

# USING RELATIONAL ALGEBRA IN DESIGNING PUBLIC HEALTHCARE REGISTERS

by

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# 1. INTRODUCTION

This research is about the usefulness of Ampersand for designing register systems.

Registry systems are designed and built for a legal task and thus have a specific purpose. In order to perform this statutory duty, register systems must be accessible to the target groups. The target groups need relevant information from such a register system. The statutory duty requires the registry systems to be up-to-date. The target groups must have confidence that the quality of the data is in order. That is why register systems that are built on the basis of legislation and regulations are always built and maintained by government agencies.

The case addressed in this research concerns the **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)**. The **Wet-BIG** is a compilation of legislation and regulations concerning the determination of the qualification of care providers. It is a register that falls under the responsibility of the Ministry of Health, Welfare and Sport. Within this ministry, the implementing organization CIBG is responsible for managing the register. The CIBG monitors all aspects that a register system must comply with. To be able to do this, she has built a register system to manage the data. The registry system, an information system called Zorro (**ZOrgverlener Registratie Requirements Ontwikkeling**)<sup>1</sup> was built in 2008 and an **Application Lifecycle Management (ALM)** has established that it needs to be replaced [de Kok et al., 2019].

The CIBG has asked whether it is possible to translate directly from the legislation and regulations into a design and possible implementation. We are going to use Ampersand for the design. We put the implementation part out of scope. Ampersand is a design method that designs and models from the source, i.e. the law and regulations. As a result, it is not necessary for the design process to rely on user information. The relevant concepts, relationships and rules are determined on the basis of legislation and regulations. Ampersand is therefore based on the relation algebra and enforces validation based on the concepts, relations and rules found [Joosten, 2017]. To make the design process visible, Ampersand has tooling to generate a functional design from a conceptual model. In addition, Ampersand offers the possibility to make a prototype. This prototype, together with the design, is used to validate the model. The involvement of the CIBG organization is essential for this validation process.

The research concerns an authentic situation, namely the redesign of the registry system of **Wet-BIG** is necessary. The case to be investigated is a real-life situation, also the **Wet-BIG**. The demand and the support comes from the CIBG organization. The researcher himself knows the register system and, in general, the legislation and regulations from which the system originates, which makes it a participatory form. As a result, Action Research [Easterbrook et al., 2008] has been chosen as the approach.

On the basis of action research, we investigate the usefulness of Ampersand for designing register systems. Usability indicates to what extent this method meets the need. It's about the ability to use Ampersand for register systems design. Is Ampersand immediately

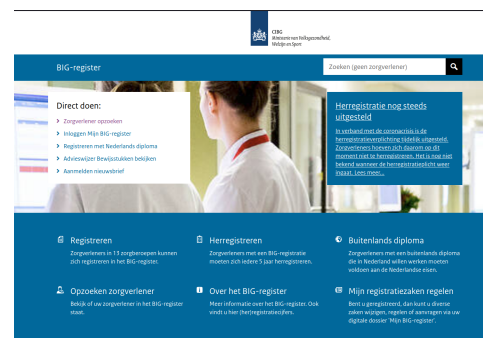


Figure 1: Big-register

<sup>1</sup><https://www.bigregister.nl/>

deployable, or is supporting knowledge required? It is also questionable whether the legislation and regulations are suitable as a source for Ampersand. The question for government organizations is what the strengths and weaknesses are of using Ampersand for registration systems.

In the **Context**, section 2, we discuss the related topics. This is a closer look at Ampersand's basics, namely relation algebra, in subsection 2.1.1. Ampersand is also discussed in subsection 2.1.2. We give an idea how an Ampersand script looks like. Unlike the common process approach, Ampersand uses an event-oriented approach. This is explained in subsection 2.2. The current system, which focuses on a workflow that will be replaced, is Zorro and the case **Wet-BIG** is also discussed. In section 3 we look at the topic of the action research, namely the **Wet-BIG**. We determine the reason for the choice of action research. In section 4 we look at the main question and related issues. We also discuss the method, approach and validation of the action research. The last section 5 focuses on planning.

## 2. CONTEXT

There are more case studies conducted in the past about the usefulness of Ampersand. Like the graduation study of **koopman** [2014] and the example study of **Baecke** [2018] about adapting Ampersand in legal environment. Also in the field of legislation. This case study aims to demonstrate that this is also possible for legislation coming from the Ministry of Health, Welfare and Sport.

For knowledge of Ampersand, the books by **Wedemeijer et al.** [2013b] and **Wedemeijer et al.** [2013a] from the Open University are available.

### 2.1. DESIGN METHOD

The method used in this study is the Ampersand method. The Ampersand method is based on relational algebra. Ampersand makes it possible to make a conceptual analysis of problems. The data model created thereby makes it possible to accelerate implementation.

#### RELATION ALGEBRA

The field of the relation algebra, founded by De Morgan, focuses on operations with sets. The signature item of relational algebra is the relationship, as the name implies. This relationship has several properties, namely the attributes. The attributes in the example of **Wet-BIG** would be the surname, first names, gender, date of birth, nationality and address of the person concerned and the number and time of registration <sup>2</sup>. In addition, the relationship consists of tuples. Since the relationship is always between two objects, this is called 2-tuples. The tuples contain the attributes of the relation.

Basically the operations on sets are the following:

- Union,  $R \cup S$
- Intersection,  $R \cap S$
- Difference,  $R - S$  or  $S - R$

A distinction must be made between relation algebra and relational algebra. Ampersand uses relation algebra, so is tuple related and the relational algebra is the foundation of e.g.

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<sup>2</sup>**Wet op de beroepen in de individuele gezondheidszorg** article 3, paragraph 2

relational databases. This includes projections, selections and joins. The latter are therefore not part of relation algebra.

## AMPERSAND

Ampersand is based on relation algebra and focuses on business rules [Wedemeijer et al., 2013a]. Ampersand supplies correct information systems. In this case, Ampersand's goal is to provide a correct registry system. Ampersand's other strengths are its support for conceptual analysis. It is a platform for reactive programming and generates prototypes. Ampersand describes the goals rather than the steps.

Business rules are there to pursue a common goal. These rules are converted into an information system. The Ampersand method ensures that when a precise set of rules has been established, an information system can be generated. Ampersand focuses on business rules. To learn how Ampersand works in real life, we design a registry in Ampersand that implements the **Wet-BIG** [van, 1993-2021] .

The principle of rule-based **Business process Management** (BPM) as mentioned in [Joosten and Joosten, 2007] is that any violation of a business rule may be used to trigger actions. This is described in the section **Reactive approach**.

Ampersand consists of concepts that in turn consist of atoms. An atom is an implementation of the concept. Inside the **Wet-BIG** is a concept "beroep" with associated atoms like "arts, tandarts, etc". The concepts are given a name, and the name must be recognized by the business. This also applies to the definition and purpose of the concepts. These attributes are not mandatory, but when one wants to generate a functional design, these descriptions of the attributes are very useful.

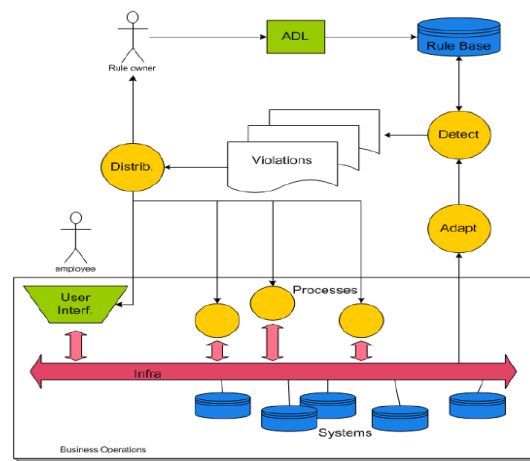


Figure 2: rule-based-proces

```

1 CONCEPT Beroep "Beroep van een persoon zoals bedoeld in de wet"
2 PURPOSE CONCEPT Beroep
3 {+Beroep dat uitgeoefend wordt+}
4 POPULATION Beroep CONTAINS [
5     "arts",
6     "tandarts",
7     "apotheker",
8     "gezondheidszorgpsycholoog",
9     "psychotherapeut",
10    "fysiotherapeut",
11    "verloskundige",
12    "verpleegkundige",
13    "physician assistant",
14    "orthopedagoog-generalist"
15 ]

```

Concepts can have relationships with each other. If the data of the concepts is true and the rules yield consistent data then the relationships between real data are facts. These facts together form one truth. Not all concepts are directly related. Within the domain of the

**Wet-BIG** we could distinguish the concept of "registratie" and the concept of "beroep". This name is also referred to within **van [1993-2021]** in article 3 of **Wet-BIG**. Even the name of the relationship is mentioned in this article, which the legislator calls a "beroepsbeoefenaar". The law requires that data of the "registratie" be recorded, indicating the corresponding profession (beroep). In Ampersand, this is modelled as follows. On the one hand, the "beroep" and also the concept "registratie".

```

1  CONCEPT Registratie "De registratie van een persoon binnen het
    register"
2  PURPOSE CONCEPT Registratie
3  {+Vastlegging in het register geeft toegang tot uitoefenen taak
    binnen de gezondheidszorg+}

```

Between the "registratie" and the *persoon* exists the relationship "beroepsbeoefenaar".

```

1  RELATION beroepsbeoefenaar [Persoon*Registratie]
2  MEANING "geregistreerd persoon"
3  POPULATION beroepsbeoefenaar CONTAINS
4  [
5    ("Piet",1);
6    ("Susan",2);
7    ("Gerard",3);
8    ("John",4)
9  ]

```

Also adding the concepts of *persoon* and *handeling*. Persons may perform the medical actions, but only when they are qualified.

```

1  CONCEPT Persoon "Persoon die werkzaam wilt zijn binnen de zorg"
2  PURPOSE CONCEPT Persoon
3  {+Vastleggen van de identiteit van de persoon+}

```

```

1  CONCEPT Handeling "Acties die uitgevoerd worden"
2  PURPOSE CONCEPT Handeling
3  {+Vastleggen van de mogelijke handelingen die uitgevoerd kunnen
    worden binnen de zorg+}

```

These concepts can lead us to the following scheme.

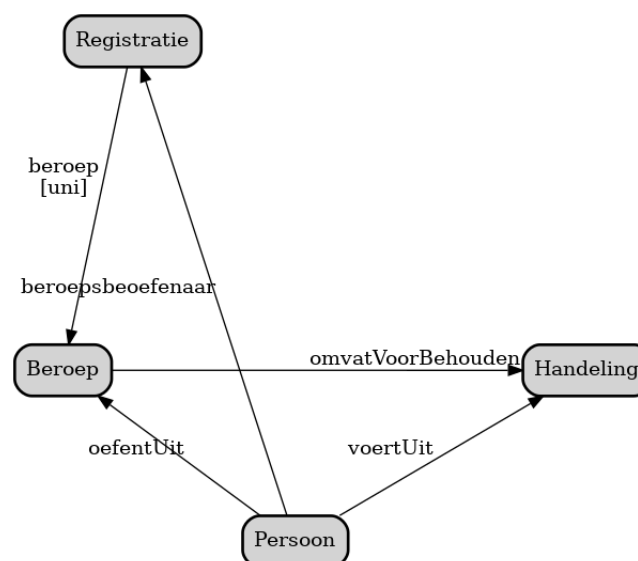


Figure 3: relations

The multiplicity must also be determined for each relation.

function	The corresponding control question for the above relation <i>voerUit</i> is
Univalent	For each <i>Persoon</i> there is at most 1 <i>Handeling</i>
Total	For each <i>Persoon</i> there is at least 1 <i>Handeling</i>
Injective	For each <i>Handeling</i> there is only 1 <i>Persoon</i>
Surjection	For each <i>Handeling</i> there is at least 1 <i>Persoon</i>

Table 1: multiplicity

By modelling using the Ampersand method, the question can be answered whether Ampersand provides more insight into the relationships. As part of the research question, Ampersand can help you gain insight into the relationships. Although you have to recognize and define these yourself, Ampersand will be helpful in generating functional design and prototype. The generated prototype will validate the named constraints. This will prevent registrations that do not meet the constraints. These constraints are laid down in rules within Ampersand. For example, a rule can be drawn up that determines whether a person is allowed to perform a certain action. In figure 3 the relations are named. It was previously established that there are 2-tuple relationships. Here we use the following notation: "*relation*[*Concept*  $\times$  *Concept*]".

$$\begin{aligned}
 &voertUit[Persoon \times Handeling] ; omvatVoorBehouden[Beroep \times Handeling] \sim \\
 &\subseteq \\
 &beroepsbeoefenaar[persoon \times registratie] ; beroep[registratie \times beroep]
 \end{aligned}$$

The compared sets are

[*Persoon*  $\times$  *Beroep*]

The rule then will determine if the previous equation is true.

If this is the case, then the rule is validated, otherwise the violation message occurs.

```

1  RULE HandelingDoorPersoon: voertUit; omvatVoorBehouden[Beroep*
   Handeling]~ |- beroepsbeoefenaar; beroep
2  MEANING "Een persoon mag handelingen uitvoeren wanneer hij een
   bepaald beroep uitoefend"
3  MESSAGE "Geen toegestane handeling."
4  VIOLATION (TXT "Persoon ", SRC I, TXT " voert de handeling uit ",
   TGT I, TXT " die niet tot zijn beroep behoren ", SRC I[Persoon];
   oefentUit)

```

## 2.2. REACTIVE APPROACH

The start of the reactive approach started with the reactive manifesto [rea, 2014]. This defines the aspects that a reactive system should meet. This includes Responsive, Resilient, Elastic and Message Driven. These are systems that are flexible, loosely coupled and scalable and that makes them easier to develop and maintain. Reactive Systems are made highly responsive and provide interactive feedback.

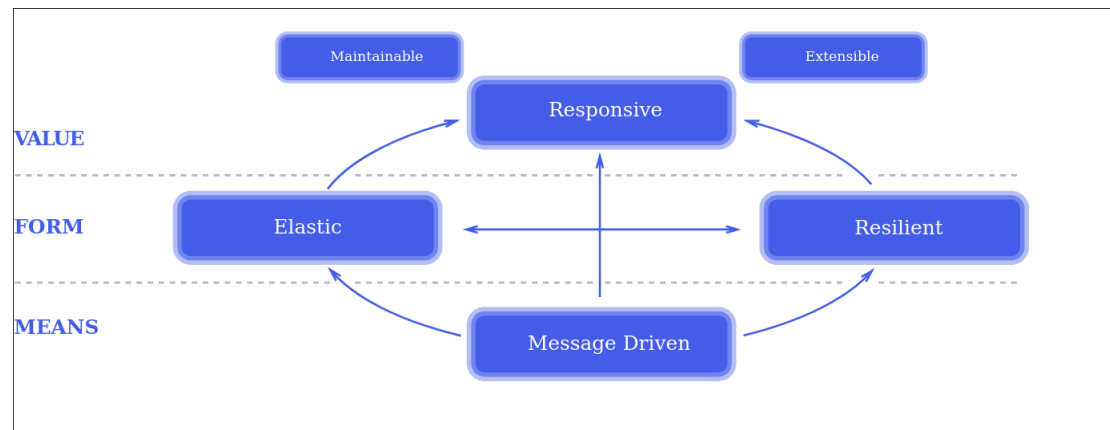


Figure 4: reactive manifesto

AmperSand is a form of Functional Reactive Programming (FRP) [Elliott and Hudak, 1997]. The basic of reactive programming is the fact that it involves asynchronous communication. This means that, as the *rea* [2014] prescribes, use is made of message driven systems, but AmperSand is more than a message-driven system. It is actually an event-driven system. The glossary of the *rea* [2014] indicates the difference between message driven systems and event driven systems. An event-driven system targets event-bus while a message-driven system targets recipients [Bainomugisha et al., 2013]. The essence is that the order of the flow cannot be determined in advance. The system will respond to events caused by constraints, AmperSand determines a dynamic flow [Joosten, 2018].

#### LAW ANALYSIS

The tax authorities have developed a method that is intended to analyse tax laws and other laws. This is performed in these 6 steps:

1. Determining the work area.
2. Making the structure visible in legislation.
3. Defining the meaning of legislation.
4. Validate the analysis results.
5. Identify missing execution policy.
6. Setting up the knowledge model.

Emphasis is placed on the cooperation between the implementer, ICT and policy. By going through the method step by step, one arrives at a shared language. This shared language includes the definition of concepts by the collaborating parties. An important part of the approach is dividing the law into small pieces and always refer to these pieces of law in the implementation. As a result, the method meets the requirement of the justification of government decisions. The decisions are traceable, explainable, and it is possible to account for them. What is not clear from the webinar *Belastingdienst* [2021] is how these steps were converted into an implementation. The book *Ausems et al.* [2021] indicates that the legal analysis method does not contain a development tool, but that the Tax and Customs Administration has developed an instrument based on the legal model, which is not freely available.



### 2.3. WET-BIG

The first health care law was enacted in 1865. This law, together with eleven other laws, forms the basis of the **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)**<sup>3</sup>. The **Wet-BIG** [van, 1993-2021] replaces the ban on medical action by unauthorized persons by granting responsibilities to healthcare providers. The professions regulated in Article 3 of the BIG Act, which include doctors, nurses and physiotherapists, have a compulsory registration with periodic re-registration, a statutory disciplinary law and a protected professional title. The former paramedical professions that are now regulated in Article 34 of the BIG Act have no registration obligation and no legally regulated disciplinary law. These Article 34 professions are only certified.

Then we have the **Wet-BIG**. It describes the following:

de tot dusverre geldende wettelijke regeling op het gebied van de uitoefening van de geneeskunst, inhoudende een het gehele gebied der geneeskunst bestrijkend verbod van beroepsuitoefening zonder hiertoe wettelijk verleende bevoegdheid, te vervangen door een regeling welke een ruimer gebied van individuele gezondheidszorg bestrijkt en waarbij slechts het verrichten van bij de wet aangewezen categorieën van handelingen wordt voorbehouden aan categorieën van daartoe overeenkomstig de wet gekwalificeerden, terwijl het voeren van wettelijk beschermde beroepstitels uitsluitend toekomt aan degenen die in de voor de desbetreffende beroepen overeenkomstig de wet ingestelde registers ingeschreven staan en ten aanzien van andere beroepen op het gebied van de individuele gezondheidszorg voorzien wordt in de mogelijkheid tot het regelen van de opleiding tot die beroepen;  
voor onderscheidene categorieën van overeenkomstig de wet gekwalificeerden een aan de gebleken behoeften aangepaste regeling van tuchtrechtspraak in het leven te roepen;

This law consists of 148 articles, of which a number are still pending. The articles are also regularly updated. More recently, in July 2020 there were still amendments to the law.

On the website of [wetten.overheid.nl](https://wetten.overheid.nl)<sup>4</sup> are the laws and therefore also of **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)**. Within this website, the content is kept up to date. All changes to the law are traceable. So it is also possible to go back in time, to see what the law looked like at a certain time.

When we talk about the new **Wet-BIG**, we can say that it is not there yet. Proposals have been written about a new law [Bussemaker, 2019], but it has not yet been enacted into law, and it is also a descriptive text and not an article-by-article summary.

### 2.4. REGISTERS

The current system developed to support the **Wet-BIG** still has the project name Zorro. This stands for **ZOrgverlener Registratie Requirements Ontwikkeling**. This system was developed in 2008 as a successor to the Ribiz system. Zorro is a Microsoft .net application running on a windows platform with an underlying MS-SQL server. The architecture of the system is based on an internal workflow, but continuous design changes over the years has caused a maintenance issue that requires new construction for this system.

<sup>3</sup>[https://nl.wikipedia.org/wiki/Wet\\_op\\_de\\_beroeppen\\_in\\_de\\_individuele\\_gezondheidszorg](https://nl.wikipedia.org/wiki/Wet_op_de_beroeppen_in_de_individuele_gezondheidszorg)

<sup>4</sup><https://wetten.overheid.nl/BWBR0006251/2020-07-01>

The **Application Lifecycle Management (ALM)** advice [de Kok et al., 2019] has shown that in addition to a maintenance problem, there are also issues in the field of security, outdated architecture and process support. In consultation with the policy directorate (beleidsdirectie) that is responsible for **Wet-BIG**, the CIBG has embarked on a process for new construction. The **ALM** advice has been there since 2019. Preparations for the new building have started, but construction has not yet started.

As mentioned, the current **BIG-registration System** is built as a workflow system. The idea behind this was that when adding a new profession within the **Wet-BIG** only a new professional title should be added. Practice proves to be more unruly, and numerous exceptions have been made within the software for trajectories within the professions and specializations. What does make the software complex is the integration of disciplinary law within **BIG-registration System**. Also, the support of the trajectory of foreign persons who want to work in the healthcare field. This interweaving has made the program great. The current **Software Improvement Group (SIG)** rebuild calculation has estimated it at 27 man-years.

Zorro is divided in several building blocks. Building blocks related to the persons called **health care person (HCP)**, concerning the workflow called Case and creating files called File. The case building block has its focus on the process of registration. Looking at the main data model blocks, one can see that it involves metadata, product, state and of course the case and its requests and activities. On the other hand, the dossier is only about physical documents that are scanned and archived. Technically, this is solved via a SharePoint solution. Also, an outdated solution for archiving documents. The most important building block is about the people who want to be registered. During the design, they clearly looked at what the **Wet-BIG** has in it. This is also reflected in the current data model. One sees in this data model the interdependence with the "tucht" process. It's called Judgment and JudgmentProvisionNote. All signs of disciplinary action. The physical implementation of this data model is much more complex. This is due to the inclusion of foreigners in the system.

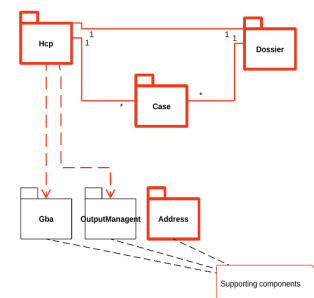


Figure 5: overview zorro

### 3. PROBLEM ANALYSIS

#### 3.1. IMPLEMENTATION OF WET-BIG

The action research has as subject the **Wet op de beroepen in de individuele gezondheidszorg**. This law dates from 1993 and is still valid today. As mentioned before, the law will eventually be replaced as stated by Bussemaker [2019].

The current system, called **BIG-registration System**, is built to support the **Wet-BIG**. Research in 2019 showed that the current system is end-of-life. It has been depreciated financially, but also technically it is lagging behind and can only be maintained at high costs. Also, not all intended processes can be supported within **BIG-registration System**. The problems with Zorro show that a workflow approach involves a high administrative burden, because exceptions to the rule are always necessary. In order to determine the usefulness of the Ampersand method, we will investigate this case with a real-life situation,

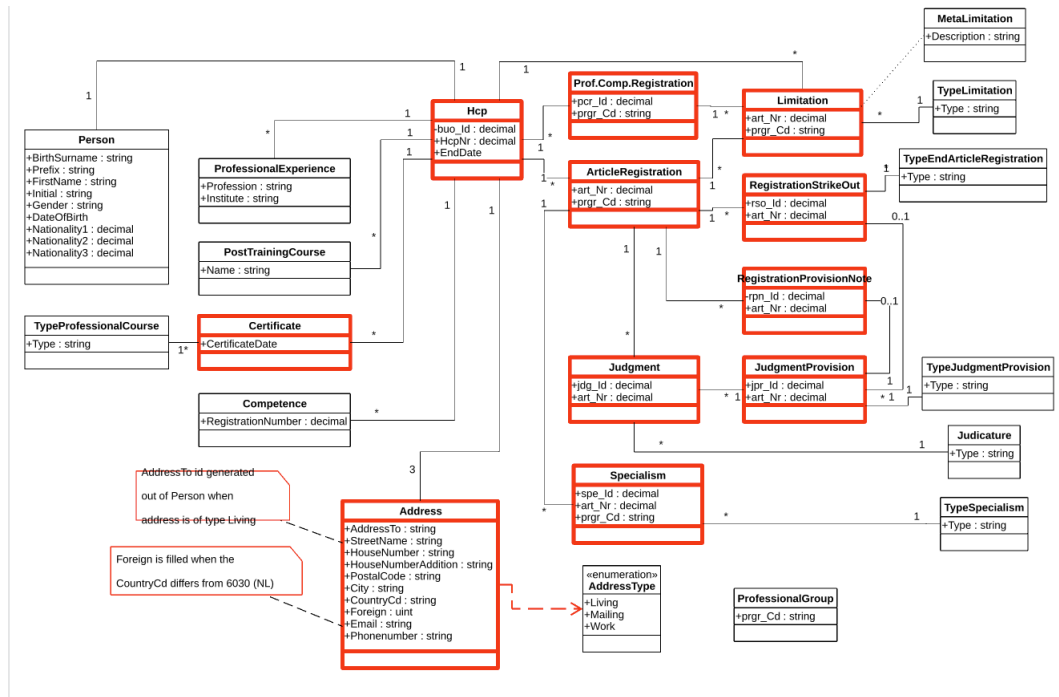


Figure 6: HealthCarePerson

namely **Wet-BIG**. Since the BIG system needs to be replaced, this is an authentic problem. As an application manager, I have been involved with BIG-system for a number of years. The CIBG organization has asked whether it is possible to investigate a more direct link and translation of the legislation towards registers. That is why we are going to use Action Research [Easterbrook et al., 2008] as a research approach.

The system that supports the **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)** within the **CIBG** does not provide sufficient functionality for the organization. People are insufficiently able to perform daily activities with the aid of the system. Many activities require workarounds to support the process. In particular, the performance of the Disciplinary and Recognition of Foreign Diplomas tasks is not supported by the system and can only be performed with a lot of manual work outside the system. The management organization often has to intervene using SQL scripts and therefore has a major impact on the primary process. The information system does not meet the information needs of the business, client and external parties (such as the press), so these can only be answered with manual searches in the database named by **de Kok et al. [2019]**. Modifications to the system require intensive development work. In its current state, it is sensitive to security breaches and does not meet all **General Data Protection Regulation (GDPR)**<sup>5</sup> and archive law requirements<sup>6</sup>. Security breaches can lead to reputational damage and even to the closure of DigiD.

### 3.2. ACTION RESEARCH

The use of relation algebra contributes to the knowledge about register design with Amper-sand and for that we use action research [Easterbrook et al., 2008]. Mainly aimed at users

<sup>5</sup><https://gdpr-info.eu/>

<sup>6</sup><https://www.nationaalarchief.nl/archiveren/kennisbank/wet-en-regelgeving>

who have never done anything with Ampersand. We use Ampersand to convert the law into relation algebra to see how this works in real-life situations. This research focuses on this translation and the aspects involved. An important aspect of the Conceptual analysis is the common language that is defined. The intentions are even more important than the actual text.

This concerns the prior knowledge needed to apply Ampersand. Matters that will also be discussed are related to legislative changes. How can these be included in the method. How are they visible? What about the stored data if there are changes in the law? In a webinar about legal analysis from [Belastingdienst \[2021\]](#), the relationship between articles of law and decisions taken is explicitly recorded. The question is whether Ampersand also provides for this.

## 4. RESEARCH

### 4.1. RESEARCH QUESTIONS

Within the CIBG we manage the [BIG-registration System](#) that needs to be replaced. The [BIG-registration System](#) is an implementation of [Wet-BIG](#). However, because [BIG-registration System](#) is end-of-life, it needs to be redesigned and rebuilt. This is a unique opportunity to test the usefulness of Ampersand for the design in practice. With the help of Ampersand, for a real-life situation, we make a design that can be put into practice. This law will be analysed and converted into the relational algebra as used within Ampersand.

The above leads to the following research question:

**How useful is Ampersand for designing registry systems by analysing public health legislation and regulations, in particular the [Wet-BIG](#).**

When investigating the research question, the following sub-questions will contribute to the answer to the research question.

Related questions:

- RQ1 - What knowledge, in the role of software engineer, is needed to use Ampersand.
- RQ2 - What are the Concepts, Relationships and Rules in the [Wet-BIG](#).
- RQ3 - How are the laws and regulations set up so that they can be used in a useful way for the Ampersand method.
- RQ4 - What are the strengths and weaknesses (SWOT) in using Ampersand for registry systems for a government organization.

When investigating RQ1, we will determine what knowledge is needed to start as a software engineer with Ampersand and to be able to perform the conceptual analysis. Is it then sufficient to have a brief knowledge of relational algebra and of Ampersand, or is it necessary to have in-depth knowledge of this domain. The result of RQ2 should follow from the conceptual analysis of the [Wet-BIG](#). This is input for making the prototype and the functional design. Another aspect of the usefulness of the Ampersand method concerns the source of the data. This data source, the laws and regulations of the [Wet-BIG](#), should be structured in such a way that concepts, relationships and rules can be derived from it. In order to determine the usability of the Ampersand method, it is also necessary to be accepted by an organization in addition to the implementation of the method. The sub-question RQ4 is therefore about the strengths and weaknesses of the Ampersand method.

## 4.2. RESEARCH METHOD

The research question focuses on the usefulness of Ampersand for designing registration systems. The design of a real life situation of a register system. The CIBG has asked to take the **Wet-BIG** as a case. The system that supports the **Wet-BIG** needs to be replaced. We focus on a case. Due to years of involvement in this system, it is not possible to look at the system completely objectively. So this case is authentic. This is why we opt for action research as a research approach.

By solving a real world problem in the form of an empirical research method. A pre-requisite for action research is having a problem owner who is willing to cooperate and tackle the problem. It is an authentic problem and there are authentic knowledge results for those involved. An additional challenge of this method is the relative unfamiliarity with the method. Within the field of software engineering, this is a more commonly used method, but not always recognized as such. We opt for the method of an action research. The action research [Easterbrook et al., 2008] method was chosen precisely to contribute to Ampersand.

The chosen research method is based on the research results of Easterbrook et al. [2008]. Easterbrook et al. [2008] distinguish between different types of empirical research. The empirical research is always presented from someone his own perspective. The different philosophical points of view determine the view on the research approach. As mentioned, the approach is in the form of a case, in which a confirming case is the starting point. This form is used to test existing theories. The chosen case is a single case. The theory must be shown to hold. The unit of analysis concerns the professions in individual health care. A weakness of this research method is the creation of bias and more open interpretation. To avoid these weaknesses, Easterbrook et al. [2008] recommends using an explicit framework for case selection and collection. Using only one case prevents this from leading to bias. Our philosophical position is based on constructivism. The main concern of this point is to understand how the **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)** transformation can and will be used in a real government organization.

The mentioned unit of analysis, namely the **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)** is the basis of the data collection technique. Because we are talking about an existing law here and there is a lot of knowledge about it within the CIBG organization. The tool to be used is triangulation [Carter et al., 2014; Farquhar et al., 2020; Runeson and Höst, 2008]. Triangulation offers the possibility to view the source from multiple perspectives. The perspective of the law itself. In addition, the engineers have the necessary knowledge and information about the application of the law and from the business perspective. This is a way of assuring the validity of research through the use of a variety of methods to collect data on the same topic, which involves different types of samples as well as methods of data collection<sup>7</sup>.

## 4.3. VALIDATION

From a constructive perspective, the validation of the results is quite complex. The repeatability of the study and obtaining equal results seems impossible according Sandelowski [1993]. Many of the results are based on interpretation of the information, in this case **Wet op de beroepen in de individuele gezondheidszorg (Wet-BIG)**. Triangulation can be used to validate the results. This has also been used to collect results. In addition to supplementing, the information can also be used to check the results among themselves. In addition, it must

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<sup>7</sup>[https://en.wikipedia.org/wiki/Triangulation\\_\(social\\_science\)](https://en.wikipedia.org/wiki/Triangulation_(social_science))

be made clear what bias is involved. Deviations from the expected result must also be made transparent. To prevent my own organization from failing in the process, it is important to properly involve them in the process.

The usefulness of the Ampersand method is determined by two things. On the one hand, it is the method itself that must be understood and used correctly. This point is hedged in RQ1 and RQ2. The validation of these points will emerge during the investigation.

On the other hand, the research relates to the usability of the end product. The CIBG organization will have to determine whether they can continue with the end product. The recognizability and the degree of acceptance determine the usability for the organization. In order to determine this usability for the organization, we will have to regularly discuss the results with the key players during the research.

The identified key players within the CIBG organization are:

- Enterprise architect.
- Tactical triangle with the product owner, advisor information provision and application manager.
- Development team Zorro.

Consultation structure with the enterprise architect has been set up and will take place once every two weeks. This needs to be coordinated with the other groups.

## 5. PLANNING

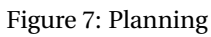
After approving the **SE Graduation assignment preparation (VAF-SE)** the legal analysis phase starts. This identifies the Concepts and Relationships. These are divided into subsystems and recorded in an Ampersand script. A definition of the Concept is stored per Concept and the Purpose of the Concept. A number of Atoms are also devised per concept. The Purpose can be removed directly from the law. The Purpose also mentions the article of law from which the concept originates, so that traceability is guaranteed. For the relationships, concepts are named, indicating the direction of the relationship. With the relation, the Meaning of the relation is also recorded. These concepts and relationships are extracted from the text and only the concepts that we really need. We introduce an agile approach to collecting Concepts, Relationships and Rules. A prototype and functional document is realized in two-week sprints. The information collected is discussed in the scheduled meetings. This information is also input for the other meetings.

See the planning Figure 7 The Concepts, Relations and Rules must be continuously coordinated with the parties involved. During the collection, the report is worked on so that the information collected during the process is a good reflection of the usefulness of Ampersand for analysing legislation and regulations.

### 5.1. RISK ANALYSIS

A short risk analysis

Ampersand wet Big

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