thead>
<tbody>
<tr>
<td>Plants and Systems</td>
<td>Activity</td>
</tr>
<tr>
<td>Civil, Structural &amp; Architectural</td>
<td>Procedures</td>
</tr>
<tr>
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2 feb 1996

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Structure of the Gellish Dictionary / Taxonomy / Ontology

- Concept hierarchy incl. Relation types

>20,000 concepts

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Structure of the Gellish Dictionary / Taxonomy

Anything

- relationship
  - fact
  - occurrence
  - correlation

- physical object
  - matter
    - wave
  - space
    - signal
    - organization
  - person
    - organism

- lifeform
  - item, artifact
    - plant, equipment, system, components, etc.
    - geographic objects
  - batch (fluid)
  - info (fluid)
    - file
    - picture, video
    - software
    - symbols, drawing

- aspect
  - time
  - mathematical asp.
  - spatial aspect
  - start/end of exist.
  - characteristic
  - state
  - information
  - role, function

- event
- process
- (human) activity
  - design, fabrication, supply, construction, maintenance, etc.

- count, number
- encoding aspect
- shape
- property
- quality

- array, matrix
- text, language
- algorithms
- substance properties
- mechanical properties
- behavioral properties
- phase
- process material (fluids)
- construction material (solids)

- documents / procedures / methods
- input, output, subject
- performer, enabler, facility, tool, catalyst, identifier

2 July 1998
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