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De stichting NIOC neemt de archivering van de resultaten van de congressen voor zijn rekening. De website [www.nioc.nl](http://www.nioc.nl) ontsluit onder "Eerdere congressen" de gearchiveerde websites van eerdere congressen. De vele afzonderlijke congresbijdragen zijn opgenomen in een kennisbank die via dezelfde website onder "NIOC kennisbank" ontsloten wordt.

Op dit moment bevat de NIOC kennisbank alle bijdragen, incl. die van het laatste congres (NIOC2023, gehouden op donderdag 30 maart 2023 jl. en georganiseerd door NHL Stenden Hogeschool). Bij elkaar bijna 1500 bijdragen!

We roepen je op, na het lezen van het document dat door jou is gedownload, de auteur(s) feedback te geven. Dit kan door je te registreren als gebruiker van de NIOC kennisbank. Na registratie krijg je bericht hoe in te loggen op de NIOC kennisbank.

Het eerstvolgende NIOC vindt plaats op donderdag 27 maart 2025 in Zwolle en wordt dan georganiseerd door Hogeschool Windesheim. Houd onze website ([www.nioc.nl](http://www.nioc.nl)) in de gaten.

Wil je op de hoogte blijven van de ontwikkeling rond Stichting NIOC en de NIOC kennisbank, schrijf je dan in op de nieuwsbrief via

[www.nioc.nl/nioc-kennisbank/aanmelden\\_nieuwsbrief](http://www.nioc.nl/nioc-kennisbank/aanmelden_nieuwsbrief)

Reacties over de NIOC kennisbank en de inhoud daarvan kun je richten aan de beheerder:

R. Smedinga [kennisbank@nioc.nl](mailto:kennisbank@nioc.nl).

Vermeld bij reacties jouw naam en telefoonnummer voor nader contact.

## **Ms IS-ontwikkeling**

### **Generatieve applicatieontwikkeling: masteronderzoek in de praktijk**

*Door: Misja Nabben, Hogeschool van Arnhem en Nijmegen*

*Trefwoorden: systeemontwikkeling, praktijkcontext, generatieve software tools*

**Voor het Final Project binnen de masteropleiding Information System Development is een informatiesysteem voor Individueel Onderwijs gemigreerd van Windows naar Web platform. Gedurende dit project is intensief gebruik gemaakt van concepten als code generatie, model – model transformatie en webapplicatie-generatie. In de presentatie werden de belangrijkste aspecten van het project getoond, het proces én het gerealiseerde product. Daarbij speelde de concrete context van de praktijk een belangrijke rol. Het nieuwe systeem is recent geïmplementeerd in de organisatie.**

*'A generic transformation approach to application migration from Windows to Web of the HAN Individueel Onderwijs system'*

### **Background**

Misja Nabben is lecturer in studyprogrammes for bachelor of ICT and master MISD and member of the HAN research group Model Based Information Systems (M-BIS) developed by professor emeritus Guido Bakema (since 2004) and by Professor. Dr. Stijn Hoppenbrouwers (since August 2012). The research themes of M-BIS are: Fact Oriented Modeling (FOM) & Meta modeling; Application & code generation/interpretation; Model to Model Transformations.

Starting in 1995 a combination of research and tool development for research and application-development is continuously conducted at Informatics Communication Academy in research and development activities. The themes for the tool development are: Model driven application generating engines; Generic graphical drawing engines; Fact based modelling tool; From code to data using thin clients.

Since the realization of the first tools application development for practical production used the research and tools. Proof in practice tested and improved the efficiency and functionality of the tools.

### **The Project HAN Individueel Onderwijs**

In 2002 the HAN acquires PBNA modules for correspondence and part time studies. One year later the project "HAN Individueel Onderwijs" started to develop the HAN IO system. In parallel the research project to develop an Application Generator succeeded to deliver the first application generation tool (Universal Form Generator; UFG) on the Windows platform (figure 1).

In 2004 the project delivered and implemented the HAN IO system successfully for 'HAN Centrum voor Post-Bachelor- en Master-opleidingen (HAN CPM). During 6 years the HAN-IO system delivered all the information systems requirements for HAN-CPM satisfactory with minimal additional application developments for maintenance. According to plan in 2008 HAN IO students should have finished their programmes and HAN IO could be stopped. However the HAN-IO system delivered valuable productivity in general for individual studyprogrammes (for distance learning) and therefore

was continued until the first problems occurred for HAN IO in 2010 due to the planned system migration to Windows 7. In 2011 an analysis on upgrading HAN IO was conducted and in 2012 due to Windows 7 rollout planning the second project HAN IO II started.

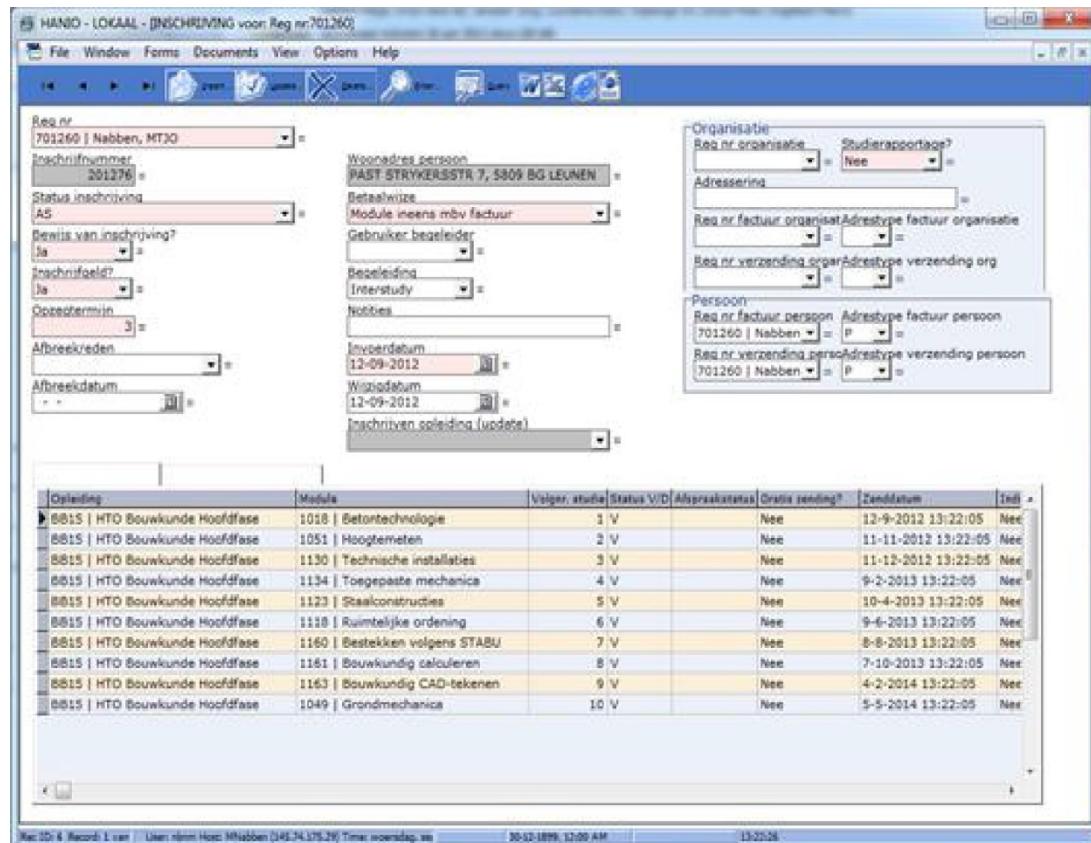


Figure 1. Windows based generated enrollment application HAN-IO (2004).

### Project and problem statement

HAN IO is based on the Application Generator developed in Delphi and that development platform was not supported in Windows 7. Secondly the database version MS SQL 2000 was outdated. Since HAN IO end of life was schedule in 2008 no significant functionality was added since 2004.

The objective of the HAN-IO II project was to develop a new version of HAN-IO system that:

- Can support the process of distance education;
- Has at least the same functionality as HAN IO and can easily adapt to new functionality;
- Is easy to use by the current end users and could be used in the future by students;
- Fits in the HAN architecture, is developed and is easy to maintain at the lowest cost.

Finally the project assignment was defined as a Master thesis project to develop:

'A generic transformation approach to application migration from Windows to Web of the HAN Individueel Onderwijs system'. The web version of HAN-SIS is the final result of the project (figure 2). The major task was transforming the business model and application model to this new platform (web) by model to model transformation and code generation. A web-based application interpreter called 'Information Model Application Generating engine (IMAGIne)' and the relational database management system MS SQL Server were used as development tools.

Inschrijving van: Persoon (701260, Nabben, MT30, Misja)(3)

Toevoegen Bewerken Eigendelen Zoeken Tabel-weergave Exporteren Inschrijven voor complete opleiding

<b>Inschrijving</b>	<b>Betrouwbaarheid</b>	<b>Beëindiging</b>
Reg nr 701260-Nabben-MT30-Misja	M1 AC-Module ineens mbv factuur	Afbrekreden
Inschrijfnummer 201276	Gebruiker begeleider	Afbreekdatum
Status inschrijving AS-Actief studerend	138-Cecilia Gertsen	
Bewijs van inschrijving? Ja	Begeleiding 1-Interstudy	
Inschrijfgeld? Ja	Notities	
Opcategorieën 3	Invoerdatum dinsdag 17 juli 2012	
Woonadres: 	Wijzigdatum	
PAST STRYKERSSTR. 7 , 5809 BG LEU		

Gewijzigd 2 maanden geleden vanaf 11-1 doorgeschreven, aangemaakt 2 maanden geleden vanaf 11-1 doorgeschreven.

**Samenstelling studieprogramma (12)**

Opleiding	Module	Volgorde, studie indicator werving	Status Y/D	Afsprakestatus	Zondatum	Reg nr docent
AL14-Vooropleiding HTO niet meer gebruiken	6121-Natuurkunde: isolering HTO:0,30	N-Nee	V-Voorlopig	-	16-9-2012	241428-Schaaf-J.-
BB15-HTO Bouwkunde Hoofdfase	1018-Betontechnologie	1.00	N-Nee	V-Voorlopig	15-12-2012	591306-Kerbusch-E.J.W.C.-Erwin
	1051-Hoogtemeten	2.00	N-Nee	V-Voorlopig	13-2-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1130-Technische installaties	3.00	N-Nee	V-Voorlopig	15-3-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1134-Toepaste mechanica	4.00	N-Nee	V-Voorlopig	14-5-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1123-Staalconstructies	5.00	N-Nee	V-Voorlopig	13-7-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1118-Ruimtelijke ordening	6.00	N-Nee	V-Voorlopig	11-9-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1160-Bestekken volgens STABU	7.00	N-Nee	V-Voorlopig	10-11-2013	591306-Kerbusch-E.J.W.C.-Erwin
	1161-Bouwkundig calculeren	8.00	N-Nee	V-Voorlopig	9-1-2014	591306-Kerbusch-E.J.W.C.-Erwin
	1163-Bouwkundig CAD-tekenen	9.00	N-Nee	V-Voorlopig	9-5-2014	-

Figure 2. Web based enrollment generated application HAN-IO-II (2013).

The fundamental method for the project is using meta-modeling for the information model, the relational model, the business model, the application interface model, application interpreter model and the transformation of repositories.

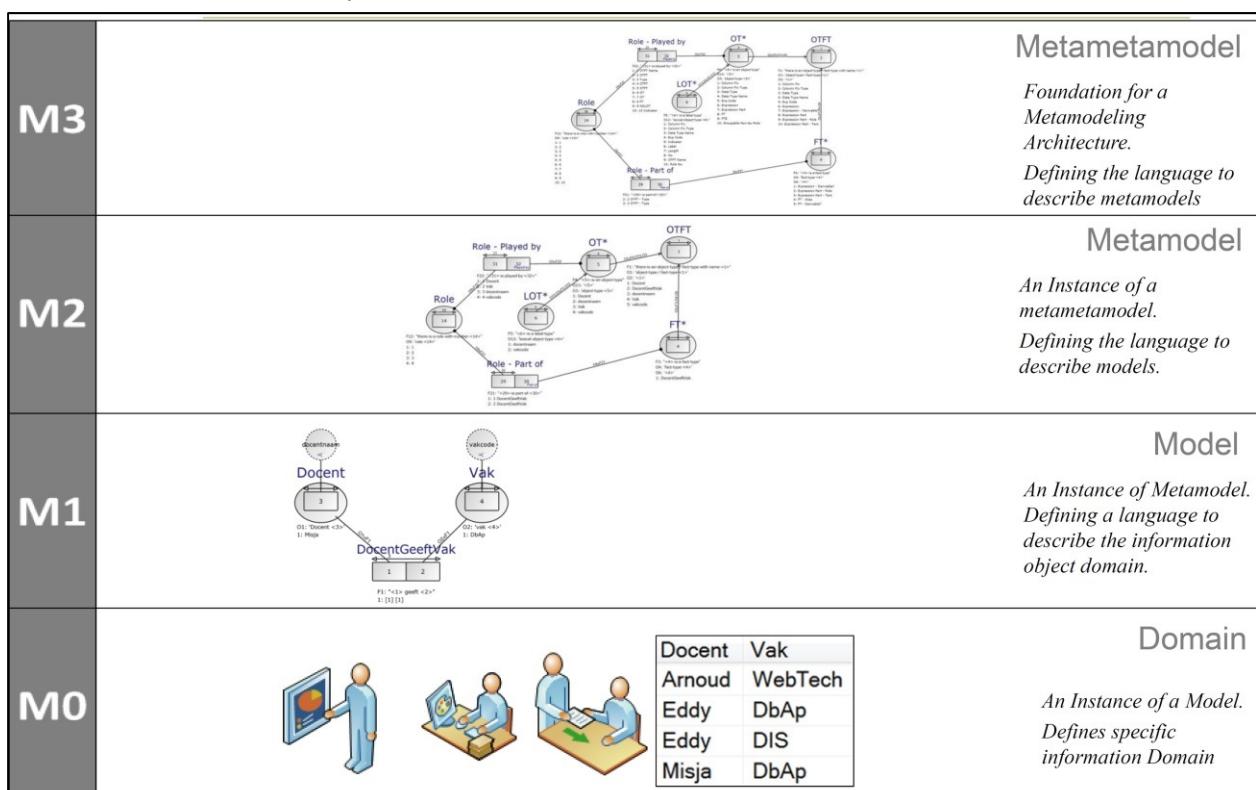


Figure 3. Four Layered metamodel of Fully Communication Oriented Information Modeling (FCO-IM).

Figure 3 presents an example of the 4 levels of information modeling: domain model (M0), information model (M1), meta information model (M2) and metameta information model (M3). An equal figure represents the 4 levels of relational modeling: domain model (M0), relational model (M1), relational meta model (tables, columns, relations) (M2), meta-meta-model system tables (M3) (figure 4).

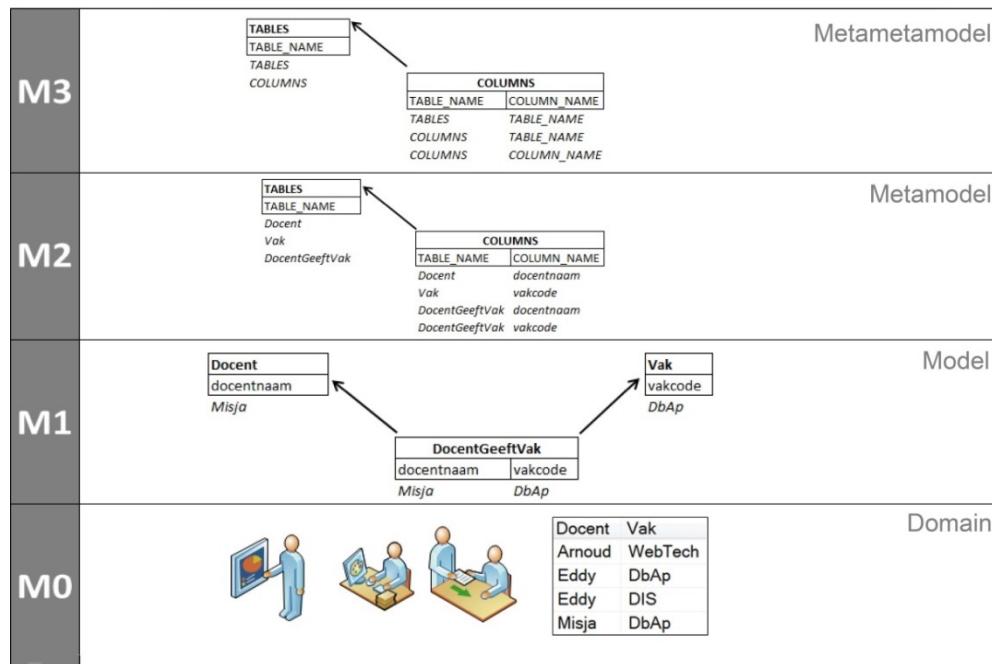


Figure 4. Four Layered metamodel of Relational Modelling.

The main task is the transformation of (old) models to (new) models as shown in figure 5.

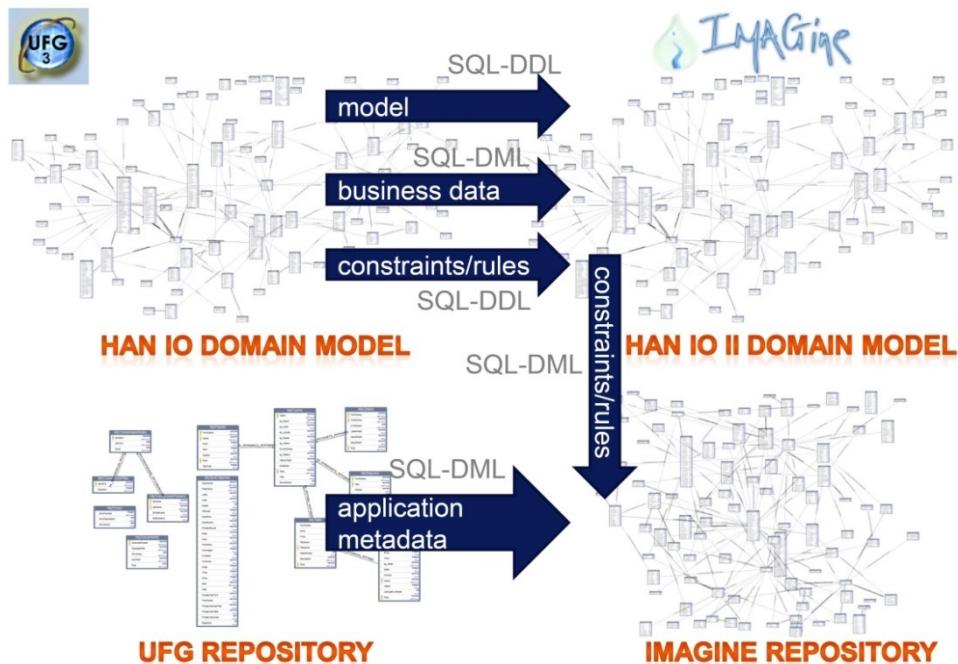


Figure 5. Model to model transformation for HAN-IO-II application generation.

All transformations can be done by SQL-only , because all models are implemented in relational databases (SQL-server) (figure 6).

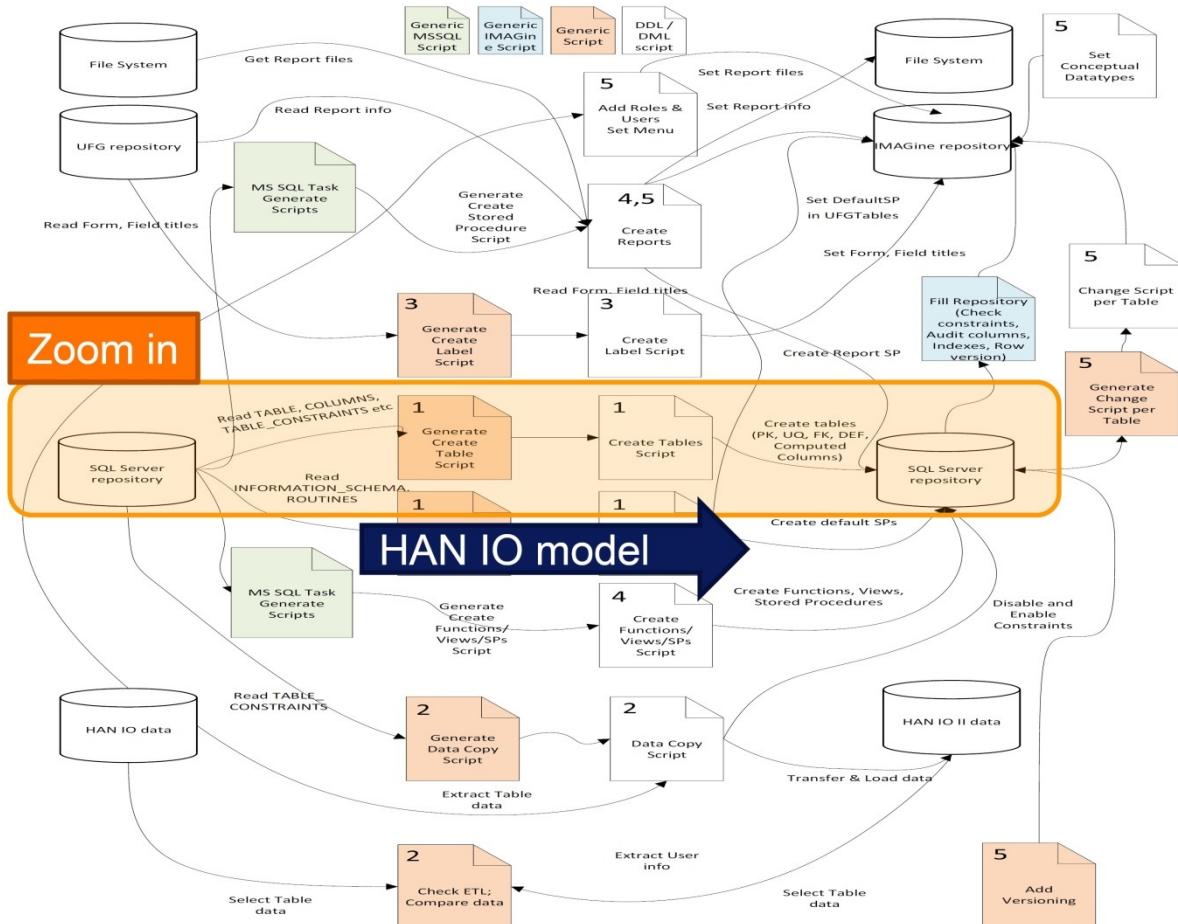


Figure 6. Development of the transformations for HAN-IO-II.

The repository transformations for 'HAN-IO' to 'HAN-IO-II' is realized by create and alter tables (figure 7). Create Table(s) for column (data type, length, mandatory, identity and calculation) and primary key definition and Alter Table(s) for Foreign key definition, Unique key definition, Check Constraints and Default constraints (inclusive default Stored Procedures).

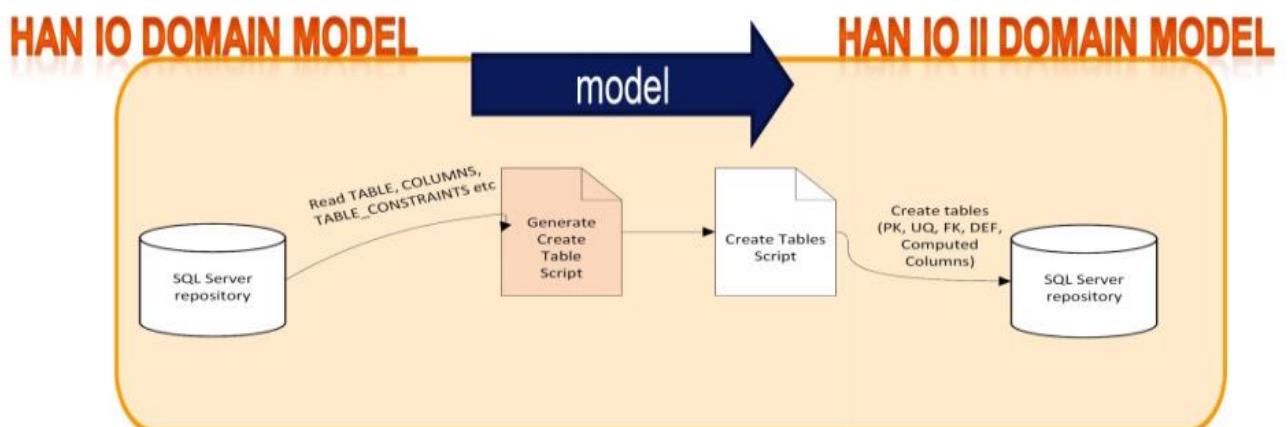


Figure 7. Repository transformations by SQL Create and Alter statements only.

## Project results

A web based HAN Individueel Onderwijs system was implemented for CPM department in March 2013 (figure 8). The development is based on (meta-) data transformations instead of programming with more declarative rules instead of procedural code. Testing is primarily based on testing the existence of (meta-) data in the new environment and not in the domain level population, not in user interface and not in generated (!) application functionality. Errors arise in procedural code not in declarative rules. Due to major reduction in testing capacity the project cost of HAN IO II was less than 10% of the original costs of the first HAN IO system (2004).

The screenshot shows a web-based application for enrollment. At the top, there's a header bar with links like 'Formulieren', 'Inschrijving (2/23)', 'Start', and 'Inschrijving'. Below the header, the main area is divided into sections:

- Inschrijving:** This section contains fields for registration number (Reg nr), status (AS-Actief student), term (Opzegtermijn), and contact information (Woonadres, Email).
- Onderbreking, Beëindiging:** Fields for cancellation (Afbrekreden) and end date (Afbrekkedatum).
- Organisatie:** Fields for organization (Reg nr organisatie) and address (Adressering).
- Factuur naar, Verzenden naar:** Fields for billing person (Factuurnaar, Adrestype factuurnaar) and shipping person (Verzendenaar, Adrestype verzending persoon).
- Samenstelling studieprogramma:** A table showing study programs (Opleiding), modules (Module), credits (Volgnr. studie), indicators (Indicator vrijstelling), status (Status V/D), and other details.

Figure 8. Generated User Interface Screen for Enrollment in HAN-IO-II system.

## Future developments

The project delivered valuable input for future research and improvements regarding application generation for HAN business applications and in study programmes for bachelor and master students.

The research aims at specific improvements in default heuristics, subtype support, foreign key titles generation, the visualization of child records and improvements in the user interface controls to support high volume domain tables. Adding the verbalized fact type expression to the user interface is a major goal to enhance the generated applications with context sensitive help for detailed user interface interaction functionality at facttype and factvalue level.

Wilt u reageren op deze presentatie? Neem dan contact op met:

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