Step by step into STEP

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Abstract

The term PDI-State is introduced. A PDI-State is the cornerstone of a method for step by step implementations of Product Data Interchange in specific environments. PDI-States can also be used for the typology of STEP-Parts.

1. CIC-IMPLEMENTATION-PROJECT

One of the goals of the CIC-Implementation-Project, performed at the faculty of Civil Engineering of Delft University of Technology, is a PDI-Implementation-Guide in which a method is described for a step by step implementation of Product Data Interchange. The duration af the project is four years, and the firts concept of the PDI-Implementation-Guide will be ready at the end of 1991. In 1992, the project will be terminated with a first validation of the method by the execution of two case-studies.

Product Data Interchange -PDI- is definied as the collection of activities needed to describe/archive, exchange, and maintain product- and process-data in the form of technical documents or models. PDI is seen as the "communication back bone" of Computer Integrated Construction.

Two aspects of the method described in this PDI-Implementation-Guide will be discussed in this paper. The definition of so called "PDI-States" and the "Typology of STEP-parts" needed in order to define for which PDI-States, which STEP-Parts are applicable.

About 100 national and international PDI-Implementation-Projects and PDI-Standard-Development-Projects are analysed with a focus on the strategic implementation approaches, the advanced levels of PDI and the bottlenecks felt in the projects. The data collected was input for the development of the PDI-Implementation-Method, the way a PDI-State can be defined, and the recognition of general PDI-States on conceptual level.

2. PDI-STATE

An important part of a strategic plan for the implementation of PDI is the definition of required states of PDI at the milestones of the plan. These milestones, in the PDI-Implementation-Guide called "PDI-States", can be defined by a description of the "context" in which the PDI-State must be implemented and the "PDI-concepts" on which the implementation should be based. The context and the PDI-concepts are defined by giving each "PDI-State-parameter" a value or a list of values. Examples of these PDI-State parameters are:

- organisational element
- process-phase
- activity
- producttype
- system-type, -function, -make. -version
- document/model -type
- data-type, -structure
- standard
- library type
- exchange method

2.1 Examples

For example the design department of company A (organisational elements) exchanges detail-drawings (documenttype) with the process-planning department of company B by using DXF (standard), and exchanging the files by post (exchange method). Both, the sending system and the recieving systems are 2D-CAD-systems (system-type) but from different vendors (system-make).

In a next phase of the PDI-Implementation plan of company A is stated, that 3D-shape models (model-type) containing geometry, topology and some property data (data-types), by using a Application Protocol of STEP (standard), should be exchanged in and between the design and construction departments (organisational element, process-phase) needed to generate 2D-drawingviews, stresscalculations and archiving (activities). The models must be stored in a interactive accesible database (exhange method) and must be applicable for single parts, so no assemblies, of some specified products (producttype).

This kind of descriptions of a successive PDI-States gives already a rough indication of the milestones of the PDI-Implementationplan

2.2 Definition of PDI-State in concrete environments

For the analysis of the effects on the organisation, required functionality of the systems, costs, workingmethods, benefits, etc. a much more detailed descriptions of the successive PDI-States is required. In most cases are the values of the PDI-State-Parameters pointers to nodes in Models of the Organisation, Product, Process and Systems; at least to Break Down Structure Models of these parameters. For instance the design-department is a node in the Organisational Break Down Structure, and a draughtsmen a node on a lower level in that Break Down Structure.

In the examples given above the definition of PDI-States is used for the analysis of the effects of the implementation of that PDI-State in a concrete environment. The PDI-Implementation-Guide uses only with that application of PDI-States.

2.3 Definition of PDI-States of generic environments

PDI-States can also be defined for more generic environments like industries (construction, shipbuilding), associations, countries, etc. In such a case one can say then that such an environment has reached the specified PDI-State. The definition of a PDI-State in a concrete environments (e.g. specific company with its subcontractors) should of course in balance with the more generic PDI-State in the environment, culture, from which the concrete environment an instance is, c.q. to which these companies belong.

To define PDI-Sates in generic environments, generic Break Down Structure Models are required. For example pointers to nodes of a generic Product Break Down Structure for buildings, specifies for which generic elements of a building (producttypes) the PDI-State is applicable.

2.4 PDI-State-Quotient

An interesting open question is whether it is possible and worthwhile to calculate for a PDI-State one value which gives an indication of the level of communication- capacity of systems, like the Intelligence Quotient is a global measure for the capacity of a human being to communicate, create, etc.. Such a PDI-State-Quotient could perhaps give an indication of the evolution of the PDI-States of a certain organism -concrete or generic environment-, in time, as well as a measure of the benefits of a PDI-State relative to a previous PDI-State of a given environment.

In the way the implementation-method has been developed now, is such a PDI-State-Quotient not used. The level of a PDI-State is measured by analysing the different values of the parameters. Such an analysis results in a describtion of the required changes in the organisation (environment), the required added functionality a the Systems, etc. and a estimation of the benefits in terms of delivery-time, costs and more general the compatitivity of the environment.

The analysis of the PDI-Implementation-Projects has shown very clearly that in most cases it is beter not to maximize the different parameters, but to optimize them for a specific target of the environment.

2.5 Semantical level

The value of the PDI-Sate-Parameter "Document/Model-type" is a measure for the semantical level of the type of documents or models that are exchanged or archived in a specific PDI-State. The higher the semantical level the more machines can automaticaly interpretate the documents or models. High level models have a low degree of redundancy of the data and a high degree of completeness and minimum of relations with a maximum of semantical coherence.

An example of a low semantical level documenttype is a raster-drawing and an example of a high level model is a shape-model with features.

This a one of the PDI-State-Parmeters were it is proven that it is beter to optimize the semantical level to the effects on organization, workmethods, systems, etc., rather then to maximize to the state of technology.

3. TYPOLOGY OF STEP-PARTS

The values of the PDI-State-Parameter "standard" are pointers to specific PDI-standards. These standards can be company-, project-, branche-, national-, continental- or international-standards. So, for each PDI-State must be defined which standards, will, or can be used in that state. For example in a PDI-Implementation-Plan of a specific environment are three successive PDI-States defined. In the first state DXF (de facto standard) is used, in the second STEP/2DBS (German Standard), and in the third Application Protocol "Explicit Draughting" (ISO/STEP-standard).

This is an example of a step by step implementation of ISO/STEP as well as an step by step increase of the sementical level of the PDI-States.

3.1 The STEP-world

The name STEP -STandard for the Exchange of Product model data- is informally used for the collection of ISO-Standards, which are identified with the code "ISO 10303-Part#". For example ISO 10303-201 is the ISO-identification for Application Protocol "Explicit Draughting". So ISO/STEP will not be one standard, but a collection of standards.

However not only on ISO-level are, so called STEP-Standards, under development, but also on European, National, Branche and Company level. In [1] is explained that on these four levels different types of STEP-standards can occure. These types are:

- Resoure-Model-Standards on international level,
- Application Protocol Standards on international and European level,
- Companion Standards on national and branche level,
- Prototype Companion Standards on Company and Project level.

An Application Protocol is an intersection through a number of Resource Models. A Companion Standard uses elements of a Application Protocol, and add to those elements that elements that are country or sector specific. A Prototype Companion Standard is a standard that is only valid within a certain project or organization, but uses as much as possible elements from the STEP-Resource Models, with the purpose to come to a Companion Standard, or even a Application Protocol.

The figure on the last page shows an example of a Dutch project were a National Companion Standard "STEP/Road/ Drawings" will be developed based upon the more general purpose Application Protocol Explicit Draughting (part 201 of ISO/STEP).

3.2 Scope of STEP-Parts

Application Protocols, Companion Standards and Prototype Companion Standards are directed to more or less generic "Applications". In the guidelines for the development of a Application Protocol [2], is stated that the boundaries of the applicability of an Application Protocol, called the scope of the Application Protocol, must be defined in a Application Activity Model (AAM), which could be an IDEFO-model.

Experiences with the development of Application Protocols has learned that an AAM contains not sufficient information for the developer of a strategic PDI-Implementation-Plan to decide for which PDI-States, which Application Protocols can be used.

Also the analysis of the PDI-Implementation-Projects has indicated that it is very difficult for an "environment" (company) to anticipate on the STEP-developments. One of the main problems is that it is not clear for "strangers of the STEP-arena" what the application areas of the different standards are, or in other words, in which generic PDI-State which STEP-standard is applicable. For a step by step implementation of STEP-standards is such a transparancy of the applicability a necessity.

A step by step implementation of STEP, which can, among others, go along the line form prototype Companion Standard to Application Protocols, and from low semantical models to higher level semantical models, requires a more precise and transparant definition of the scope of the different STEP-Standards.

3.3 PDI-State-Framework for the typology of STEP-parts

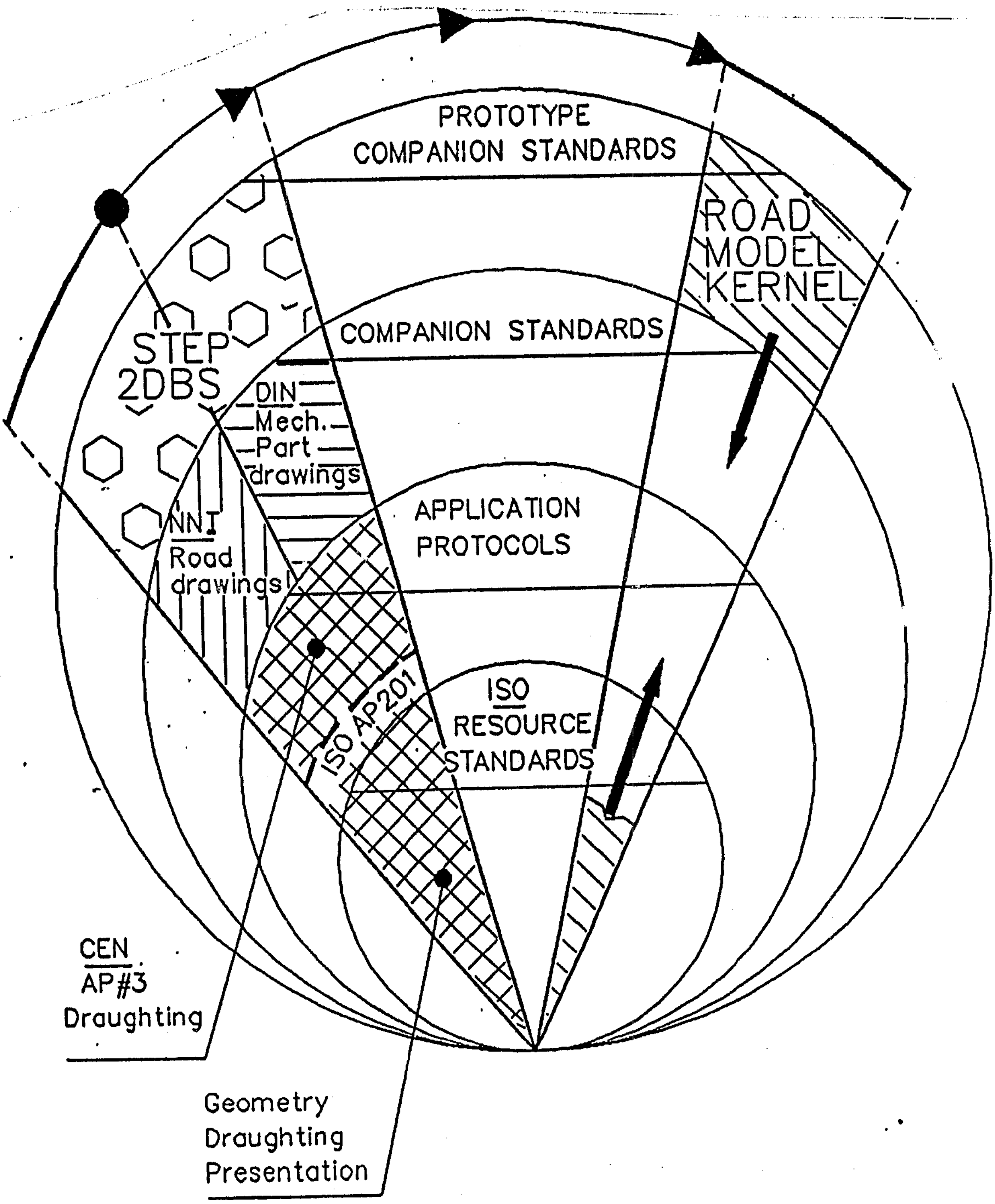
The definition of the applicability area of STEP-Parts, so the typology of the parts, could be done with the aid of a Framework which has the same type of parameters as the PDI-State-Parameters. Each STEP-part can be located in that PDI-State-Framework, and developers of PDI-Implementation-Plans can use this filled framework for the selection of the STEP-Parts applicable for the defined PDI-States for a concrete environment.

The values of the parameters of the framework are pointers to generic break down structure models of processes, systems, etc.. For the definition for the scope of Application Protocol "Explicit Draughting", for instance, is a generic Break down structure of 2D-CAD-Systems used, which is validated by instancing six concrete CAD-Systems. Defined is which functions of the CAD-Systems are required for this Application Protocol.

3.4 Example of a step by step implementation of STEP

In a scenario for a plan of the Road Design Project, noted before, are different STEP-standards in terms of PDI-States defined. The plan contains five steps, for each step is for the concrete environment the required PDI-State defined, and for each PDI-State the STEP-standards to be used, see figure on next page.

The scenario shows a step by step evolution of PDI-States containing low semantical level documents, like implicit drawings by using the German standard "STEP/2DBS", to high level models like Road-Models using the Prototype Companion Standard "Road Model Kernel". And also an evolution of the standards in the direction of Companion Standards on national level and Application Protocols on international level.



4. REFERENCES

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2 M. Palmer, Guidelines for the Development and Approval of STEP Application Protocols, ISO TC184/SC4/WG4 doc. N1, 1991.