# The Web of Data for E-Commerce: Schema.org and GoodRelations for Researchers and Practitioners

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**Abstract.** Schema.org is one of the main drivers for the adoption of Semantic Web principles by a broad number of organizations and individuals for real business needs. GoodRelations is a well-established conceptual model for representing e-commerce information, one of the few widely used OWL DL ontologies, and since 2012 the official e-commerce model of schema.org.

In this tutorial, we will (1) give a comprehensive overview and hands-on training on the advanced conceptual structures of schema.org for e-commerce, including patterns for ownership and demand, (2) present the full tool chain for producing and consuming respective data, (3) explain the long-term vision of Linked Open Commerce, and (4) discuss advanced topics, like access control, identity and authentication (e.g. with WebID); micropayment services, and data management issues from the publisher and consumer perspective. We will also cover research opportunities resulting from the growing adoption and the respective amount of data in RDFa, Microdata, and JSON-LD syntaxes.

**Keywords:** Schema.org · GoodRelations · Semantic Web · Ontologies · Microdata · OWL · RDFa · JSON-LD · Linked Open Data · E-Commerce · E-Business

## 1 Introduction

Schema.org [1] is one of the main drivers for the adoption of Semantic Web principles by a broad number of people for their real business needs. The resulting amount of real-world RDF[1] data exceeds a critical mass so that it becomes interesting as reference data for any kind of foundational Semantic Web research. At the same time, the schema.org ecosystem has become the source of, or catalyst for, many innovations in the field that reach out into core Semantic Web research, like the recent integration of transactions into schema.org [2], which is essentially a variant of the idea of Semantic Web Services (see e.g. [3]). In this tutorial, we want to cover the theoretical knowledge and practical skills for using schema.org for research and practical innovation.

[1] Including such that can be generated from Microdata, which is strictly speaking not an RDF syntax.


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### 1.1 What Is GoodRelations?

GoodRelations[2] is a generic conceptual model that can be used to exchange information about products and services, pricing, payment options, other terms and conditions, store locations and their opening hours, and many other aspects of e-commerce, between networks of computer systems [4, 5]. The focus is on interoperability between Web sites and clients consuming the information given on those sites, but it can also be used for other purposes that require a common data model for information about technical and commercial aspects of products and business entities.

In essence, GoodRelations defines (1) a generic data structure and (2) unique identifiers for all elements of that data structure, i.e. its classes (entity types), properties (relationship types and attributes), and enumerated values (individuals). GoodRelations is available as an OWL DL Web ontology according to the W3C Web Ontology Language standard and can thus be used for exchanging data on the WWW, e.g. in Semantic Web and Linked Open Data projects.

GoodRelations is designed so that it fits any industry, any position in the value chain, and any country or legal environment. It is a truly generic model of information for offering any kind of goods (e.g. cameras, cars, consulting, medical treatment, etc.) to others and for specifying the expected compensation (e.g. money or other goods in barter trade) and conditions (e.g. indicating the time your offer expires or the payment methods accepted).

### 1.2 What Can I do with GoodRelations?

While it is impossible to enumerate all possible usages of GoodRelations, here is a list of prominent ones (taken from [5]):

1. **Search Engine Optimization** for Google, Yahoo, Bing, and Yandex with schema.org: Since November 2012, GoodRelations is the official e-commerce model of schema.org. schema.org is an initiative driven by several major search engines and allows site-owners to mark-up information in their Web content so that search engines can extract and process it better, i.e. more reliably and with less effort. In short, one can use the GoodRelations data model to add small data packets to Web pages in HTML that represent products and their features and prices, stores and opening hours, payment options and the like. Search engines will then be able to understand the content better and trigger many positive effects for the site in the search results, like Google Rich Snippets, or individualized relevance ranking.
2. **Product Information Management (PIM/PDM)** inside a single organization or a value chain: If you have to handle information about products and services from multiple sources, GoodRelations can serve as a global database schema for integrating the information, for it is typically easy to map existing data structures to GoodRelations. GoodRelations will then provide a common model to maintain, cleanse, consume, and share the data.

[2] http://purl.org/goodrelations/

3. **E-Commerce Data Quality Management:** One can also use GoodRelations to manage technical or commercial data from heterogeneous sources in graph databases (e.g. RDF triplestores) and implement data quality management projects on top of this model.

## 2 The Agent-Promise-Object-Compensation Model

As said, the goal of GoodRelations is to define a data structure for e-commerce that is

1. industry-neutral, i.e. suited for consumer electronics, cars, tickets, real estate, labor, services, or any other type of goods,
2. valid across the different stages of the value chain, i.e. from raw materials through retail to after-sales services, and
3. syntax-neutral, i.e. it should work in Microdata, RDFa, RDF/XML, Turtle, JSON, OData, GData, or any other popular syntax.

GoodRelations focuses on the early stages of business transactions, i.e. search and selection. Transactions were outside the initial scope, but have recently become relevant, as schema.org has started supporting transaction-related data.

At the very heart of GoodRelations is the assumption that most e-commerce information can be represented using just four entities [6]:

1. **An agent** (e.g. a person or an organization),
2. **A promise (offer) to transfer some rights** (ownership, temporary usage, a certain license, etc.) on some object or to provide some service,
3. **An object** (e.g. a camcorder, a house, a car, etc.) or service (e.g. a haircut), and
4. **An** expected **compensation** (e.g. an amount of money), to be provided by the accepting agent and related to the object or service.

A fifth entity that is often relevant is **a location from which that offer is available**(e.g. a store, a bus stop, a gas station, etc.).

This **Agent-Promise-Object-Compensation (APOC)** [6] principle can be found across most industries and is the source of the wide applicability of GoodRelations. It allows using the same vocabulary for offering a camcorder as for a manicure service or for the offer to dispose of used cars. The respective classes in GoodRelations are

- **gr:BusinessEntity** for the agent, i.e. the company or individual,
- **gr:Offering** for an offer to sell, repair, lease something, or to express interest in such an offer,
- **gr:ProductOrService** for the object or service,
- **gr:PriceSpecification** for the compensation, and
- **gr:Location** for a store or location from which the offer is available (in previous versions gr:LocationOfSalesOrServiceProvisioning).

Note that the object does not have to be a physical thing; it can also be a patent, a creative works, an action or happening, and the compensation does not have to be in money. GoodRelations makes minimal assumptions about what objects can be the subject of an offer, which bundles of rights can be offered, and about the nature of a compensation expected, if any.

## 3 GoodRelations in Schema.org

GoodRelations is a decade-long initiative and started as an independent Web vocabulary ("ontology") that was meant to be used in RDFa or other RDF-syntaxes (like RDF/XML, Turtle, etc.). In 2009, Yahoo started to honor GoodRelations in RDFa syntax, and in 2010 Google followed, creating significant incentives for real businesses to adopt this data model.

Initially, this all happened in the original GoodRelations namespace, i.e. with identifiers like

**http://purl.org/goodrelations/v1#**OpeningHoursSpecification

After the announcement of schema.org in 2011, we worked with Google, Bing, and Yahoo to integrate GoodRelations into schema.org. The result was released in 2012 and has since been an ongoing effort of evolving both projects in parallel. In essence, the integration into schema.org meant that (almost) any element from GoodRelations also became part of schema.org; for details, see [7]. Thanks to this, GoodRelations is now the official, extended e-commerce model of schema.org. Since schema.org is a single-namespace vocabulary (at least as of now), the result is that every GoodRelations element has now **two identifiers**, the original one, like

**http://purl.org/goodrelations/v1#**OpeningHoursSpecification

and the one in schema.org, like

**http://schema.org/**OpeningHoursSpecification

In some cases, the local part of the names differs between the original GoodRelations namespace and the derived version in the schema.org namespace, in order to be consistent with the existing naming conventions in schema.org, or because a similar element had existed before (for a full list of naming differences, see here[3]). For enumerations (individuals), the original namespace remains the official one, e.g. `http://purl.org/goodrelations/v1#Cash` for the payment method "cash". This was decided because we wanted to reduce the number of new elements for schema.org.

[3] http://wiki.goodrelations-vocabulary.org/Cookbook/Schema.org#Naming_Differences

## 4 Contents of the Tutorial

In the ICWE 2015 tutorial, we (1) give a comprehensive overview and hands-on training on the advanced conceptual structures of schema.org for e-commerce, including patterns for ownership and demand, (2) present the full tool chain for producing and consuming respective data, (3) explain the long-term vision of Linked Open Commerce, (4) describe the main challenges for future research in the field, and (5) discuss advanced topics, like access control, identity and authentication (e.g. with WebID); micropayment services, and data management issues from the publisher and consumer perspective. We also cover research opportunities resulting from the growing adoption and the respective amount of data in RDFa, Microdata, and JSON-LD syntaxes.

Participants learn how to use the GoodRelations elements in schema.org to articulate information about business entities, products and services, prices, warranty, shop locations, terms and conditions, etc. This can improve the visibility of an offering in next generation Web search engines, allow more precise search, and support partners in the value chain to extract and reuse product model data easily. Attendees will also understand how such metadata can be used by search engines, browser extensions, and mobile applications, and how researchers can access and integrate respective data into their work.

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