A model for structuring concept systems of activity

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Abstract

The paper discusses a model for structuring concept systems of activity. In terminological literature, these type of concept relations are classified as associative relations, and are given not much attention. However, the paper argues that they are useful as a starting point for a terminological analysis of a field or a subfield, and help to bring together many separate concept systems and fragments of systems in an ontology. A classification of activity relations is discussed with help of examples from the field of scuba diving.

1 Introduction

The purpose of my research has been to develop a classification of concept relations that would not only cover the most often used relations but also more rare relation types. The first version was created in 1994 [1] and during the last couple of years I have started to revise it [see e.g. 2]. The latest version is presented in the enclosure. The numbering of the relation types in this paper refers to the enclosure.

In this paper, I will look at some details of concept systems of activity and concept relations in them. Terminological literature classifies these types of concept relations as associative relations, and does not give much attention to them. However, I would like to argue that activity relations and concept systems they are forming are useful as a starting point for a terminological analysis of a field or a subfield, and help to bring together many separate concept systems and fragments of systems in a macro concept system or an ontology of the field.

Originally, the model for activity relations presented in Nuopponen 1994 was based partly on Dahlberg's [e.g. 3] and Haarala's [4] functional relations. I made a distinction between two types of functional relations: origination relations and activity relations. Origination relations (2.2.3.2) prevail between a concept that refers to a concrete or abstract entity and concepts that refer to the origin of the entity*: original material, producer, instrument, manufacturing method, manufacturing process, place of origin*, etc. Activity relations take an *action, activity* or a *phase of a process* as the point view from which the other concepts are considered.

2   Activity and activity relations

Activity is considered here as a wider concept than *action* or *process*. An activity may be composed of several *actions* of *processes*. An activity is performed as an action or as a process. Thus, *activity* is a higher-level concept. Activity relations are based on a connection between an *activity* concept and phenomena involved in the activity (*agent, location, purpose, tool, object/patient, result,* and *time*). As the starting point for the analysis of we can ask the classic "wh"-questions: *Who? Where? Why? With what? What? With which result?* as well as *When?* These basic questions for almost any information retrieval task can be used as the starting point for a terminological concept analysis. Activity relations overlap with other types of relations and can be combined with them. They also support structuring e.g. generic or partitive concept systems.
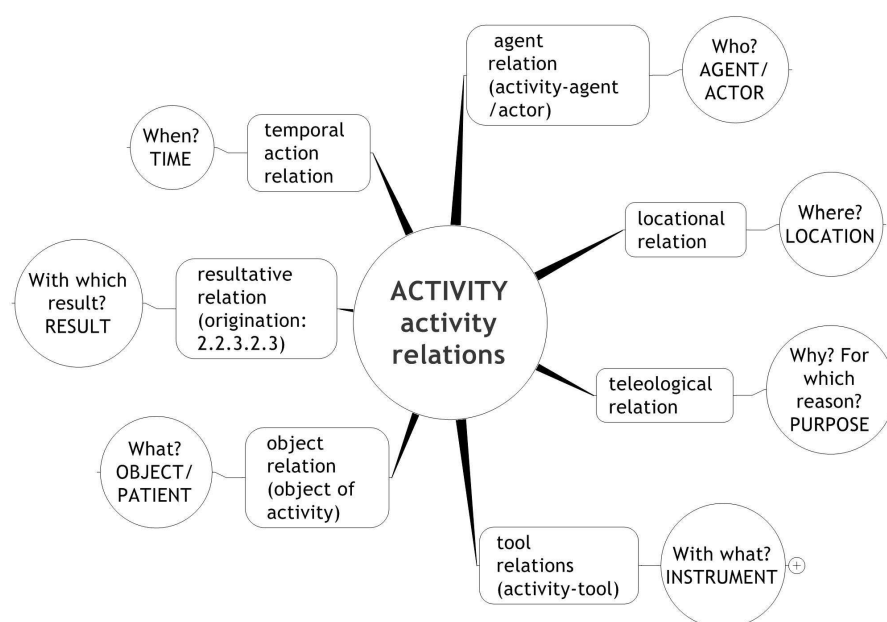

Figure 1. Activity relations

In this paper I will, however, concentrate mainly in activity relations and take *scuba diving* as an example of a main activity concept. The term 'scuba' (self-contained underwater-breathing apparatus) refers to "an apparatus utilizing a portable supply of compressed gas (as air) supplied at a regulated pressure" [8] and *scuba diving* can be defined as swimming done underwater by using a scuba (set) [see 9]. Scuba diving is practiced both for professional and recreational purposes. I will mainly concentrate on the recreational side here. The terminological and conceptual problems encountered reflect a popularized language usage, because I use for the analysis of the field popularized texts, numerous websites [e.g. 5] and a couple of diving manuals [6,7]. Only a rough analysis was done in this stage, because the emphasis is here on illustrating the activity relations instead of presenting a complete analysis of scuba diving concepts. For a further and thorough analysis, texts that are more specialized are needed.

When analyzing concepts of scuba diving, the main guiding questions were *Who? Where? Why?* and *With what?* The rest of the questions did not prove to be as relevant as on many other fields of activity, e.g. *research, health care*. Therefore, I will discuss them as the last ones.

2.1   Agent relations

When we analyze an activity, the first thing to be asked often is: *Who performs the activity?* There may be various agents or actors carrying out the activity, either together, or alternatively. *Agent* or *actor* refers here e.g. to a person, a group, or an organization that intentionally carries out some activity or contributes to it, or takes part in it. When we think of scuba diving as a single action or an act, *diver* is the agent. However, in many activities there are several actors involved to perform the tasks or to make the activity possible, e.g. *health care – doctors, nurses*, and other health care professionals. Scuba diving as a wider activity involves often more actors, too, e.g. *dive shop operators, diving schools, dive masters, boat operators*. In concept analysis, **agent relation** (2.2.3.1.1) can function as a link between the main activity concept and a generic concept systems consisting of the typology of agents or actors involved in the activity (see fig. 2).
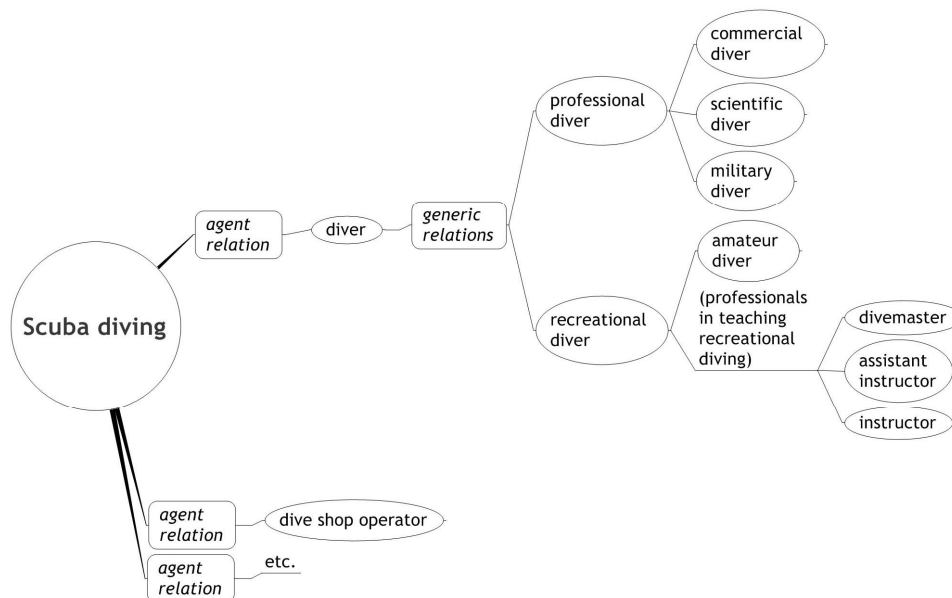

Figure 2. Agent relations in scuba diving

2.2   Locational relation

For scuba diving, the place or location where the activity is performed is important. One of the main characteristics of scuba diving is that it is done *underwater*. Therefore, the primary **locational relation** (2.2.3.1.4) is between *scuba diving* and *underwater*. Furthermore, the sources mentioned several types of locations (*ocean, sea, lake*, etc.), which I first connected directly to the main activity concept by arranging them in a circle around the central node. This kind of "satellite" representation was convenient for collecting different alternatives from the sources. A further concept analysis suggested that *underwater* together with another concept, *body of water,* could function as a key concept (see figure 3). The relationship between *underwater* and *body of water* could be classified as locative (2.1.3) or even as partitive (2.1.1) relation – the line between these two relations is not always easy to draw. *Body of water* is a generic superordinate concept for *ocean, sea, lake, river,* and forms a generic

concept system together with them. It leaves, however, outside several natural and man-made formations in the ground, which sometimes are filled with water and used for diving.
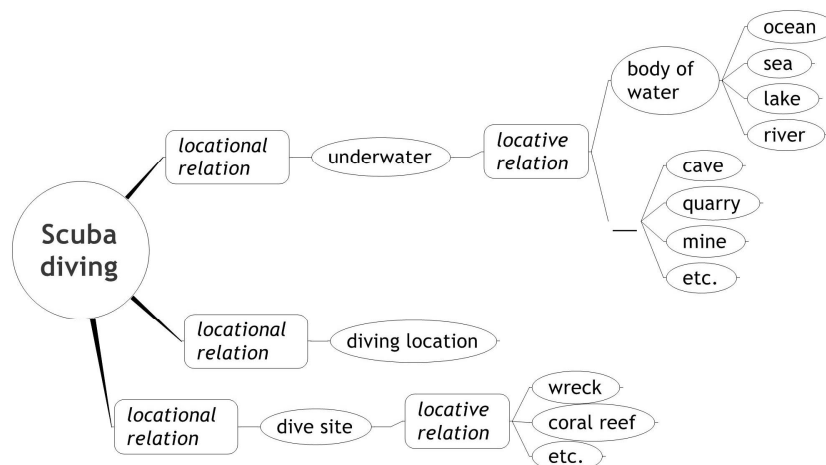
Figure 3. Locational relations in scuba diving

When analyzing further on, diving specific terms 'diving location' and 'dive site' were found in the sources. The concept, or concepts behind them remained however elusive, because the terms are often used as synonyms. The term 'dive site' (also: 'diving site') seems to refer mostly to an exact spot where diving is done (e.g. "This dive site is absolutely covered with purple and pink soft corals [...]"). Dive site descriptions include information on types of fish and corals that can be found there, as well as on boat wrecks located there (see fig. 3). The term 'diving location' refers often to a wider area where scuba diving activity is performed (e.g. "The world-famous scuba diving locations: The Great Barrier Reef, Australia, [...]"). In addition to this common usage in recreational scuba diving industry, work safety instructions for professional divers seem to use these terms for even more restricted concepts defining *dive site* as the "Physical location of a diver during a dive"[10] and *dive location* as "A surface or vessel from which a diving operation is conducted"[11]. A Google search shows that in the recreational diving, 'dive location' seems to be a synonym for 'dive site'. Because these terms are used interchangeably and concepts behind them are vague, I leave the question open for a further analysis.

As the questions raised here show, also locational relations may function as connectors between an activity concept and different types of concept systems, which location concepts form. The typology of dive sites is also visible in the generic system of scuba diving, e.g. *cave diving, wreck diving, reef diving, deep sea diving,* and functions thus as one of the division criteria.

2.3   Tool relations

Tool relation (2.2.3.1.3) is the relation between *activity* and *tool* in my classification. *Tool* is understood here very generally as "whatever is being used to perform an activity or to carry out an action". In different types of activities, "whatever" can refer to a vide variety of different types of tools, why I have distinguished between four different main types of "tools": *equipment (*or *instrument), material, method*, and *manner* (see fig. 4). There is no need to make this distinction, if the activity in question does not involve use of many kinds of tools. As to scuba diving, however, some of these relation types are important and worth of distinguishing from each other. "Equipment" is a general group of mostly concrete tools utilized to perform an activity, e.g. *scuba set* or *self-contained underwater-breathing apparatus – scuba diving*.

In addition to *scuba set,* scuba divers utilize other equipment, such as *depth gauge, pressure gauge, compass,* and *diving computer*, which correspond more or less to the meaning of the word 'instrument' as "a measuring device for determining the present value of a quantity under observation"[12]. Actually, I have been using earlier the term 'activity-instrument relation' (2.2.3.1.3.1) for this type of tool relation, but especially in the context of scuba diving, the term "activity-equipment relation' was more accurate, because scuba divers are additionally using equipment such as: *buoyancy control device, diving mask, diving suit, weighting system, fins,* etc. The concept *scuba equipment* covers all the equipment used in scuba diving, and could be regarded as the superordinate concept in a partitive concept system (2.1.1) (see fig. 4).
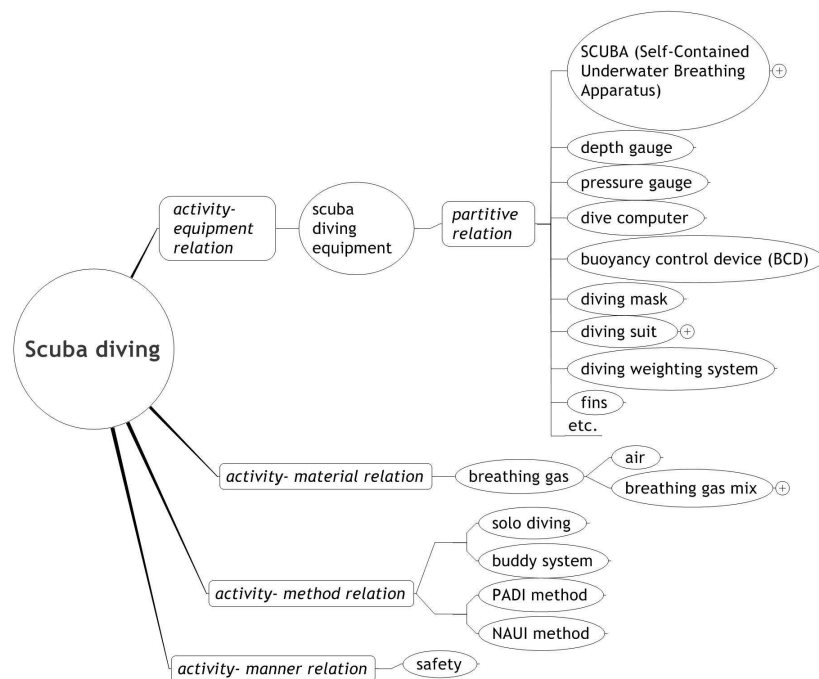

Figure 4. Tool relations in scuba diving

The tool relation *activity-material* (2.2.3.1.3.2) is relevant in cases where some material, e.g. substance or chemical, is used when performing an action or an activity. In the case of scuba diving, *breathing gas* is needed to perform a dive. *Compressed air* or a *breathing gas mix* can be used as breathing gas. Other examples of activity-material relations from other fields could be *dental care – toothpaste*; *painting – paint; agriculture – fertilizer.*

In addition to equipment and material, also *methods*, *procedures*, and *principles* are means to achieve something and perform an activity, therefore the classification includes a third group of tool relations: activity-method relation (2.2.3.1.3.3). An example from scuba diving could be *buddy system,* which is a practice applied especially in recreational diving. Divers dive in pairs or in groups of three in order to be able to co-operate and help each other when needed. On the field of scuba diving, there are several organizations that have established their own scuba training programs and teach their own diving procedures, thus e.g. *PADI method*, *NAUI method*. In addition to these "methods" even other established procedures can be found in scuba diving activities.

As the last of the tool relations, I have listed activity-manner relation (2.2.3.1.3.4). *Manner* is again understood here widely referring to "a way of acting or doing something" and is not always clearly distinguishable from *method* as it is in the case of scuba diving. An example might be *scuba diving –*

safety. Safety issues are an important aspect of scuba activity, and plenty of diving safety concepts would be involved in a wider concept analysis.

2.4   Teleological relation

The relation based on the connection between an activity and its purpose is called '**teleological relation**' or 'purpose relation' (2.2.3.1.6) in my classification. As to scuba diving, the purpose may be either *leisure*, *recreation,* or *profession* (commercial purposes, scientific purposes, etc.). These may be not relevant concepts for a scuba glossary; instead, this division leads to an interesting discussion on the difference between *leisure*, *recreational* and *professional diving* or *leisure*, *recreational* or *professional dive* as well as to the question, who is *leisure*, *recreational* or *professional diver*. An analysis of different purposes of the activity is needed, not only for the concepts of purpose as such (e.g. *recreation*), but rather to clarify some other concepts of the field (e.g. recreational diving).

2.5   Object relation

The relevance of **object relations** (2.2.3.1.2) depends on the type of activity and the level of detail of the concept analysis. Object in this context refers to something affected by an activity, or a patient of an activity, something that undergoes an activity without being an agent or an actor in it [cf. semantic roles, 13], e.g. *research – research material, fishing – fish, interior design – interior, nursing – patient, cognitive science – cognition, terminology work – term/concept/concept relation/*etc. An example from the field of scuba diving could be *underwater photography – coral reef/fish/wreck*.

2.6   Resultative relation

In order to give a more complete picture of an activity, it is always possible to combine relations from other relation categories, e.g. **resultative relations** (2.2.3.2.3). Resultative relations are those origination relations that are based on the connection between an intentional activity and its result, e.g. *cooking – food, film production – film, research – research result*. As to scuba diving, it could be possible to say that a *dive* is some kind of object or result: a diver performs a dive. A dive has length in time, depth profile, and other characteristics that may be recorded manually or with a dive computer. The same goes for instance for other sport performances as well as for musical and other art performances, which in some cases are evaluated by a jury (a *ski jump*, a *marathon run* etc.).

2.7   Temporal action relation

As the last activity relation, I have earlier had **temporal action relation** (2.2.3.1.5), which prevails between *activity* and *time*. In certain activities, time is a relevant factor, e.g. *studies – academic year/semester*. Also diving involves several temporal factors, e.g. *bottom time* and *dive time*. *Bottom time* is the time starting when the diver leaves the surface and begins to descent until the time the diver leaves the bottom and begins a direct ascent to the surface. *Dive time* starts at the same moment, but ends when the diver surfaces at the end of the dive. Dive time includes the time used for a *safety stop* when ascending while bottom time excludes it. After a dive, the diver must spend a certain time on the surface, i.e. *surface time*. Time is thus a crucial factor in scuba diving and different types of time intervals must be measured, planned and counted as well as recorded in diver's logbook.

2.8   Directional activity relations

Madsen et al. [14] include **activity-source** and **activity-target relations** in their classification of activity relations. I have earlier treated them as transmission relations (2.2.4.1), but will now add them in my classification of activity relations, too, and add the relation *activity – route*, e.g. *crossing the street - pedestrian crossing*. *Scuba diving* may start from the *shore* or from a *boat*, and end to either of them, too. Furthermore, a *dive* starts when the diver enters the water from the *surface* and heads for the *bottom* and a dive ends when the diver returns to the *surface* (see fig. 5).

3 Conclusion

As shown here, by taking an activity concept as a central node, a plenty of concepts from a field of the activity in question can be brought together. Asking the questions *Who? Where? Why? With what? How? What? With which result?* as well as *When?* and *From where and to where?* leads often not only to a couple of concepts but to whole hierarchies of concepts. In many cases, it may be fruitful to analyze also such relationships that do lead to any relevant concepts with established terms of the field. The concepts may be considered too general for a glossary of the field, e.g. *ocean, leisure* in scuba diving glossary. Instead, they can be needed to clarify distinguishing characteristics of other related concepts, as was the case with purpose and location when analyzing types of diving and different types of divers.
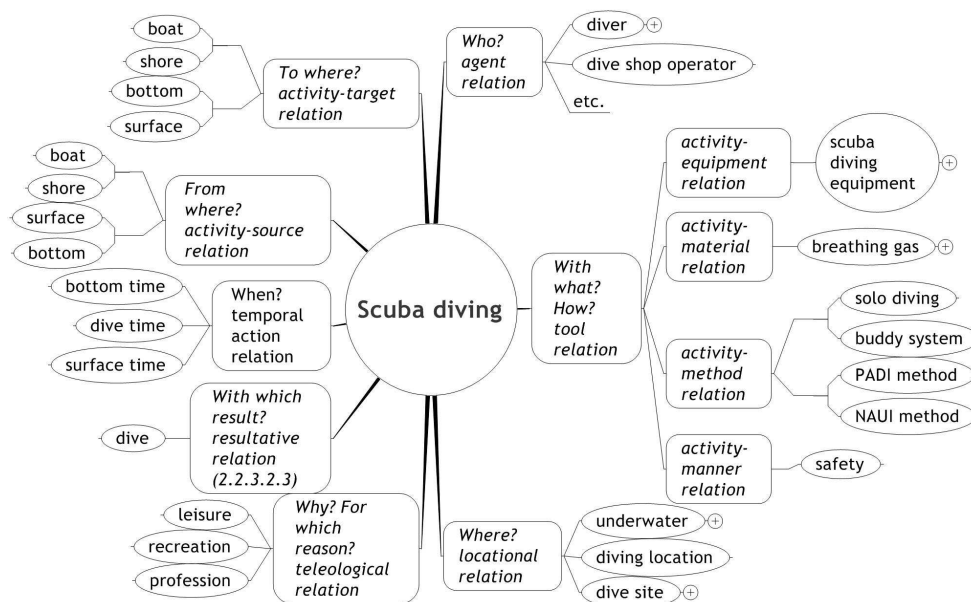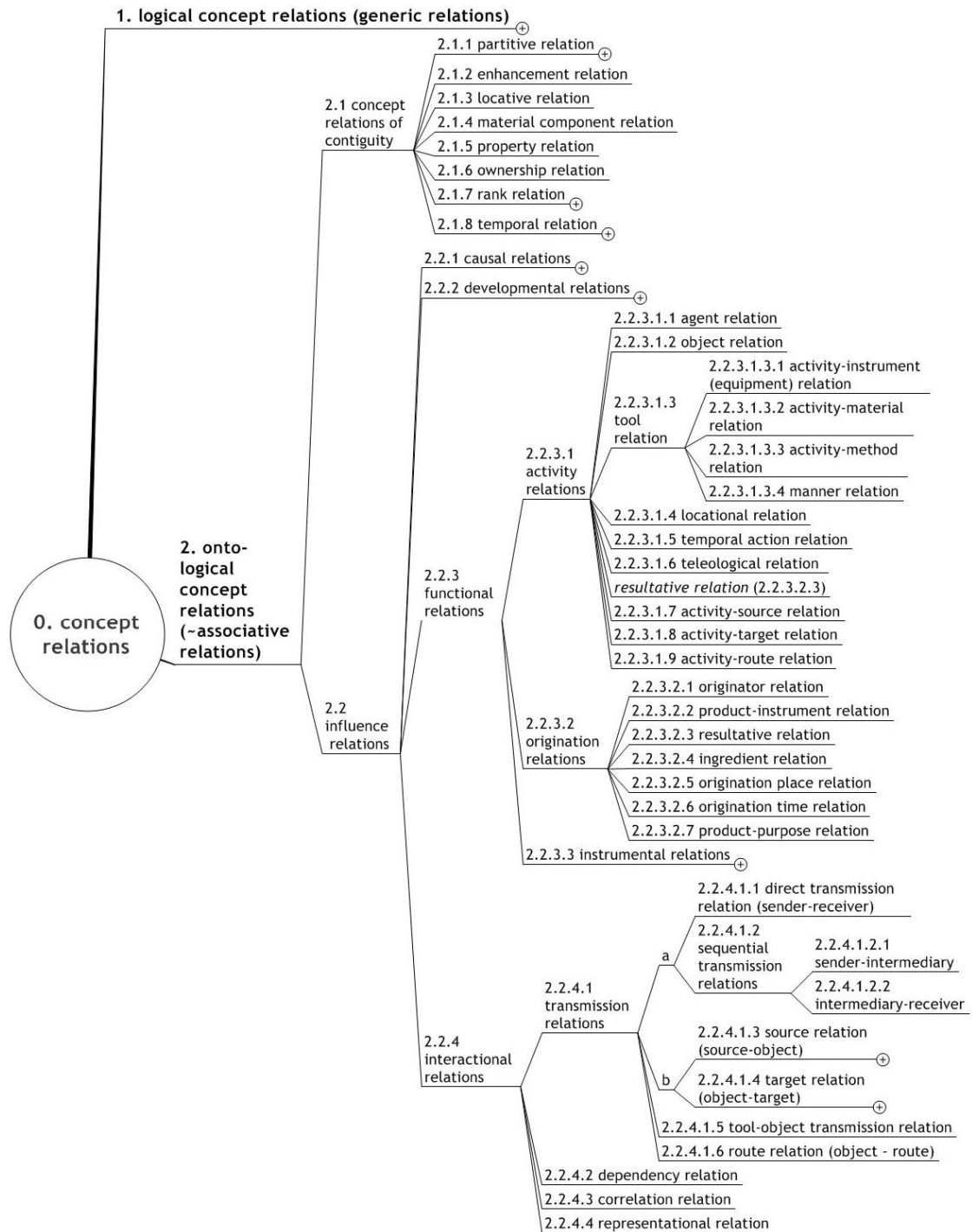

Figure 5. Activity relations in scuba diving

Enclosure: Classification of concept relations Nuopponen (2006)

1. logical concept relations (generic relations) ⊕

2.1.1 partitive relation ⊕
2.1.2 enhancement relation
2.1.3 locative relation
2.1.4 material component relation
2.1.5 property relation
2.1.6 ownership relation
2.1.7 rank relation ⊕
2.1.8 temporal relation ⊕

2.1 concept relations of contiguity

2.2.1 causal relations ⊕
2.2.2 developmental relations ⊕

2.2.3.1.1 agent relation
2.2.3.1.2 object relation

2.2.3.1.3 tool relation
- 2.2.3.1.3.1 activity-instrument (equipment) relation
- 2.2.3.1.3.2 activity-material relation
- 2.2.3.1.3.3 activity-method relation
- 2.2.3.1.3.4 manner relation

2.2.3.1.4 locational relation
2.2.3.1.5 temporal action relation
2.2.3.1.6 teleological relation
resultative relation (2.2.3.2.3)
2.2.3.1.7 activity-source relation
2.2.3.1.8 activity-target relation
2.2.3.1.9 activity-route relation

2.2.3.1 activity relations

2.2.3.2.1 originator relation
2.2.3.2.2 product-instrument relation
2.2.3.2.3 resultative relation
2.2.3.2.4 ingredient relation
2.2.3.2.5 origination place relation
2.2.3.2.6 origination time relation
2.2.3.2.7 product-purpose relation

2.2.3.2 origination relations

2.2.3.3 instrumental relations ⊕

2.2.3 functional relations

2.2.4.1.1 direct transmission relation (sender-receiver)

a 2.2.4.1.2 sequential transmission relations
- 2.2.4.1.2.1 sender-intermediary
- 2.2.4.1.2.2 intermediary-receiver

b 2.2.4.1.3 source relation (source-object) ⊕
2.2.4.1.4 target relation (object-target) ⊕
2.2.4.1.5 tool-object transmission relation
2.2.4.1.6 route relation (object - route)

2.2.4.1 transmission relations

2.2.4.2 dependency relation
2.2.4.3 correlation relation
2.2.4.4 representational relation

2.2.4 interactional relations

2.2 influence relations

2. onto-logical concept relations (~associative relations)

0. concept relations

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