

Fact-Orientation Applied to Develop a Flexible Employment Benefits System

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Abstract. This paper describes FlexBenefits, a commercial software system designed to support flexible employment benefits, and shows how the use of fact-based modeling aided in the development of this system. Flexible employment conditions are labor conditions which can be traded off against each other. They give employees the opportunity to tailor their working conditions to their personal situation. Flexible employment conditions have to comply with four different levels of legislation presently; governmental laws, collective labor agreements, the company policies and the personnel group policies, each of which change constantly in the course of time.

Keywords: Fact Oriented Modeling, Fact Based Modeling, Case Study, Compliance Modeling, Business Rules, Natural Language, NIAM2007, CogNIAM, Doctool, OMG, SBVR, BPMN.

1 Introduction

More and more employers offer their employees the possibility to organize their own employment conditions. They represent a trend towards more individual employment agreements, in response to a more demanding and individualized society.

Flexible employment conditions are labor conditions which can be traded off against each other. They give employees the opportunity to tailor their working conditions to their personal situation.

Flexible employment conditions have a hierarchy of applicable rules; they have to obey governmental laws, collective labor agreements, company policies and personnel group policies, each of which change regularly in the course of time. Therefore, automating flexible employment conditions requires a flexible system.

Using fact-based modeling and its associated principles, a successful flexible benefits system called FlexBenefits was developed for ADP Netherlands.

2 Case Study

2.1 About ADP the Netherlands, Project Initiator of FlexBenefits

ADP Inc is a New York Stock Exchange (NYSE) listed company with a history of more than 55 years, and in 2008 enjoyed approximately US\$ 9 billion in revenues. It

has 45.000 employees and 545.000 organizations as customer. ADP has a presence in over 130 countries worldwide. The business focus of ADP is to provide payroll, benefits and HR products and services to organizations (employers). ADP has a triple A credit rating and has recently started offering treasury services to its customers.

ADP Netherlands (ADP for short) has 550 employees and is a fully owned subsidiary of ADP Inc. ADP is the initiator of the FlexBenefits project. ADP Netherlands has existed for over 40 years, and in 2008 enjoyed approximately € 80 million revenues in 2008. ADP has about 8.000 organizations as customer. In 2008, ADP Netherlands handled the payroll services (and associated payroll slips) for approximately 1,2 million employees monthly, who were employees of these 8.000 organizations. PNA Group has a 15 year history of close working relationship with ADP, and is responsible for co-developing cutting-edge products for ADP, aimed at large scale use as explained above. Starting 2004, ADP and PNA have entered into a strategic partnership, thereby explaining the PNA involvement in building and maintaining some of ADP's mainstream and flagship products.

The product mix of ADP to support the fields of payroll, benefits and HR, consists of in-house developed products under the control of ADP, as well as acquired and customized third-party software solutions (based on SAP, for example).

Development of the native ADP products occurs for a small part within a European setting (together with other European ADP companies, under auspices of the ADP European head office in Paris). However, the largest share of work occurs in-house, together with development partners, such as PNA.

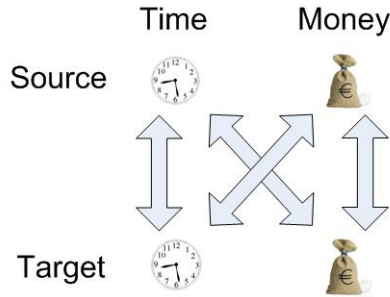
Of the 550 ADP employees in the Netherlands, approximately 100 are involved directly or indirectly with product development. There are approximately 20 business analysts, the rest of the numbers consisting of programmers, testers, documentation makers and project managers. Development occurs within several technical environments such as Delphi, Smalltalk, assembler, Java and .net, resulting in target environments such as mainframe, Windows and internet/browser based.

2.2 The Domain of Employee Benefits: What Does It Entail?

First of all, let's define what Employee Benefits are. Employee benefits are all benefits which an employer offers to its employee ("targets") in return for certain commodities or assets which are of the employee ("sources") [6].

Sources can be seen as assets (or potential assets) over which the employee has control. Examples of accumulated and available sources include salary, the amount of labor hours, vacation days and others. Potential assets include the ability to work longer hours/overtime.

Targets are offered by the employer and can be seen as benefits which the employee can save for, by exchanging them with sources. Examples of targets include additional vacation days, child care facilities, a company bicycle, free beverages and others.



2.3 Applicable Law and Compliance Issues

There are four levels of applicable legislation involved when determining a flexible benefits exchange model:

1. governmental laws; these dictate minimum wage levels, minimum amount of holidays per fulltime employment, allowable tax-deductible benefits (such as a company PC, bike etc), tax-free savings possibilities and sabbatical possibilities.
2. collective labor agreements; these usually focus on the calculation methods for hourly wages, overtime and weekend pay compensation, possible combinations of exchange (for example, if one is saving for a company car then they cannot also save for a company bike).
3. company-wide policies; a company can add its own exchange possibilities, as long as these comply with all the previous (higher) levels of legislation
4. personnel group policies; for example, a company may decide that the personnel group “board members” may use their bonus towards a golf set.

Depending on the legislation involved, a personalized arena for exchanging sources against targets is created.

2.4 Rules Applied to the Exchange of Sources and Targets

There are prerequisites and restrictions coupled to the use of sources and targets for an individual employee.

A prerequisite stipulates that a certain source or target can appear as a usable item in the source / target exchange arena. For example, a prerequisite may state that, to be able to save for the target named “Free beverages for 55+ employees”, an employee needs to be 55 years of age or older. Another example is that to be able to use “Overtime” as a source, an employee must have worked at least 200 hours overtime in the calendar year, otherwise the source cannot be exchanged for a target.

So essentially prerequisites determine whether an item can be entered into the exchange arena, otherwise known as the exchange benefits ‘playing field’.

A restriction stipulates that an allowed source or target, and the exchange thereof, is bound by certain restrictions (or rules). For example, if one is allowed to save for a company bicycle as a target, then the total amount of money to be saved for that bicycle must be between € 500 and € 1000. Referring to the example of the source

“Overtime”, a restriction may also state that overtime hours must be exchanged in certain increments, e.g. “Overtime” may be exchanged in multiples of 8 hours.

Sometimes, prerequisites apply across multiple employees / to a personnel group or company. After every employee has indicated a choice, only then can be determined whether the source or target can and will be offered. An example of this is a group restriction coupled to the target “Child care”, which may stipulate that child care will be offered and arranged for by the employer if and only if at least 30 people commit to have at least 1 of their children use this target facility.

Apart from these previous intricacies, consider that certain targets span over multiple calendar years. In the Netherlands, it was at one stage possible to have a tax-free company PC if this saving was spread over three years in equal amounts.

Adding all this, it becomes obvious that the legally correct administration of all individual employee “playing fields” and associated choices in an efficient and understandable manner, is an absolute necessity to have employers offer employment benefits to its employees in a cost-effective manner. As ADP has thousands of customers, a traditional IT approach with reprogramming due to a change in the “playing field” was not an economical option.

2.5 The Commercial Value of Offering Employee Benefits

Why is there a demand for flexible employee benefits by society? The answer is twofold. [6]

In times of economic growth, and a shortage of employees, it allows the employer to offer employees an attractive and interesting package of benefits (which can constitute both primary and secondary labor conditions). Hereby, employers can differentiate themselves with regards to other employers in their fight for the favors of the employee.

In times of economic decline, it allows employers to either offer employees

- a. more (perceived) value to the employee at equal employer costs, or
- b. equal employee (perceived) value at lower employer costs.

This is largely achieved due to the way that sources are valued and exchanged when traded, namely often at gross (pre-tax) level instead of nett level (post-tax).

Other ways that advantages can be gained by the employee occur if the employer decides to promote certain targeted benefits by adding a multiplication factor, if an employee trades certain assets in return.

For example, if a production company is operating at full capacity during regular working hours, but has orders requiring 110% capacity, they may offer their employees that for every hour of overtime worked, they gain 1,5 hours towards holidays. The result hereof is that production is ramped up within the existing facilities and the company avoids investment in additional production facilities. The employee gains a better ‘return’ on this overtime because he gets 1,5 times his hours back in holidays, and the employer gains a higher production quota and sales. Both parties benefit.

To illustrate the financial/tax aspect involved, lets say an employee has gained the right to a € 1000 bonus (source) from his employer. Normally, if this bonus was processed regularly via payroll and taxed at the 52% income tariff (the top income

tariff in the Netherlands), this would result in a net payout of € 480 to the employee. With this money, he could (for example) privately go and buy a € 480 bicycle.

Assuming a valid and accepted employee benefits system which contains the mentioned sources and targets, the employee could also use the € 1000 bonus as a source, and use it towards the “Company bicycle” target. The company would effectively spend the bonus of € 1000 on a bicycle on behalf of the employee, and give the bicycle to the employee. The employee thus gains the spoils of a € 1000 bike, instead of a € 480 bike, yet in both cases the ‘cost’ to the employee is the same € 1000 company bonus. Additionally, by working with large numbers, employers usually obtain better prices on targets. For example, the bicycle, which the company paid € 1000 for, may normally have a € 1100 retail price.

So as a result of a flexible benefits arrangement, the effective value for the employee of his € 1000 bonus towards a bicycle has increased from € 480 in a regular payroll processing and taxing situation, to € 1100 in his flexible benefits package.

Flexible employee benefits fit into the trend of modern society towards individual arrangements with regards to employee benefits, because it allows each employee to make and record his own choices from within the allowed ‘playing field’ for his personnel group. Apart from the plain desire or usefulness in offering flexible benefits, many collective labor agreements already stipulate that individual employees have a right to participate in a flexible employment benefits system.

Because each employee can usually trade one or more sources against one or more targets, whereby the amount of money and/or time traded in each combination can usually be determined by the employee, this already requires quite an extensive administration. Add to this the fact that there are different rules applying to different combinations, as well as the fact that certain combinations executed prohibit others, and you can imagine that an impressive system is needed to efficiently and effectively handle all these rules, which are essentially business rules.

3 Requirements Placed on the Project

High demands were placed by ADP on the FlexBenefits product, which was to be developed in-house by PNA, under the control of ADP. To give an impression of the difficulty level of the project (and consequently the analysis and development method to be used for successfully completing this complex project) the main requirements are listed here:

1. The product would have to be complete and flexible; changes in government or collective labor agreements should not require any re-programming. In this aspect, FlexBenefits had to be completely future-proof. All possible future restrictions and prerequisites, as well as how these could be applied, had to be covered by the product. This implies that FlexBenefits would be a generic product, working in a rule-based fashion.
2. The user interface for entering the company and personnel group policies was to be constructed in such a way, that employers could enter these policies themselves, independent of the IT-department. This implies a domain or target-group specific graphical user interface.

3. FlexBenefits would have to be a single product, that would work in combination with several of ADP's Personnel Information Management (PIM) products. PIMs are an essential part of flexible benefits, because they contain the relevant employee information (such as wages, amount of holidays, overtime worked, birth-date/age) used for exchanging flexible benefits. PIMs are also used, after the exchange of sources and targets, to record the final employee choices. The "single benefits product – multiple PIM bases" requirement implies technical flexibility in exchanging information with other products.
4. When entering policies, it should not be possible to overrule a higher level of legislation. For example, if national law dictates that a fulltime employee must receive at least 20 days of holiday leave, then downstream (e.g. personnel group) policy levels needed to comply with these. This implies that FlexBenefits should have built-in compliance.
5. The employee should be able to have a clear view of the sources and targets available, and the (financial) impact of exchanging one against another. When the employees would be making their choice, illegal choices should be made impossible by the product. Also, it should be clear to the employee which rules are applicable in a given situation, and if a certain action is not possible, what the reason was for this – in a language the employee could understand. This implied understandability, transparency and clarity.

4 The Use of Fact-Based Modeling in the Project

4.1 Introduction to NIAM2007, the Fact Based Modeling Approach Used

NIAM2007, which is known in Dutch as "Kenniskunde" [5] is a fact-orientation conceptual modeling method with a strong pedigree in business application. NIAM2007 is a successor of NIAM [8] and the predecessor of CogNIAM.

NIAM2007 was the formal internal standard for information analysis at ADP, at the time of the FlexBenefits project. In the second half of 2009, the internal information analysis standard within ADP was upgraded to CogNIAM. The major difference with NIAM2007 is that CogNIAM expands this approach with the integral use of OMG's BPMN for process modeling aspects and output in OMG's SBVR [7] structured language, amongst others. These additional features were therefore not utilized in the FlexBenefits project.

4.2 Philosophy of NIAM2007 Applied to the Project and in Communication with the Stakeholders

The use of the fact oriented approach using NIAM2007 resulted in the following:

- A. The use of concept definitions. Within ADP (as in other larger organizations), and to design a successful product that would fulfill the wishes of the stakeholders, it was essential that the internal disciplines (marketing, sales, development, customer service, management) would work together effectively and efficiently. Within NIAM2007, there are extensive procedures on how to

define concepts and generate a concept tree in order of knowledge acquisition. This means that each new concept is defined using already defined concepts. Although the accurate definition of the concepts took quite some time in the beginning of the project, this was not minded by the stakeholders since they could see that clarity on this point was essential before the project started. For example, it took some time before the basic concept of “client” was clearly defined, because of different opinions between marketing and IT on what it entailed. For IT, each company (be it within a group) had a unique identifier, while to marketing, a group of related companies was ‘one account’. **The use of clear, natural language concept definitions greatly aided all stakeholders involved in the project in communicating effectively; misunderstanding and ambiguity was avoided. [1, 2, 3, 4]**

- B. The use of concrete examples. While many domain experts and other people involved in development projects like to discuss things on a general level, it was the systematic use of concrete examples that caused the requirements to become unambiguous and accurate. By using practical cases described in natural language and posing questions formulated in natural language, interaction between domain experts of collective labor agreements (for example) on the one hand and the business analysts on the other hand, was effective and clarifying. Also, to discover and clarify the applicable rules, concrete examples were drawn up and the domain experts were asked if they were allowed, and if not, why they would not be allowed. This way, an accurate and validated model of the flexible benefits arena was built up.
- C. The use of verbalization/sentence patterns for the application screens and the associated graphical representation. By providing verbalizations with every application screen, all stakeholders could follow the information being depicted. In the help file, the concept definitions associated with the variable fields in the screen were explained.
- D. Integrated use of the same concrete examples as cases, in all aspects of the development process, such as prototyping screenshots, legislation examples, documentation. For the illustrative examples to be used, several fictional “characters” and their associated employee benefit wishes were created. For example: Jan Smit, 37 years of age, who works 32 hours per week at HollandMetal, which falls under the collective labor agreement for metal working employees. Jan wants to use his flexible benefits possibilities to maximize his leave, and is willing to sacrifice his profit sharing bonus and part of his monthly salary to achieve this.
- E. The mapping and consequent use of domain-specific jargon. It is the philosophy of NIAM2007 (already introduced in the seventies [8]) that one should speak the jargon of the ‘client’, so the jargon of the benefits and payroll world was mapped to synonyms to the world which was known by all participants of the project. Extending this towards the graphical arena, it was decided that the application screens (which would allow the client’s payroll expert to enter company or personnel group regulations) would have two forms of native jargon support. On the one hand, a sentence pattern which verbalizes the concrete rule/legislation as it is being created, and on the other hand a graphical representation depicting the

impact and associated restrictions of the rule/legislation as it is being created. Examples are shown in the next section.

- F. Reduced (perceived) complexity, by using all the above to structure legislation. Quite often, when reading through the specifications which included concept definitions, sentence patterns, examples and other aspects, comments were made by the domain experts saying that “by doing it this way, you make it seem so easy”.

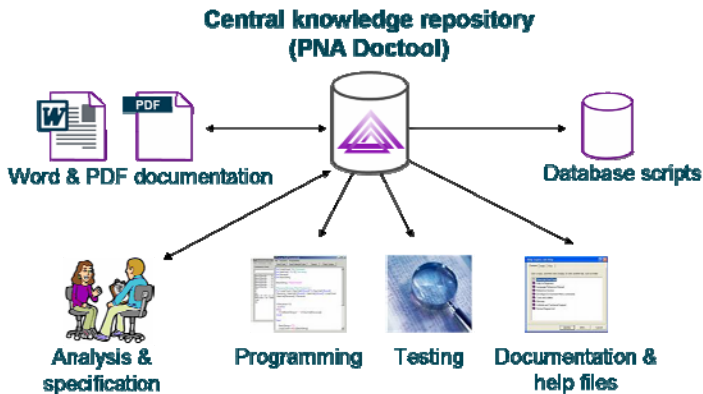
4.3 The Use of a Central Knowledge Repository for Consistency

When developing FlexBenefits, the four phases of software development (information analysis, programming, testing, and documentation) were all addressed and supported from one central knowledge repository, in this case PNA’s Doctool.

This repository contained all the NIAM2007/fact orientation ‘artifacts’ which captured the analysis and design of the FlexBenefits application. By the fact orientation artifacts, we mean [2,3]

1. the structured concept definitions,
2. fact types,
3. sentence patterns (fact type readings),
4. constraints,
5. derivation rules,
6. exchange rules and events.

Additionally, the repository also contained elements which helped support the technical realization of the product. These included source documentation (e.g. relevant legislation, collective labor agreements) and how they were linked to the analysis, concept screen shots which appeared in various functional documents, and automatic generation of database scripts, amongst others.



4.4 Statistics of the Project

The main statistics of the FlexBenefits analysis performed and registered in PNA’s Doctool repository are as follows:

Fact orientation artifact (NIAM2007)	Amount
Concept definitions (structure)	1260
Fact Type Diagrams	125
Placeholders (roles)	1410
Sentence patterns	327
Constraints	704
Derivation rules	20

Due to confidentiality and ownership agreements, the authors are not in a position to disclose the underlying fact-oriented model.

5 Examples of the Finished Product: FlexBenefits

5.1 Figure 1: The Main Screen for the Employee

Source "Monthly salary"

Employee information

FlexBenefits - Keuzepakket samenstellen

Keuzepakket: **kladit**

Status: **kladit**

Periode: 01-07-2009 t/m 31-12-2009

U wilt de bron Bruto Salaris gaan inzetten voor het doel Extra verlofuren. Een inzet van 2,93 €/Mnd komt hierbij overeen met een opbouw van 1 Uur/Jr.

Naam: Persoon 32509

Adres: Ergens-in-straat 310

Persoonsnummer: 32509

Klantnaam: Klant XXX

Uren per week: 40,00

Prijs van een uur: €16,96

Sluiten Openen Opslaan Verwijderen Ongedaan maken Valideren Bruto-netto Indienen Afrukvoorbeeld Afrukken

Bronnen

Bruto salaris €339,86

2.828,79€

137,00

€113,07

Employee exchanges €113,07 salary per month towards the additional leave

Employee has saved the maximum allowed additional leave (40 hours/year)

Doelen

Bedrijfsfitness 50

Extra verlofuren 40

Leverloos 4.593,84

Roos

FlexBenefits - Detailsgegevens voor Doel Extra verlofuren

Transacties Restricties Eigenschappen

Hier is te zien welke beperkingen er gelden met betrekking tot het doel Extra verlofuren.

Bij sparen voor het doel Extra verlofuren geldt een maximum van 40,00 uur/jr.

Verbalization of the restriction: "Saving for additional leave cannot exceed 40 hours/year."

Sluiten Help

Target "additional leave"

Restriction is currently being obeyed (green light)

Figure 1 shows an individual employee’s personal flexible benefits ‘playing field’, in this case consisting of only one source (Monthly Salary) and six different targets to choose from. By selecting a source and a target, sliders appear. By dragging either the source or target slider, both adjust while the associated benefits are exchanged and instantly valued and calculated. By pressing the blue information button, verbalization of the restriction(s) coupled to the source or target is displayed, as well as a visual (traffic light) indication of whether the restriction is being obeyed. In a transient/intermediate state, it may be that a restriction is not yet being obeyed, resulting in a red traffic light.

5.2 Employer Screen, Adding a Restriction

Unit and frequency of the source (€/month)

Minimum amount to be used is fixed (€500,00)

Graphical depiction of the restrictions on the source "Monthly salary"

Maximum amount to be used is calculated by the function "Determine parttime salary"

Verbalization of restrictions: "When using the source 'Monthly salary' a minimum of €500,00/month and a maximum determined by the function 'Determine parttime salary' applies."

When adding a restriction (in this example a minimum and maximum constraint, for the source Monthly salary), the domain expert entering the restriction is guided through a wizard, whereby on the left side, the restriction choices and associated

variables are entered, while on the right side the restriction is depicted both graphically as well as verbalized.

The choices to be made for minimum and maximum restriction amounts are: ‘not applicable’, ‘fixed amount’ and ‘to be determined via a Function’. This last option shows the flexibility of FlexBenefits; a function can take any employee data that is stored in the PIM as input, and have it be manipulated via the generic function editor, to achieve a personalized applicable value for the employee in question.

6 Conclusions and Recommendations

Fact oriented modeling enables analysts to precisely and understandably model a knowledge or business domain [1]. From a business perspective, many problems are branded as “IT” problems but really boil down to communication problems [2]. Or rather, the problem that the information and knowledge cannot be effectively captured and accurately shared between all stakeholders or the people involved in projects.

Traditional IT methods like UML fail to effectively use natural language and the semantics associated with a business domain in a structured and accurate way and fail to reach complete and unambiguous stakeholder comprehension of the analysis.

By using fact orientation and applying its associated principles, large productivity and speed of development gains were made in the FlexBenefits project. The use of concrete examples, concept definitions, natural language, and jargon of the business were instrumental in clarifying and specifying the business requirements. This also avoided placing a burden on the stakeholders to learn a foreign “IT” language.

By storing the requirements in a central fact oriented repository, different output documents for the different participants were generated, thereby always up to date and consistent. The maintainability of the knowledge stored in the repository is also optimal. By using fact orientation as well as the central repository, it was clear beforehand what the impact of proposed changes would be.

The FlexBenefits project was very successful from a business point of view. This can be attributed for a decisive part to the use of fact oriented modeling throughout the project. We therefore recommend the widespread adoption and use of fact orientation in business (and IT) settings, for achieving maximum understanding and maintainability of knowledge domains and their associated software applications.

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