Development of Domain Ontology on Movies: Proof of Concept with Methontology

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Abstract:

In the movie production process, numerous personnel are involved in different production processes. Ontology is a structured framework and systematic representation of concepts, entities, and relationships serve as a foundational structure for organizing and categorizing knowledge within a specific domain. This paper has detailed the domain modelling of the movie domain and has been evaluated with competency questions.

Keywords: *Domain Ontology, Movie Ontology, Data Modelling, Bengali Movies, Methontology*

1.Introduction:

Ontology development is a complex process that involves the integration of knowledge from multiple domains and requires a deep understanding of the domain-specific concepts and relationships. The process of ontology development can vary depending on the knowledge architecture of the domain and the intended application use-cases. One of the main challenges in ontology development is reconciling the diverse perspectives and assumptions that different stakeholders might perceive about the domain. This can result in different ontological commitments, or assumptions about the nature of the domain, which can lead to the development of different ontologies focusing on objectives of its applications. In addition, the choice of application use-cases can also influence the ontology development process. Different applications may require different levels of specificity and granularity in the ontology, which can impact the choice of concepts and relationships to include (El-Diraby and Tamer, 2013)[1].

Building an ontology is essentially a practical and applicative knowledge organization process and systematic approach towards its development also lead us to get the advantage of sharing, storing and information/data retrieval process. The components of ontology are concepts, relationships, functions, individuals or instances and axioms.

$$\text{Ontology} =< C, R, F, I, A >$$

Where, C is Concepts; R is Relationships; F is Functions; I is Individuals; A is Axioms.

[1]El-Diraby, Tamer E. "Domain ontology for construction knowledge." Journal of Construction Engineering and Management 139.7 (2013): 768-784.

1.1 Concepts (classes):

Class represents concepts of a domain which are defined and described through ontology editor. Class can be perceived as basic building block of an ontology because, through this one can create different properties with related concepts, populate members within it scope inheriting the class attributes of the concepts, binding attributes values through data property and described its inherent characteristics through pre-defined annotation properties; e.g. Movie Genre, which are thematic category of a movie.

1.2 Relationships:

It shows how different objects are related to each other in ontology. In ontology relationships is expressed as properties, two types of properties can be defined. One is object property and another one is data property. Here object property creates a link or relation between two individuals as well as classes, whereas data property binds a individual with a data value.

1.3 Functions: Functions are elements with the purpose of calculating information from the other elements.

1.4 Individuals: Individuals or instances are the member of a class. In OWL syntax, individuals can be of two types. Which are 1. Named Individuals (identified by global IRI); 2. Anonymous Individuals (identified by local node ID- also known as blank node).

1.5 Axioms: Axioms are the statements that identifies and define structural specification about classes, data property, object property, data type specifications, annotations and assertions.

$$M_1 \bigwedge M_2 \ \wedge M_3 \ldots . \wedge M_N \ \rightarrow \ T_1 \wedge T_2 \wedge T_3 \wedge \ldots . . T_N$$

Where M_i ($1 \leq i \leq n$) and T_i ($1 \leq i \leq n$) are ground atomic facts with quantified variables declared in classes or instances. For example, Stephenie is a girl can axiomatized as Class Assertion (o:Girl o:Stephenie).

2. Objectives:

i) Creation of Knowledge base for movies
ii) Identification, definition and declaration of classes, assertion of properties, creation of instances of the entities-attributes of movie information.
iii) Axiomatize association and dissociation of semantic links between domain knowledge and operational knowledge.

3. Ontology Development:

METHONTOLOGY is a methodology for developing ontologies, which are formal representations of concepts, relationships, and knowledge within a particular domain.

3.1 Specification: The specification step in METHONTOLOGY involves several sub-steps, including:

i) Defining the scope of the ontology: This involves determining the boundaries of the domain that the ontology will cover.
ii) Identifying the concepts: This involves listing all of the important concepts that are relevant to the domain, as well as any relationships or properties that exist between them.
iii) Defining the properties: This involves specifying the characteristics or attributes of each concept, including any relationships that may exist between them.
iv) Establishing the axioms: This involves defining the logical rules that govern the relationships between concepts and properties, as well as any constraints or restrictions that may exist within the domain.
v) Creating the ontology structure: This involves organizing the concepts, properties, and axioms into a formal structure that can be used to represent knowledge within the domain.
vi) Evaluation of the Knowledge Base: This involves structuring legacy questions from different users and experts, translating the attributes and entities of the legacy questions into framing either framing SPARQL queries or getting answers through representational schematic diagram of the ontology.

Overall, the specification step in METHONTOLOGY[2] is crucial for creating an ontology that accurately represents the knowledge and relationships within a particular domain. By carefully defining the concepts, properties, and axioms, ontology developers can ensure that their ontology is both comprehensive and consistent, which is essential for effective knowledge representation and reasoning.

3.2 Conceptualizing Movie Domain:

According to Merriam-Webster dictionary, Movie has been defined as “a recording of moving images that tells a story and that people watch on a screen or television” as form of motion picture. There are several terms that are associated with the term “Movie”- they are – motion picture, movie picture, photoplay or flick. Movie Production can be subdivided to 5 major parts- Movie Development, Pre-Production, Production, Post-Production and Distribution. While developing an ontology of a movie as a domain, the conceptualization of the domain must touch all the aforementioned parts entailing the systematic existence of terms bound by explicit relations.

[2]Fernández-López, M., Gómez-Pérez, A., & Juristo, N. (1997). Methontology: from ontological art towards ontological engineering.

3.3 Movie Related Entities and Properties:

The entities related to movies have been segregated according to five phases of movie production. In other way, personnel related to movie can be also be associated and grouped onto different departments.

Phases of Movie Making	Class Name	Sub-Class Name	Role/Definition
Movie Development	Person	Script Writer	"individual who creates a movie's screenplay. A "scripter" can either create an original screenplay or adapt another's work, such as a book or news article, into a film." [https://www.studiobinder.com/blog/movie-film-terms/]
		Producer	"A **Producer** is a chief of a film's production. The producer is in charge of raising funds, acquiring a story, hiring key personnel, finalizing the script, and arranging for distribution. The producer often serves as the liaison between the filmmakers and the financiers". [https://www.studiobinder.com/blog/movie-film-terms/]
		Film Director Department	Entire department of direction
		Writer	The individual who writes the original novel based on which a film is based.
		Finance Manager	"Their job to make sure the film is completed within budget and the money is spent properly." [https://www.screenskills.com/job-profiles/browse/film-and-tv-drama/production-management/finance-controller/]
	Genre	**"A film genre is a stylistic or thematic category for motion pictures based on similarities either in the narrative elements, aesthetic approach, or the emotional response to the film." [https://en.wikipedia.org/wiki/Film_genre]**	
Pre-Production	Production Company		The company involved in production of a movie
	Person	Screen Players/ Screen Writer/ Script Writer	Same as Script Writer
Production	Place		Place/venue of shooting
	Person	Action Director	Director who directs the action scenes e.g. fight, combat, explosions etc. for a movie
		Additional Crew	Crew members who are responsible for various miscellaneous jobs in movie production
		Art Director	"Individual responsible for the design, look, and feel of a film's set, including the number and type of props, furniture, windows, floors, ceilings dressings, and all other set materials; a member of the film's art department."[https://www.elginisd.net/cms/lib6/TX01917830/Centricity/Domain/560/Film%20Terms%20Glossary.pdf]

		Business Manager	Business Manager manages finances in entire movie productions, movie distribution etc.
		Camera Department	This department includes Cameraman, Camera Attendant, Crane Operator/Boom Man, Camera Attendant, photographer, trolley operator etc.
		Choreographer	"A choreographer conceives, creates, and directs dance and movement in a wide range of performance contexts, including dance, theatre, film, television etc."[https://artdepartmental.com/resources/filmmaking-glossary/#C]
		Cinematographer	"The person expert in and responsible for capturing or recording-photographing images for a film, through the selection of visual recording devices, camera angles, film stock, lenses, framing, and arrangement of lighting; the chief cinematographer responsible for a movie is called the director of photography (or D.P.), or first cameraman." [https://www.elginisd.net/cms/lib6/TX01917830/Centricity/Domain/560/Film%20Terms%20Glossary.pdf]
		Actor	"Refers either to a male performer, or to any male or female who plays a character role in an on-screen film." [https://www.elginisd.net/cms/lib6/TX01917830/Centricity/Domain/560/Film%20Terms%20Glossary.pdf]
		Electricians	Electrician manages electrical work in set including light work.
		Light Department	This department manages all light related works
		Makeup Department	It includes makeup artists and makeup materials
		Music Department	Music department includes music composer, music director, background musician, score composer, lyricist, music director, singer, sound mixing engineer, musical instruments, editing softwares etc.
		Production Department	Production department manages logistic operations, set preparation and design, story development, script preparations and other post-production activities. Production department includes Production Manager, Production Associates/Assistants, Production designers, Production Managers, supervisors, unit manager etc.
		Sound Department	Sound Department includes Sound Recordist/ Recording Engineer, Foley Artist, Sound Mixer Artist etc.
		Suppliers	Supplier of props, instruments and others in movie production process.
Post-Production	Presentation	Color info	"Information about the color of the film i.e. Black and White, Grey Scale, sepia tone etc." [https://en.wikipedia.org/wiki/Color_motion_picture_film]
		Language	Language of the script and actors delivers dialogues
		Sound mix	"Audio/Sound mixing is the process by which multiple sounds are combined into one or more channels. In the process, a source's volume level, frequency content, dynamics, and panoramic position are manipulated or enhanced. This practical, aesthetic, or otherwise creative treatment is done in order to produce a finished version that is appealing to listeners. Audio mixing is practiced for music, film, television and live sound. The process is generally carried out by a mixing engineer operating a mixing console or digital audio workstation." [https://en.wikipedia.org/wiki/Audio_mixing]
	Person	Editing Department	This department is responsible for "selecting, assembling, arranging, collating, trimming, structuring, and splicing-joining together many separate camera takes(includes sound also) of exposed footage (or daily rushes) into a complete, determined sequence or order of shots (or film) - that follows the script; digital editing refers to changing film frames by digitizing them and modifying them

			electronically; relational editing refers to editing shots to suggest a conceptual link between them; an editor works in a cutting room; the choice of shots has a tremendous influence upon the film's final appearance" [https://www.elginisd.net/cms/lib6/TX01917830/Centricity/Domain/560/Film%20Terms%20Glossary.pdf]
		Title Designer	"A title designer is a professional who creates the opening sequences for TV shows and movies. Title designers include standard elements like the movie studio's name and logo, the name of the film and the credits." [https://www.indeed.com/career-advice/finding-a-job/what-is-title-designer]
Distribution	Country		Country of origin of the movie as well as it is released.
	Distributor		"A film distributor is responsible for the marketing of a film. The distribution company may be the same with, or different from, the production company." [https://en.wikipedia.org/wiki/Film_distributor]
	Online Retailer		Subscription based online movie watching platform like – Netflix, HoiChoi, Disney Hotstar etc.
	Territory	Africa	Name of the continents
		America	
		Asia	
		Europe	
		Oceania	
Other	Award		"Prize for the movies in different categories, e.g. Academy Award, Golden Globe Awards, National Film Awards, Dadasaheb Phalke Award, BAFTA film awards, Filmfare Awards, Annie Awards etc."[https://en.wikipedia.org/wiki/Film_award]
	Certification		"A motion picture content rating system classifies films based on their suitability for audiences due to their treatment of issues such as sex, violence, or substance abuse, their use of profanity, or other matters typically deemed unsuitable for children or adolescents. Most countries have some form of rating system that issues determinations variously known as certifications, classifications, certificates, or ratings. Age recommendations, of either an advisory or restrictive capacity, are often applied in lieu of censorship; in some jurisdiction's movie theatres may have a legal obligation to enforce restrictive ratings." https://en.wikipedia.org/wiki/Motion_picture_content_rating_system
	Consumable Products		Movie as consumable product

3.4 Reusing Ontology:

Identifying and using existing ontology is also a very good practice in ontology development process and its main objective is to maintain consistency and standardization across different systems and designs. IMDb has developed one movie database (2009) which has been used here, IMDb ontology [http://www.movieontology.org/2009/11/09/movieontology.owl] has been integrated into this ontology and the main point of development is to define the different personnel associated to the movie production process.

3.5 Defining Properties:

The properties defined here into two types – object properties and data properties. The properties have been developed according to the guiding methods (Noy and McGuiness, 2001). While defining the properties, relations should be built between different relations, domains or concepts. The main aim is to create a comprehensive and coherent knowledge structure which can reflect a semantic interconnections and dependencies between different domains/concepts and work under interoperable framework (Guarino,2009). This involves recognizing how concepts and entities in one domain impact or relate to those in another domain. Such influences can be hierarchical (parent-child relationships), associative (related concepts), or even causal (cause-effect relationships). A well-defined and semantically justified representation supports robust inference and reasoning capabilities(Guarino,2009)[3]. The object properties are mostly defined here to establish the association between persons and their activities pertaining to movie productions at different stages. The actions needed to be taken here for framing Competency Questions for evaluation are as follows:

Action-1: Given the context of competency of the ontology, entities and classes needed to semantically associate in order to translate them to static as well as temporal actions.
Action-2: Contextual questions must translate set of facts/events/classes/entities S_1 into target vocabulary set S_2.
Action-3: Semantic translation after integration of the Ontology O_1 and Ontology O_2.

3.5.1 Object Properties:

Table No.1: Relation Between Domain and Range Defined by Object Properties

Domain	Object Property	Range
Director	Directs	Movie
dbo: Actor	HasActedIn	Movie
Movie	HasActionDirector	Action Director
Movie	HasActor [inverse of hasActedIn]	dbo:Actor

[3]Guarino, Nicola, Daniel Oberle, and Steffen Staab. "What is an ontology?." Handbook on ontologies (2009): 1-17.

Movie	HasAdditionalCinematographer	Additional Cinematograher
Movie	HasArtDirector	Art Director
Movie	has Artist	Artist
Movie	hasArtSetter	Art Setter
Movie	hasAssistantArtDirector	Assistant Art Director
Movie	hasAssistantCameraman	Assistant Cameraman
Movie	hasAssistantComposer	Assistant Composer
Movie	hasAssistantCostumeDesigner	Assistant Costume Designer
Movie	hasAssistantEditor	Assistant Editor
Movie	hasAssistantFilmEditor	Assistant Film Editor
Movie	hasAssistantHairDresser	Assistant Hair Dresser
Movie	hasAssistantMakeupArtist	Assistant Makeup Artist
Movie	hasAssistantMusicDirector	Assistant Music Director
Movie	hasAssistantProductionController	Assistant Production Controller
Movie	hasAssistantProductionManager	Assistant Production Manager
Movie	hasAssistantSoundRecordist	Assistant Sound Recordist
Movie	hasAssistantUnitManager	Assistant Unit Manager
Movie	hasBackgroundMusician	Background Musician
Movie	hasBackgroundScoreComposer	Background Score Composer
Movie	hasBusinessManager	Business Manager
Movie	hasCameraAttendant	Camera Attendant
Movie	hasCameraman	Cameraman
Movie	hasCarpenter	Carpenter
Movie	hasChoreographer	Choreographer
Movie	hasCinematographer	Cinematographer
Movie	hasConceptDesigner	Concept Designer
Movie	hasContactLensTechnician	Contact Lens Technician
Movie	hasContactLensTechnician	Contact Lens Technician
Movie	hasCostumeCoordinator	Costume Coordinator
Movie	hasCostumeDesigner	Costume Designer
Movie	hasCraneOperator	Crane Operator
Movie	hasDraughtsman	Draughtsman
Movie	hasDressman	Dressman
Movie	hasEditor	Editor
Movie	hasElectrician	Electrician
Movie	hasFilmLocation	Place
Movie	hasFinanceManager	Finance Manager
Movie	hasFoleyArtist	Foley Artist
Movie	hasFoleyRecordingEngineer	Foley Recording Engineer
Movie	hasGenre	Genre
Movie	hasGraphicDesigner	Graphic Designer
Movie	hasGreensman	Greensman
Movie	hasHairDresser	Hair Dresser

Movie	hasHDCameraOperator	HD Camera Operator
Movie	hasLightAttendant	Light Attendant
Movie	hasLyricist	Lyricist
Movie	hasMakeupArtist	Makeup Artist
Movie	hasMakeupStylist	Makeup Stylist
Movie	hasModeller	Modeller
Movie	hasMusicDirector	Music Director
Movie	hasMusician	Musician
Movie	hasPainter	Painter
Movie	hasPlasterer	Plasterer
Movie	hasPostProductionAssociates	Post Production Associates
Movie	hasPostProductionHead	Post Production Head
Movie	hasProductionAssistant	Production Assistant
Movie	hasProductionController	Production Controller
Movie	hasProductionDesigner	Production Designer
Movie	hasProductionManager	Production Manager
Movie	hasProductionSupervisor	Production Supervisor
Movie	hasPropMaker	Prop Maker
Movie	hasProstheticMakeupArtist	Prosthetic Makeup Artist
Movie	hasProstheticMouldMaker	Prosthetic Mould Maker
Movie	hasReleaseTime	
Movie	hasReleasingCountry	dbo:Country
Movie	hasScreenPlayer	Screen player
Movie	hasScriptWriter	Script Writer
Movie	hasSetDecorator	Set Decorator
Movie	hasSinger	Singer
Movie	hasSoundDesigner	Sound Designer
Movie	hasSoundMixer	Sound Mixer
Movie	hasSoundMixingEngineer	Sound Mixing Engineer
Movie	hasSoundRecordist	Sound Recordist
Movie	hasStillPhotographer	Still Photographer
Movie	hasSupplier	Supplier
Movie	hasTitleDesigner	Title Designer
dbo:Language	hasTranslatedMovie [inverse of isTranslatedTo]	Movie
Movie	isTranslatedTo	dbo:Language
Movie	hasTrolleyOperator	Trolley Operator
Movie	hasUnitProductionManager	Unit Production Manager
Assistant Art Director	isAssistantArtDirectorOf	Movie
Movie	isDirectedBy	Director
Movie	isDistributedBy	Distributor

3.5.2 Data Properties

Table No. 2: Relation Between Domain and Range Defined by Data Properties

Domain	Properties	Range/Data Type
Movie	imdbrating	xsd:double
Movie	releasedate	xsd:date
Movie	runtime	xsd:int
Movie	title	xsd:string

3.6 Ontology Evaluation:

Ontology evaluation is equally important as well as its development; ontology is typically developed to act as a robust knowledge-base(KB) which should be capable enough to access, navigate, and understand domain knowledge by putting queries to the knowledge base from the users. A robust and well-designed ontology should be coherent, consistent, expressive, interoperable, reusable and scalable. Usually, ontologies are developed using open world assumption (Razniewski,2016; Vinu,2015)[4], that means – the ontology is amenable to changes, embrace/remove new concepts/classes/instances.

Ontologies are usually developed incrementally, populating the entities and attributes in the file. Art_Director, Art_Setter, Artist,Assistant_Art_Director, Carpenter, Concept_Designer, Draughtsman, Graphic_Designer, Greensman, Modeller, Painter, Plasterer, Prop_Maker, Set_Decorator ⊆ **Art_Department**

Production_Manager, Production_Supervisor, Production_Designer,Unit_Production_Manager, Production_Designer, Production_Controller, Production_Assistant, Post_Production_Head, Post_Production_Supervisor, Post_Production_Associates, Assistant_Unit_Manager, Assistant_Unit_Manager, Assistant_Production_Manager, Assistant_Production_Controller ⊆ **Production_Department**

Assistant_Costume_Designer, Costume_Coordinator, Costume_Designer, Dressman ⊆ **Costume_Department**

[4]Razniewski, Simon, Ognjen Savkovic, and Werner Nutt. "Turning the partial-closed world assumption upside down." Proceedings of the 10th Alberto Mendelzon International Workshop on Foundations of Data Management, Panama City, Panama, May 8-10, 2016. Vol. 1644. CEUR-WS, 2016.
Vinu, E. V. (2015). A novel approach to generate MCQs from domain ontology: Considering DL semantics and open-world assumption. Journal of Web Semantics, 34, 40-54.

Table No. 3: Different Criteria and Definition of an Ontology

Criteria	Definition
Accuracy	Does the asserted knowledge in the ontology agree with the expert's knowledge, which is often measured in terms of precision and recall?
Completeness	Is the domain of interest appropriately covered (i.e., coverage)?
Conciseness	Does the ontology define irrelevant elements with regards to the domain to be covered or redundant representations of the semantics?
Consistency	Does the ontology include or allow for contradictions, which is often measured as the number of terms with inconsistent meaning?
Computational efficiency	How fast can the tools (e.g., reasoners) work with the ontology?
Adaptability	How easy or difficult is it to use an ontology in different contexts? Adaptability often measures coupling (i.e., number of external classes referenced) and cohesion (i.e., modularity of the ontology)
Clarity	How effective can the ontology communicate the intended meaning of the defined terms?

3.7 Competency Questions:

While gauging ontology as Knowledge Base (KB), it is expected that, the users' query is expected to be answered by the ontology. Any knowledge management system can be evaluated using users' defined queries and the keywords stated within competency questions encompass the concepts and classes defined over the ontology (Haghighi,2013)[5]. Essentially such questions are used by domain experts, developers and related stakeholders to test its efficacy whether the ontology meets all of its operational objectives of the domain of discourse as well as the specific necessities of the intended services. Sixteen users have been interviewed and encouraged them to ask questions and the ontology was evaluated according to declared entities, classes, object properties and data properties.

Table No. 4 : Competency Questions to evaluate Movie Ontology

Competency Questions	Concepts	Relations
Who has directed the film X?	Movie, dbo:Person-> Director	isDirectorOf, hasDirector
What are the different job roles under Production Department?	dbo:Person -> Production Department	Subclasses of Production Department
Who are the actors of the movie X?	Movie, Actors	hasActor, isActorIn
Who is the music director of the Movie X?	Movie, Music Director	hasMusicDirector
What is the IMDb rating of the Movie X?	Movie	Data Property – Imdbrating,

[5]Haghighi, Pari Delir, et al. "Development and evaluation of ontology for intelligent decision support in medical emergency management for mass gatherings." Decision Support Systems 54.2 (2013): 1192-1204.

		type – xsd:double
When was the releasing year of Movie X ?	Movie, time	Data Property – releasedate Type – xsd:date
Who was the choreographer of the Movie X?	Movie, Choreographer	hasChoreographer
Who was the cameraman of the movie X?	Movie, Cameraman	hasCameraman
Who was the producer of the Movie X?	Movie, Producer	hasProducer
Name the movies where actor Y has acted so far.	Actor , Movie	isActorIn
Who was the lyricist of the movie?	Movie, Lyricist	hasLyricist
What is the genre of the movie X?	Genre, Movie	isGenreOf, belongsToGenre
Where was the Movie X originated?	dbo:Country, Movie	isReleasingCountryOf
Who was the cinematographer of the movie X?	Movie, Cinematographer	hasCinematographer
Who was the editor of the film X?	Movie, Film_Editor	hasEditor
Who was the lyricist of the movie X?	Movie, Lyricist	hasLyricist
Who is the script writer of the movie X?	Movie, Script_Writer	hasScriptWriter
Who are the singers of the movie X?	Movie, Singer	hasSinger
Name the awards which have been received by a movie X?	Movie, Award	isAwardedWith
Name the movies which have received the Award X?	Not Applicable	No such property has been defined
Name the production company which has produced the movie X?	Production_Company, Movie	Produced
Who is the sound recordist of the movie Z?	Movie, Sound_Recordist	hasSoundRecordist
Who is the distributor of the movie X?	Movie, Distributor	isDistributedBy
Who is the production manager of the Movie X?	Movie, Production_Manager	hasProductionManager
Name the languages in which the movies have been translated.	Movie, dbo:Language	isTranslatedTo
In which country, the movie X was released?	dbo:Country, Movie	isReleasingCountryOf
Who is the finance manager of the movie X?	Movie, Finance_Manager	hasFinanceManager
Name the movies which are directed by the Director M?	Director, Movie	isDirectorOf
Name the musicians who played as background music player in Movie X?	Movie, Musician	hasMusician

4. Efficacy Analysis:

The ontology is intended to design to be able to encompass the associated personnel with the total movie production process. The entire movie making process involves a series of contiguous steps [Development, Pre-Production, Production, Post-Production and Distribution] involving designated and functional manpower. As the present ontology has been integrated with Imdb (International Movie Database) ontology, the same class dbo:Person has been in use and further developed associating many other personnel e.g. Dress man, Costume Designer, Production

Controller, Production Supervisor, Sound Recordist, Sound Mixer, Hair Dresser and many other entities. Several competency questions have been framed and out of these only one question could not be answered due to absence of defining such property. The success of the ontology can be ascertained when object properties are defined against each declaration of personnel as well as framing of more and more critical questions from the users and domain experts. The following pictures shows the different sub-classes of the super-class dbo:Person and this class has been subsumed from the ontology developed by IMDb(Osman,2021)[6].

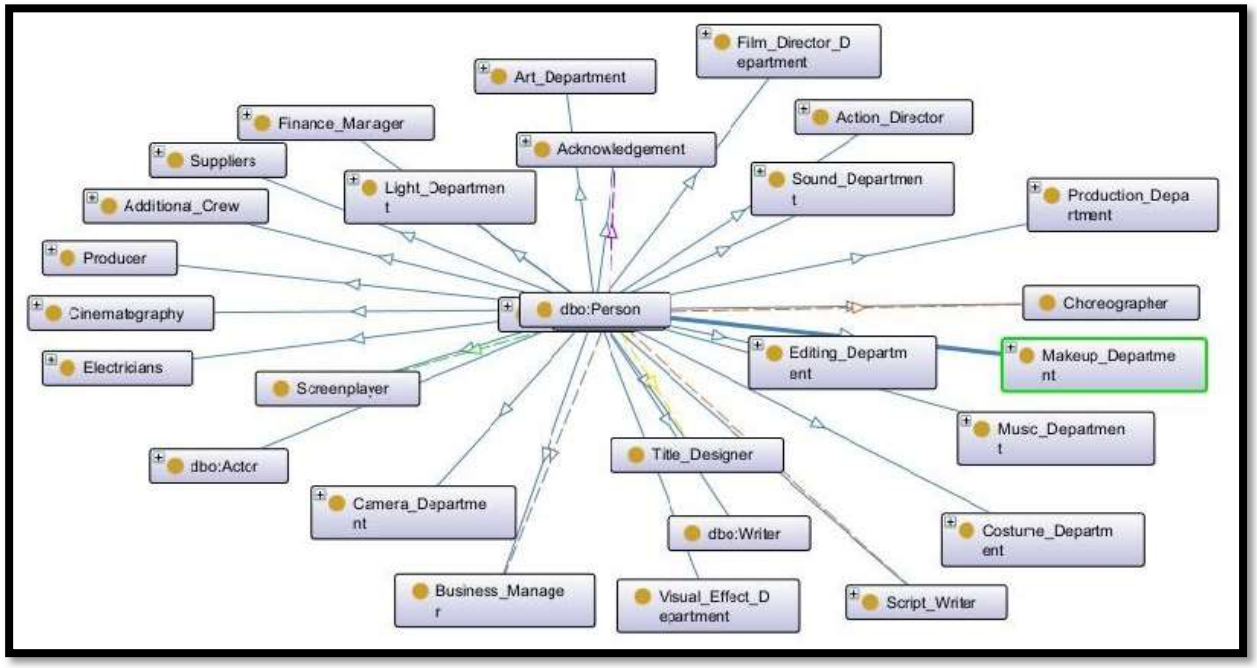

Fig-1: Person associated with Movie making Process [Generated through OntoGraf in Protege]

Statistically, the resultant ontology, after integration and further development, is consisted of 1928 axioms, 1220 logical axioms, 691 declaration axioms, 179 classes, 119 object properties, 4 data properties, 383 individuals, 6 annotated properties, 162 subclasses, 3 equivalent classes, 8 disjoint classes, 16 inverse object properties, 665 class assertions, 115 object property assertions 15 annotation assertions.

5. Conclusion:

In this paper, a domain ontology has been developed by defining classes, entities and instances and also mapping them with different properties as well as merging with other standard ontology. Movie is such a domain which is an agglomeration of complex processes. Modelling such complex domain into ontology is really a technically challenging task. While developing the

[6]Osman, Inès, Sadok Ben Yahia, and Gayo Diallo. "Ontology integration: approaches and challenging issues." Information Fusion 71 (2021): 38-63.

ontology, it was learnt that, with the application of new computer technologies, the job roles in production processes are also changing, for example, VFX, Maya, Moho and other commercial animation softwares are being continuously used in movie making process and thus the names of the job-roles are also changing. But there is no ontology which has incorporated latest technologies and job roles. Ontology development is always incremental process, there is still open space for further development in future.

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