# Todo list



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**Bachelor's Thesis**

# Student Consulting Organizations

## A Domain Ontology

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## Abstract

This work develops a domain ontology for SCOs. The model declares the domain knowledge and defines its vocabulary. It contains the information necessary to establish or run such an organization in a university context. Additionally it allows for optimization in existing organizations and contributes to cooperation between SCOs by organizing the existing knowledge. It maximizes the use of vocabularies, relations, and classes from established ontologies like Friend of a Friend (FOAF), Financial Industry Business Ontology (FIBO), General Formal Ontology (GFO), and GIST (GIST) to link the domain knowledge into a bigger context. The main resource of the developed ontology are SCOs from Germany, but the concepts can be transferred and made applicable in a wider area.

## Formatting

- Hyperlinks are embedded and clickable in the PDF. They are marked with an arrow and a light blue border: ↪Hyperlink
- Everything related to the ontology implementation, such as references to classes or relations, is written as `typewriter text`.
- Relations are written in camelCase: `subclassOf`
- Classes are bold, capitalized, and use Snake_Case: **`Human_Being`**

## Glossary

**BDSU** Bundesverband Deutscher Studentischer Unternehmensberatungen. 1

**CI** Campus Inform. 7

**DCMT** Dublin Core Metadata Terms. 10

**DOAP** Description of a Project. 10

**FIBO** Financial Industry Business Ontology. i, 11

**FOAF** Friend of a Friend. i, 10

**GFO** General Formal Ontology. i, 7

**GIST** GIST. i

**HC** Hanseatic Consulting. 1, 7

**JCNetwork** Junior Consultant Network. 1

**Schema** Schema.org Ontology. 8, 10

**SCO** Student Consulting Organization. 1, i, 1, 2, 3, 4, 5, 6, 7, 8, 10, 11, 12, 13, 14, 16, 17

Disable numbers, disable red links

# Contents

# 1 Introduction

## 1.1 Motivation

SCO are student-run consulting businesses, that focus on teaching their members essentials business and life skills exceeding the theoretical knowledge from university. They are very similar to small to medium consulting businesses, but are run and organized – most of the time exclusively – by students. Germany has two different umbrella organizations for SCOs[1] with more than 60 member organizations.

But as far as we know, there hasn't yet been any effort to collect and compose the existing domain knowledge in a publicly available and usable form. We consider this a very important task however, since it is a contribution to prevent knowledge loss that is inherent in the dynamics of SCOs: the majority of the staff are students and thus their consulting career is inherently linked to their university career:

1. The career is time-bound to the duration of the education. A bachelor's degree in Germany averages 7,5-7,6 semesters and a master's degree 4,2-4,5 semesters, which adds up to a total of 11,7-12,1 semesters or ca. six years.[3] This frames the available time for the transfer of the domain knowledge.[2]
2. The career is in parallel to the curriculum. From our experience, freshmen that decide to join student organizations typically do so at the beginning of their second or third semester, after they got acclimated with the workload of their university classes. Since students usually participate in parallel to their education – and the focus is typically on the education –, they have to manage their time accordingly, which reduce time spent with the SCO. Furthermore, students may have other (e. g. personal) interests that compete with the same time budget.

The reasons above reduce the available time for knowledge transfer and persistence and make these problems harder. Many SCOs have worked on and developed solutions to help with this problem. Some of them are informal, some formal in nature. For example: One particular organization, ↪Hanseatic Consulting (HC), used process methodology to document a lot of their knowledge.

However, the majority of available domain documents are highly individualized and miss the necessary level of abstraction to make them directly applicable to other SCOs. But even though every SCO is organized slightly differently than the next, uses different

[1] ↪Bundesverband Deutscher Studentischer Unternehmensberatungen (BDSU), ↪Junior Consultant Network (JCNetwork)

[2] There sometimes are also PhD students, but they can be considered outliers and are atypical.

vocabulary and each has their individual culture, they all share the idea of teaching consulting and project work to their members. Since they aim for the same goal, they are very similar at their core.

Therefore we try to contribute a more general model in the form of an ontology that tries to combine the domain knowledge, vocabulary, and common concepts.

## 1.2 Goal and Scope of the Work

The goal of this work is the description of an abstract SCO. It aims to extract the available implicit expert knowledge and transform it into explicit knowledge by using an ontology as its vehicle. This ontology defines common classes, roles, functions, and processes within such an organization. It uses the vocabulary of the domain and specifies it where necessary. Additionally it provides terminology and background knowledge of the domain where it is sensible.

## 1.3 Deliverables

The output of this work are two documents:

- This thesis as a documentation and explanation of the ontology development process including but not limited to: methodology, background information, decisions in regards to the ontology, etc.
- The ontology document as a representation of the domain knowledge.

## 1.4 Out of Scope

This work is not a thesaurus and not a documentation about a specific Student Consulting Organization.

The ontology will not include the individual project process, since projects differ vastly between each other and more general ontologies and frameworks for projects already exists.

Diagram of org/individual process

## 1.5 Outlook

The main motivation of this work is documenting the domain knowledge and making it available to interested parties, such as the umbrella organizations, SCOs, or students. Furthermore: Creating a computer-readable ontology with this goal in mind can help advance the idea of SCOs, for example by enabling software projects.

One particular use case in the intersection between knowledge management and software projects, is the creation of a tool that helps with founding new SCOs at universities where no SCO currently exists. Creating an organization without guidance is a daunting task; having a repository available, that structures and describes the elemental components of such an organization, can be a great help.

# 2 Ontologies

This section gives a short overview about ontologies and develops the argument, why an ontology is useful in the given context.

- Open World and Unique Name assumption und Bedeutung für die Ontologie: jede SCO legt Schwerpunkte anders UND jede Beratung hat dieselben Funktionen, aber andere Namen dafür - Auswahl der Top-Level-Ontologie und der Upper-Domain-Ontologie Auswahlkriterien

Ontologies as Domain Models: Reason for using an ontology in the given context wiki: "Ensuring the ontology is current with domain knowledge and term use"

## 2.1 Definition: Ontology

Philosophic discussion about the best way to achieve things Why ontologies are useful – especially in a SCO env: high fluctuation, ontologies can pin knowledge

Ontologies are a way of organizing knowledge. They make it possible to structure a domain in a way, that it can be used in a technical project

"In computer science, an ontology is a conceptual model specified using some ontology language; this idea was succinctly captured by Gruber in his definition of an ontology as "an explicit specification of a conceptual- isation"[2]

## 2.2 Types of Ontologies

### 2.2.1 Upper Ontology

(GFO)

### 2.2.2 Domain Ontology

### 2.2.3 Content Ontology

`http://ontologydesignpatterns.org/wiki/Category:ContentOP`

## 2.3 Ontology Representation

Model-theoretical Languages, Graph-Based Systems, Frame-Based Systems, Hybrid Systems (see GFO document)

Format: `http://www.ksl.stanford.edu/knowledge-sharing/kif/`

An ontology allows the domain knowledge to grow and to be flexible. As already stated above, the core concepts of different SCOs are very similar. However, different SCOs may use different vocabulary to describe the same thing, object or process. This creates a requirement for a knowledge system: it has to be extensible and mutable.

-> OWL

# 3 Student Consulting Organizations: Meta Discussion

## 3.1 Methodology for the Development of the Ontology

The primary goal of this work is the creation of a particular domain ontology. To achieve this goal, we use the methodology that is proposed in the documentation of the ontology editor ↪***Protégé*** – built and maintained by ontology researchers of ***Stanford University*** – as a starting point.[7]

It involves the following steps:

(1) Determine the domain and scope of the ontology,
(2) consider reusing existing ontologies,
(3) enumerate important terms in the ontology,
(4) define the classes and the class hierarchy,
(5) define the properties of classes-slots,
(6) define the facets of the slots, and
(7) create instances.[8]

Steps 1 and 2 are performed during the ***Research Phase***. Steps 3 to 6 during the ***Analysis and Synthesis Phase***. Both are discussed in more detail below. Step 7 is omitted.

explain

### 3.1.1 Research Phase

To determine the domain and scope of the ontology (1) the methodology suggests starting with answering the ontologies ***Competency Questions***.[8, Section 3, Step 1]. Naturally, related work and existing ideas (2) should always be considered before creating something new.

To find a starting point for data collection and identify existing ontologies, we take an intuitive first look at SCOs and their driving factor:

**The Idea of Student Consulting Organizations**
Selecting a career is a very difficult and important choice in a young persons life. University education is closely linked to this choice and entering a specific field often requires a specific degree (e. g. to become a lawyer, a student has to pass the bar exam).

Most universities know this and have set up dedicated offices to offer career advice

to their students. They not only help picking a fitting course of studies at the beginning of a university career, but also help the students to aim for a fitting job.

Doing an internship with a company working in the field the student is interested in, is a widespread recommendation. It allows for a glimpse into the profession as well as gathering work experience.

SCOs offer another option to further investigate a career in business consulting, as well as learning the associated skills. They offer the students a way to learn about concept like project based work – the modus operandi of consulting companies –, e. g. project planning and management, as well as structuring and presentation of information.

SCOs are connected to other knowledge domains in various ways: They are a type of organization and thus are driven by people and processes. They do consulting work, which is project based.

The main goal is a correct and robust representation of the domain as an ontology. This defines the starting point for the scope of the research:

- Theory of description logic and ontologies, e. g. modeling of roles and processes.
- Previously developed ontologies in related domains, e. g. consulting, project management, educational organizations.
- General ontologies, e. g. GFO, ***gist***.
- Available domain knowledge, e. g. process documentation of HC and Campus Inform (CI).[1]
- Personal expert domain knowledge and peer-review by other SCO members.

Since the ***Competency Questions*** can be considered part of the ontology, the answers to these questions can be found in section 4.1.

### 3.1.2 Analysis and Synthesis Phase

It requires proper organization and interpretation of the collected data and/or information and converting it to knowledge.

This makes it possible to create a loose word cloud as a starting point for the class hierarchy. This word cloud is supplemented by expert knowledge. During this processes the available implicit (or tacit) knowledge is converted into explicit knowledge.

First draft word cloud in den Anhang

The second step is the organization and structuring of the word cloud by transferring the information into the target format OWL. This creates a skeleton class hierarchy containing high-level classes and trivial sub-classes (e. g. high-level class **Process** and all the identified processes as trivial sub-classes).

[1] Two SCOs the author has worked with the longest.

Since this ontology is a development from scratch, an iterative approach for its development is selected. The steps are as follows:

The third, most important and iterative/looping step is the refinement of this document. During this phase all classes are developed and documented. This includes discussion of related work and linking the classes into available ontologies. Relations between the classes are added and verified for logical correctness.

Minimal conceptual modeling opm principle (Model-based system engineering, page 77): minimal methodolgy is best

The second step is the analysis of this information. And the third step is the synthesis of the knowledge into the deliverables: this thesis and the ontology as OWL file.

## 3.2 Related Work

Ontologies are knowledge representers SCO have overlap in two directions: project management and consulting PM is a very wide topic that basically has unlimited amount of detail -> needs abstraction Part of PM are in itself complex topics: time, problem analysis, ...

## 3.3 Classification of the Ontology

vocab vs ontology

dcterms[2]

### 3.3.1 Relevant Top-Level-Ontologies

- BFO - DOLCE - GFO - GIST

GFO: process, roles and time

### 3.3.2 Relevant Upper-Domain-Ontologies

- OWL-S - SUMO

FIBO FOAF is close to schema, link to dublin core: ”dct:Agent Dublin Core’s notion of Agent is much like FOAF’s; Dublin Core says ”A resource that acts or has the power to act.”, we say ”things that do stuff”. As nobody has provided a counter-example of something fitting one definition but not the other, we say here that foaf:Agent stands in an ’equivalent class’ relationship to dct:Agent (and vice-versa).”[4, External Vocabulary References] DOAP Schema.org Ontology (Schema): not really ideal, but useful for general concepts like Person or Organization

[2] `dcterms` is used in the ***FOAF*** rdf file, `dct` is used in the ***FOAF*** documentation.

## 3.4 General Aspects of Ontology Development

### 3.4.1 Keeping Things Simple

Polysemy Paper[1]

keep it as simple as possible (e. g. *contract* and *contract document* can be considered two distinct things, but this distinction is not important for the domain knowledge – maybe add a relation "has document"?)

Example: A contract is a document that captures a business agreement. The word "contract" can refer to the immaterial agreement between the parties, but it can also refer to the document itself. Depending on the use case of the ontology it might be useful to separate these two things.

However, in this ontology the goal is to keep it a simple as possible, since the potential users of this ontology are not necessarily experts.

### 3.4.2 Content Completeness Problem

`https://en.wikipedia.org/wiki/Content_completeness_problem` As is true for any domain ontology[**NEEDED**], the content completeness problem exists for this ontology as well.

### 3.4.3 Time

Implement time abstract -> only needed for processes before/after no absolute time

## 3.5 Domain Specific Aspects of Ontology Development

- Taxonomy Tree
- Shared vocabulary vs Domain specific vocabulary (DOAP Description of a Project (https://github.com/ewilderj/doap/wiki))

### 3.5.1 Human Beings, their Aggregation, and Contract Eligibility

The ontology is describing a social construct. The whole domain is driven by processes that involve people. This requires an adequate class representation of human individuals and their aggregation. Furthermore aggregation can occur in different degrees of formalization, e. g. informal meeting of SCO members vs. official meeting of the member council. This, in turn, is relevant for the domain model, since formal councils often have certain powers attached to them (e. g. appointing the corporate officers). Since this is not a domain specific phenomenon, it is sensible to use this observation and consider how existing and related ontologies (3.2) represent these cases.

#### Persons, Groups, and Organizations

The first thing to consider, is the modeling of human beings and their grouping. FOAF offers a very basic solution and description: The anchor of its model is the top-level class `foaf:Agent`[3], which is referred to as the class of "things that do stuff". It is connected to the name space of the Dublin Core Metadata Terms (DCMT) via `equivalentTo dcterms:Agent`. It is sub-classed by `foaf:Group`[4], `foaf:Organization`[5], `foaf:Person`[6], `Person`, and `schema:Person`. `foaf:Person` and `foaf:Organization` are disjoint. `Person` and `schema:Person` are `equivalentTo` `foaf:Person`.[7] `foaf:Group` aggregates any type of `foaf:Agent`.

Description of a Project (DOAP) reuses exactly the same classes as FOAF.

Schema models its own `schema:Person`[8] and `schema:Organization`[9]. `schema:Person` is considered `equivalentTo` `foaf:Person`. This establishes a two-way link between FOAF and Schema. `schema:Organization` is sub-classed to accommodate for specialized forms of organizations that are relevant for the use cases schema was developed for, e. g. `schema:Airline`, `schema:Corporation`. A collection class like `foaf:Group` does not exists explicitly, but a `schema:Person` or `schema:Organization` can be a `memberOf` an `Organization`.

Similarly or identically named classes with a more complex description can be found

[3] `foaf:Agent, rdfs:comment: "An agent (eg. person, group, software or physical artifact)."`
[4] `foaf:Group, rdfs:comment: "A class of agents."`
[5] `foaof:Organization, rdfs:comment: "An organization."`
[6] `foaof:Person, rdfs:comment: "A person."`
[7] The link to Schema was added in the last update in 2014.
[8] `schema:Person, rdfs:comment "A person (alive, dead, undead, or fictional)."`
[9] `schema:Organization, rdfs:comment: "An organization such as a school, NGO, corporation, club, etc. "`

in FIBO: The root class is called `AutonomousAgent`[10]. Sub-classed by `Person`[11], which represents individual humans. Like in ***FOAF***, this class is disjoint with `Organization`[12]. `Group`[13] exists as a sub-class of `Collection`[14] and is described as collection of `Autonomous Agents`.

FIBO also adds attributes to the defined classes, e. g. a `Person hasDateOfBirth exactly 1 Date`. Attributes like this are very useful for a very detailed model of a domain, but are out of scope for this work.

Check if the scope has to be adjusted accordingly

As shown above, there are two ways to model human beings and their collection: with a relation

This ontology will model the classes `Person`, `Organization`, and `Group` and link them into the name space of the related ontologies.

Link in the owl file schema:Person, etc.

### Members and Non-Members

Another aspect specific to this domain ontology is the grouping of human beings into members of the SCO and non-members. This is especially relevant, since there are typically powers attached to the member status. These powers can range from being allowed to vote in the membership council

Often times they are even a registered association and require a *formal* membership to participate.

Thus, a distinction can be made between members and non-members.

### Degree of Formalization: Natural and Legal Persons

SCOs themselves are an aggregation of individuals working towards a common goal. Their clients can be businesses – which, by German law, are represented by individuals –, but also individuals.

Next to the basic discussion of representing human beings and their aggregation, there exists the legal aspect of contract eligibility. In the German jurisdiction for example, any natural person at or above the age of 18 has contractual freedom. Additionally there

[10] `fibo-fnd-aap-agt:AutonomousAgent, skos:definition: "An agent is an autonomous individual that can adapt to and interact with its environment."`
[11] `fibo-fnd-aap-ppl:Person, skos:definition: "a person; any member of the species homo sapiens"`
[12] `fibo-fnd-org-org:Organization, skos:definition: "a unique framework of authority within which a person or persons act, or are designated to act, towards some purpose, such as to meet a need or pursue collective goals on a continuing basis"`
[13] `fibo-fnd-org-fm:Group, skos:definition: "a collection of autonomous entities"`
[14] `fibo-fnd-arr-arr:Collection, skos:definition: "a grouping of some variable number of things (may be zero) that have some shared significance"`

exists the concept of the legal person that is created to allow organizations to enter contracts in a similar way as a natural person.

### 3.5.2 Organizational vs Project Context

The project context can be considered dynamic and the organizational context static.

### 3.5.3 Ranks and Roles

Ranks as Social Roles[6, p. 67]

As already shown by *Loebe* [5, p. 130], the concepts and ideas about roles have been heavily discussed in the ontology community and literature. Since SCOs are a social construct and are defined by the people of the organization, roles also are instrumental to this ontology. It is therefore important to clearly define the term *roles* and explain its use:

In this ontology, there are two types of classes where the thought of a role arises. The first are the organizational ranks that are similar to career titles. A person receives the lowest available rank at the begin of their career with the SCO. During the time with the organization a person is awarded higher ranks based on some organizational system (e. g. a merit-based system).

The second is with organizational functions. An example for this is the CEO of the organization. A CEO has defined responsibilities and has to fulfill certain tasks. With SCOs typically any member can become CEO by being elected. The elected member still retains the aforementioned rank.

is that a thing?!

A person (is a)/(has role?) Consultant? A person (is a) Project Lead

On the other hand there are roles people take on within the organization. For SCOs these roles can be divided into two distinct groups based on their context: project roles and organizational roles.

For example, a **Consultant** (rank within the organization) can work as a **Project Member** (role in the project), while being the CEO (role in the organization) of the organization.

> **Note:** The model says nothing about social status and political power that typically come with ranks and roles within an organization (e. g. a person that holds a rank or role for a long time may still have organizational power after stepping down: ↪Éminence grise).

### 3.5.4 Processes

- processes: process ontologies and modeling/process specific languages (PSL): OPM (ISO 19450), Workflow Management Coalition

Aussage:

1. Warum überhaupt Prozesse?
2. Prozess-Denken und Ontologien können voneinander profitieren
3. Welche Prozsse gibt es
4. Es gibt zwei Kernprozesse
5. Die Kernprozesse laufen auf versch Ebenen ab (Org/Individuell)

Organizations are entities that have a particular purpose.

Looking at an organization from a process perspective reveals all the necessary steps to achieve its goal.

It allows to create a visual representation of all workflows that make up the organization (↪Flowchart)

If the processes are combined with goals and measurements, they can be a powerful tool for optimization.

This is particularly useful while developing an ontology, since creating and writing down processes require a similar thought process.

This means that process documentation is a very good source for ontology engineers.

The general idea of SCOs involves finding students that are interested in the student consulting idea and want to work with the SCO. After joining, the new members receive training by the organization. Furthermore they have the opportunity to professionalize their skills by working on consulting projects for external clients.

Therefore, looking at SCOs from a process perspective, they can be boiled down to two core processes: 1. The *Human Resource Process* (*HRP*) and 2. the *Project Process* (*PP*).

These two processes are interlinked with each other. The *HRP* focuses on the recruitment and training of interested students that can and want to use the opportunities the organization provides. The *PP* documents the way the organization handles all projects from start to finish.

Each of the processes have two important and distinct aspects. On the one hand, they can be viewed as an individual instance for one of the main protagonists of the process. On the other, they can viewed as the process of the organization. Example:

- The main protagonist of the HRP is one individual student. This individual student is following one instance of the HRP; this instance does not have to be identical with the instance of a second individual student, nor with the planned process of the organization. Both individuals might do different educational courses, hold different business ranks within the organization, or might be at different points in time of their career.
- The SCO itself has a HRP. It structures important aspects of the organization such as the career path. It describes the complete path from recruitment of a new member to offboarding at the end of the membership. Most importantly this process describes the plan on an abstract level and knowingly omits parts of the real world process that are not important to the organization.

This distinction holds for the HRP as well as the PP.

Additionally they have various amount of support processes that help facilitate the two core processes.

- Prozesse sind eine Beschreibung von Schritten - Prozesse laufen nicht sequentiell - Prozesse werden unterteilt in ProzessParts

Looking at the smallest unit of a process

### 3.5.5 Legal Requirements in the Processes

SCOs are organizations in the social context; German law applies to them, like it applies to every other German organization. It influences their structure and processes. However, discussing the impact of the law onto internal workings of an organizations would go far out of scope of this work. Therefore the ontology omits a detailed description of the legal obligations, but references them abstractly where it is necessary.

For example: Germany law requires every company to pay taxes on their earnings. Depending on the SCO and the way projects are handled, this influences the process that is concerned with taxation. To develop a perfectly correct model, a very detailed discussion of specific processes would be required; this is out of scope. However, interacting with the tax authorities and learning about and filing the correct paper work is an important part of the learning experience for student consultants. It is therefore important for the ontology. To address this fact, but keep the ontology focused, it is condensed into the class *Project Taxation Process* as part of the *Project Process*.

### 3.5.6 Consulting Topics

The main goal of consulting companies is in their name: consulting. They are a source of expertise and knowledge and can be employed as an option to solve a difficult problem

at hand. The problem space of consulting companies is vast; examples are: Digitization, Human Resources, Knowledge Management, Market Research, Marketing, Coporate Strategy, etc. These topics are obviously part of the consulting domain. However, they are deliberately omitted, since their exploration would exceed the scope of the work.

### 3.5.7 IT and Communication Systems

IT systems are an essential part of modern business and there are companies where these systems are integral to everything (e. g. AI companies). However, in the context of a consulting company they are mainly used to support, supplement, and optimize the already existing processes. Hence, a model of an IT system would not contribute in a meaningful way to the ontology.

# 4 Student Consulting Organizations: The Ontology

## 4.1 Competency Questions

### 4.1.1 What is the domain that the ontology will cover?

SCOs are a form of consulting firms. They can be compared to small consulting businesses, but are staffed – most of the time exclusively – by students. In other countries, e. g. in France and Brazil, they are also referred to as *Junior Enterprises* (JE). In Germany they are usually a registered association (German: *Verein*) and/or a group associated with a specific university (German: *Hochschulgruppe*). They aim to teach students about consulting as a profession by providing a platform that educates and trains students in the craft and provides them with the organizational means to work on consulting projects.

The domain is a specialization of the a classical consulting firm. It differs especially in terms of professionalization, since companies are focused on profit using education as the means, whereas SCOs focus on the educational aspect and on providing experience, while having profit as secondary goal.

### 4.1.2 For what we are going to use the ontology?

This ontology is a contribution to the knowledge management of SCOs. It can be used to learn or teach about the domain. It can also be used as a starting point for projects that require a model of the domain.

### 4.1.3 For what types of questions the information in the ontology should provide answers?

The ontology serves as an abstract description of the SCO domain. It defines all objects and processes that are necessarily and typically present in this type of organization. Therefore it can answer questions like:

- What processes exist and are required in an SCO?
- What roles exist and have to be filled in an SCO?

### 4.1.4 Who will use and maintain the ontology?

The users of this ontology are the leadership of SCOs in Germany as well as the leadership of the SCO umbrella organizations. The release version coincides with the finalization and grading of this work. If the ontology sees use by the target group, it will be maintained by the author. Access will be publicly provided on a GitHub repository. It is considered a living document, hence not necessarily complete until otherwise stated. Contributions and forks will be possible via the GitHub interface.

## 4.2 Classes

### 4.2.1 Agent

**Group**

**Organization**

**Person**

**Trainee**

**Junior Consultant**

**Consultant**

**Senior Consultant**

### 4.2.2 Document

### 4.2.3 Processes

#### Human Resource Process

#### Project Process

#### Support Processes

### 4.2.4 Projects

## 4.3 Relations

Verify

(◇ means the relation is implemented in the ontology)

**Agent**

- All members except trainees and almunus can be corporate officers ◇
- Non-members can't become corporate officers ◇
- Members can play project team roles ◇
- Every agent can play the customer role in a project ◇
- Every member goes through his individual HRP
- An organizational rank has tbd requirements
- Customer, Team, Contract, etc are **part of** a project
- Organizations can only **play** the customer **role** in a project ◇
- Organization can only play external roles ◇

**Processes**

- All processes have a **next_process** ◇
- **previous_process** should be inferred?!
-

before/after:

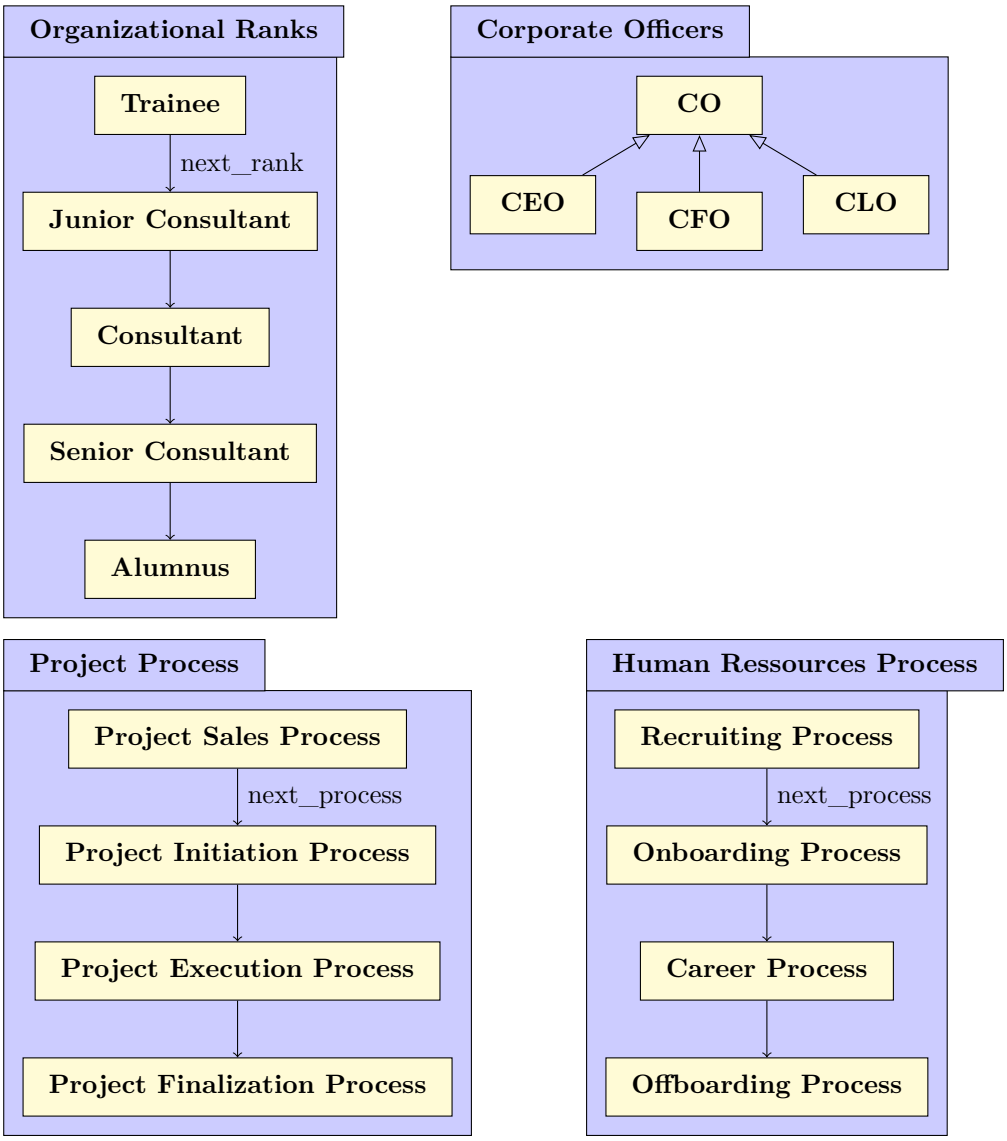
- FIBO: relates to -> precedes/succeeds?
- plays role

# 5 Result and Conclusion

# 6 Further Research

## Diagrams

Add correct relation



# Bibliography


[1] Alexandra Arapinis and Laure Vieu. "A plea for complex categories in ontologies". In: *Applied Ontology* 10.3-4 (2015), pp. 285–296.

[2] Franz Baader et al. *Introduction to Description Logic*. Cambridge University Press, 2017.

[3] Statistisches Bundesamt. *Zusammengefasste Abschlussprüfungen mit erstem und weiteren Abschluss sowie Gesamtstudienzeit (2016-2018)*. Oct. 2019. URL: `https://www.destatis.de/DE/Themen/Gesellschaft-Umwelt/Bildung-Forschung-Kultur/Hochschulen/Tabellen/bestandenepruefungen-studiendauer.html`.

[4] Libby Miller Dan Brickley. *FOAF Vocabulary Specification 0.99*. English. Jan. 2014. URL: `http://xmlns.com/foaf/spec/`.

[5] Frank Loebe. "Abstract vs. social roles–Towards a general theoretical account of roles". In: *Applied Ontology* 2.2 (2007), pp. 127–158.

[6] Frank Loebe. "An analysis of roles: Towards ontology-based modelling". In: *Onto-Med Report* 6 (2003).

[7] Mark A Musen. "The protégé project: a look back and a look forward". In: *AI matters* 1.4 (2015), pp. 4–12.

[8] Natalya F. Noy and Deborah L. McGuinness. *Ontology Development 101: A Guide to Creating Your First Ontology*. URL: `https://protege.stanford.edu/publications/ontology_development/ontology101-noy-mcguinness.html`.

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