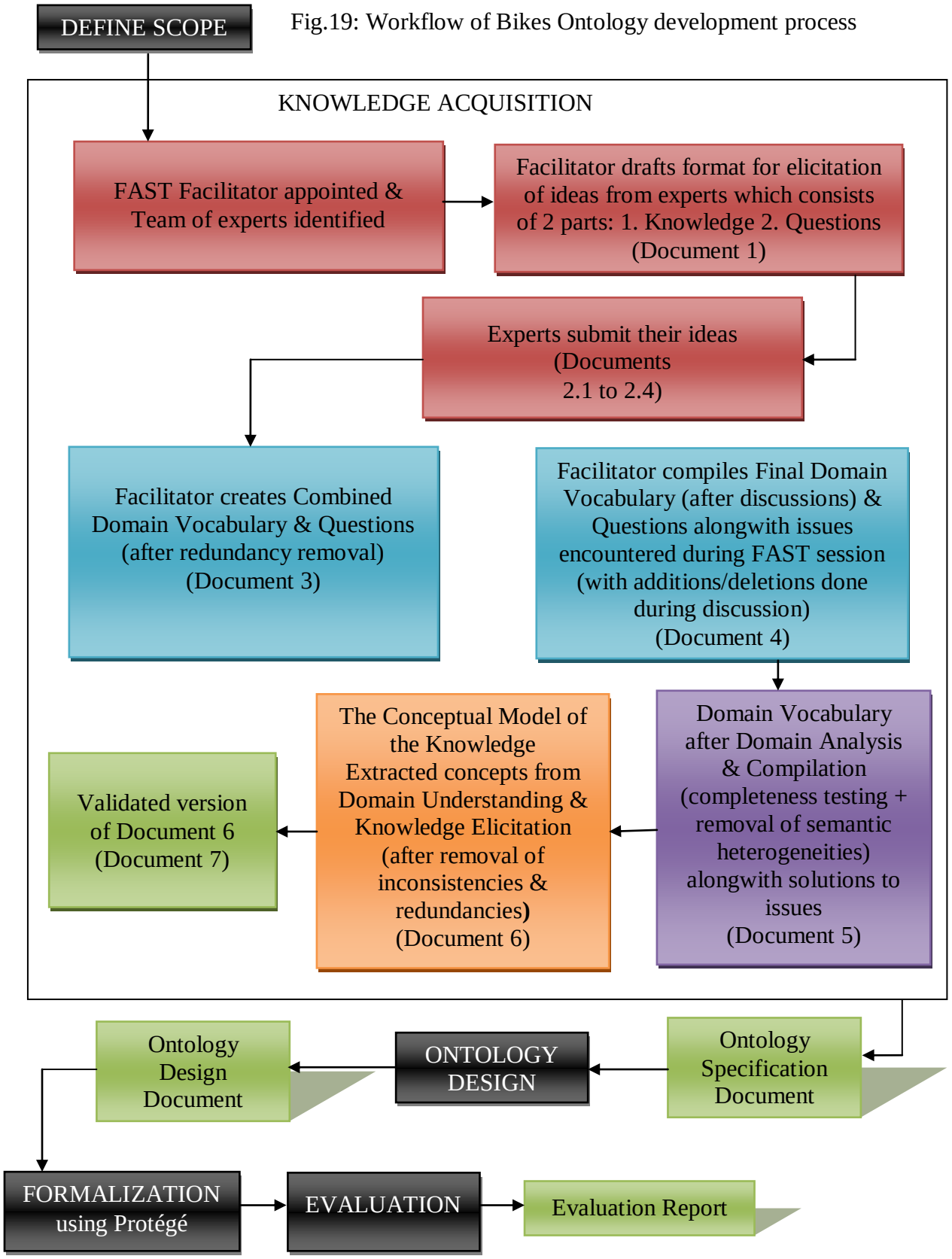
Chapter 4

DISCUSSION

Here we illustrate our methodology by working out an Ontology of Bikes. The intended ontology of Bikes will be representation of bikes in the domain of ontology. Millions of people all over the world choose bikes over automobiles for the thrill, speed, and high performance capabilities. Bikes have become a major means of transportation over the years. There exists a large group of bike users who either use it for transportation or for sports. India in one of the largest markets around the world and all has become a key market of all manufactures.

The purpose of this ontology is to provide information on bikes based on the criteria specified by the users like Make, Engine capacity, Power, Price, Fuel tank capacity, Mileage etc.
Following is the workflow of the Bikes Ontology development process (figure 19):

Fig.19: Workflow of Bikes Ontology development process



4.1 SCOPE

Date: ……

The intended ontology of Bikes will be representation of bikes in the domain of ontology. The following are the related details:

- Target Users:
  The end users of the bikes ontology are targeted to be customers who want some information regarding bikes. Other users include Bike manufacturers and retailers.

- Purpose:
  The purpose of this ontology is to provide information on bikes based on the criteria specified by the users:
  - The ontology would hold information to answer queries of customers based on single (/combination of) parameter(s) which are Make, Engine capacity, Power, Price, Fuel tank capacity, Mileage, Brake type, Weight, Wheel type, Ignition and Number of gears.
  - Bike manufacturing organizations can use this ontology to identify the bike configurations that are suitable for a particular market and can also use it to analyze current sales and make future predictions. This will guide them to plan their production & inventory.
  - This ontology can prove to be beneficial for bike retailers as they can use it to plan their inventory and analyze their sales.

- Pros:
  The advantage that this ontology would provide is its capability to answer the queries of the customers across a large information base of different bikes, based on multiple search criteria with complex inter-relations.

4.2 **DOCUMENT 1:** Date: ……

FORMAT FOR ELICITATION OF IDEAS

(Created by: Mr. Magendra Singh)

Name: ……

Educational Qualification: …….

Domain corpus consisting of various keywords:

……

……

……

……

……

……

……..

Date: …. /…./…….. Signature: ……..

( )

4.3 DOCUMENT: 6

The following document represents the conceptual model of the knowledge. The Ontology Specification document is presented next in section 4.4. The various other documents namely Document 2.1 to 2.4, 3, 4, 5, 7 (see figure -18) are listed in *Appendix-A* at the end of the thesis.

Date: ……

THE CONCEPTUAL MODEL OF THE KNOWLEDGE:

EXTRACTED CONCEPTS FROM DOMAIN UNDERSTANDING & KNOWLEDGE ELICITATION

(AFTER REMOVAL OF INCONSISTENCIES & REDUNDANCIES)

Step 1: Resolve inconsistencies and the redundancies

Engine Capacity

Power

Make

Mileage

Brakes (Disk/Drum)

Fuel Tank Capacity

Price

Ignition (KickStart/SelfStart)

Seat type (Split/Single/Step/Normal)

Weight

Wheel type (Alloy/Wirespoke)

Weight

Gears

~~(0-60)~~

~~Looks~~

~~Ground clearance~~

~~Tire size~~

~~Tire Width~~

~~Visor~~

~~Warranty (upto kms?)~~

~~Maintenance~~

~~Free Service~~

~~Suspension~~

Hero Honda

Hero

Bajaj

~~Kawasaki~~

Royal Enfield

Yamaha

TVS

~~Harley Davidson~~

Suzuki

Karizma (Normal)→ 223cc, 17bhp @7000 rpm, Rs. 74000, 15ltr., 40km/ltr, Combo, 150kg, Alloy, self, 5

Karizma (ZMR) → 223cc, 17.6bhp @ 7000rpm, Rs.120000 ,16 ltr., 40km/ltr, Disk, 159kg, Alloy, Self, 5

Splendor (Plus) → 97.2cc, 7.5bhp @ 8000rpm, Rs. 45000, 10.5ltr., 75km/ltr, Drum, 109kg, WireSpoke, Kick, 4

Splendor (NXG) → 97.2cc, 7.7bhp @ 7500rpm, Rs.48000 , 10.3ltr., 65km/ltr, Drum, 107kg, Alloy, Kick, 4

Splendor (Super) → 125cc, 9bhp @ 7000rpm, Rs.47000 ,12 ltr., 70km/ltr, Drum, 121kg, Alloy, Self, 4

Splendor (Pro)→97.2 cc, 7.6bhp @ 7500rpm, Rs.55000 , 11ltr., 80km/ltr, Drum, 109kg, Alloy, Self, 4

Paasion Pro → 97.2cc, 7.6bhp @ 7500rpm, Rs.53000 , 12.8ltr., 75km/ltr, Combo, 119kg, Alloy, Self, 4

CD-Dawn → 97.2cc, 7.7bhp @ 7500rpm, Rs.37000 , 10.5ltr., 75km/ltr, Drum, 107kg, Wire Spoke, Kick, 4

CD-Deluxe → 97.2cc, 7.7bhp @ 7500rpm, Rs.43000 , 10.5ltr., 75km/ltr, Drum, 107kg, Alloy, Kick, 4

Glamour (Normal) → 125cc, 9bhp @ 7000rpm, Rs.55000 ,13.6 ltr., 60km/ltr, Combo, 125kg, Alloy, Self, 4

Glamour (PGMFi) → 125cc, 9bhp @ 7000rpm, Rs.58500 ,12 ltr., 70km/ltr, Combo, 125kg, Alloy, Self, 4

Achiever → 150cc, 13.4bhp @ 8000rpm, Rs.60000 ,12.5 ltr., 55km/ltr, Combo, 134kg, Alloy, Self, 5

CBZ Xtreme → 150cc, 14.4bhp @ 8500rpm, Rs. 65000, 12.3ltr., 50km/ltr, Combo, 141kg, Alloy, Self, 5

Hunk→ 150cc, 14.2bhp @ 8500rpm, Rs. 63000 , 12.2ltr., 50km/ltr, Disk, 145kg, Alloy, Self, 5

Impulse→ 150cc, 13bhp @ 75000rpm, Rs.79000 , 11ltr., 55km/ltr, Combo, 119kg, Alloy, Self, 5

CT100 → 100cc, 8.2bhp @ 7500rpm, Rs. 32000, 10.5ltr., 80km/ltr, Drum, 109kg, Wire Spoke, Kick, 4

Pulsar 135 LS → 135cc, 13.3bhp @ 9000rpm, Rs. 57000, 8ltr., 68km/ltr, Combo, 122kg, Alloy, Self, 5

Pulsar 150 DTS-i → 150cc, 14.09bhp @ 8500rpm, Rs. 63000, 15ltr., 48km/ltr, Combo, 130kg, Alloy, Self, 5

Pulsar 180 DTS-i → 180cc, 16.5bhp @ 8000rpm, Rs. 67000, 15ltr., 55km/ltr, Combo, 140kg, Alloy, Self, 5

Pulsar 200 DTS-i → 200cc, 18bhp @ 8000rpm, Rs. 70000, 15ltr., 40km/ltr, Disk, 145kg, Alloy, Self, 5

Pulsar 220 DTS-i → 220cc, 20bhp @ 8500rpm, Rs. 90000, 15ltr., 35km/ltr, Disk, 150kg, Alloy, Self, 5

Avenger 220 DTS-i →220 cc, 16.5bhp @ 8000rpm, Rs. 75000, 14ltr., 40km/ltr, Combo, 152kg,

Alloy, Self, 5

Discover 135 → 135cc, 13.1bhp @ 8500rpm, Rs. 55000, 10ltr., 60km/ltr, Combo, 125kg, Alloy, Self, 4

Discover 125 → 125cc, 11bhp @ 8000rpm, Rs. 52000, 8ltr., 85km/ltr, Drum, 125kg, Alloy, Self, 4

Discover 100 → 100cc, 7.5bhp @ 7500rpm, Rs. 44500, 10.3ltr., 91km/ltr, Drum, 115kg, Alloy, Self, 4

Platina 100 → 99.27cc, 8.2bhp @ 7500rpm, Rs. 35500, 13ltr., 108km/ltr, Drum, 113kg, Alloy, Kick, 4

XCD → 125cc, 7.01bhp @ 7000rpm, Rs. 46000, 13ltr., 109km/ltr, Drum, 115kg, Alloy, Self, 4

Duke200 → 200cc, 25bhp @ 10000rpm, Rs. 130000, 10.5ltr., 35km/ltr, Disk, 136kg, Alloy, Self, 6

~~Ninja 250R~~

~~Ninja 650R~~

Bullet Electra Twinspark →350 cc, 19.8bhp @ 5250rpm, Rs. 111000, 13.5ltr., 40km/ltr, Combo, 183kg, Wire Spoke, Self, 5

Bullet Electra EFI → 500cc, 27.2bhp @ 5250rpm, Rs. 125000, 14.5ltr., 40km/ltr, Combo, 185kg, Wire Spoke, Self, 5

Bullet Electra Deluxe →500 cc, 27.2bhp @ 5250rpm, Rs. 140000, 14.5ltr., 45km/ltr, Combo, 187kg, Wire Spoke, Self, 5

Bullet 350 Twinspark → 350cc, 19.8bhp @ 5250rpm, Rs. 100000, 13.5ltr., 45km/ltr, Combo, 180kg, Wire Spoke, Self, 5

Royal Enfield Classic 500 → 500cc, 27.2bhp @ 5250rpm, Rs. 155000, 13.5ltr., 35km/ltr, Combo, 187 kg, Wire Spoke, Self, 5

Royal Enfield Classic 350 → 350cc, 19.8bhp @ 5250rpm, Rs. 117000, 13.5ltr., 45km/ltr, Combo, 182kg, Wire Spoke, Self, 5

Thunderbird Twinspark → 350cc, 19.8bhp @ 5250rpm, Rs. 116300, 15.5ltr., 45km/ltr, Combo, 182kg, Wire Spoke, Self, 5

R15 → 150cc, 16.8bhp @ 8500rpm, Rs. 119000, 12ltr., 45km/ltr, Disk, 136kg, Alloy, Self, 6

FZ → 153cc, 14bhp @ 7500rpm, Rs. 74900, 12ltr., 50km/ltr, Combo, 135kg, Alloy, Self, 5

Victor → 110cc, 8.1bhp @ 7250rpm, Rs. 50000, 11ltr., 85km/ltr, Drum, 113kg, Wire Spoke, Kick, 4

CBR → 250cc, 26.4bhp @ 8500rpm, Rs. 160000, 13ltr., 30km/ltr, Disk, 165kg, Alloy, Self, 6

Shine → 125cc, 10.3bhp @ 7500rpm, Rs. 53500, 11ltr., 60km/ltr, Drum, 122kg, Alloy, Self, 4

Unicorn → 150cc, 62000bhp @ 8000rpm, Rs. 62000, 13ltr., 60km/ltr, Combo, 165kg, Alloy, Self, 5

~~Superlow (560000, 883)~~

~~Iron883 (883, 660000)~~

~~Roadster (883, 765000)~~

~~Forty-Eight (1202,8,65000)~~

~~Nightster (1202,110000)~~

~~XR1200X(1200,121000)~~

~~StreetBob(1010000,1585)~~

~~SuperglideCustom (1165000,1585)~~

~~Mountain Bikes~~

~~Dipper~~

~~Model~~

~~Affordable~~

~~Light Weight~~

~~Looks~~

Step 2: Identify Classes, sub-classes & individuals

Root class → *Thing*

Sub-class of *Thing* → *Bikes*

Subclasses of *Bikes* →

Make
EngineCapacity
Power
Price
FuelTankCapacity
Mileage
Brakes
Weight
WheelType
Ignition
Gears

NamedBikes (It is supposed to be merely a container class.)

Subclasses of *Make* →*Hero Honda*, *Hero*, *Bajaj*, *Royal Enfield*, *Yamaha*, *TVS* and *Honda*

Subclasses of *Brakes* → *Combo*, *DiskBrakes*, *DrumBrakes*

Subclasses of *WheelType* → *Alloy*, *Wirespoke*

Subclasses of *Ignition* → *KickStart*, *SelfStart*

Subclasses of *Gears* → *4*, *5*, *6*

Subclasses of *NamedBikes* →

HeroHondaBikes
HeroBikes
BajajBikes
RoyalEnfieldBikes
YamahaBikes
TVSBikes
HondaBikes

Subclasses of *HeroHondaBikes* →

Karizma (Normal) Model:
◊ Karizma (Normal)
Karizma (ZMR) Model:
◊ Karizma (ZMR)
Splendor (Plus) Model:
◊ Splendor (Plus)
Splendor (NXG) Model:
◊ Splendor (NXG)
Splendor (Super) Model:
◊ Splendor (Super)
Splendor (Pro) Model:
◊ Splendor (Pro)
Passion Pro Model:
◊ Passion Pro

CD-Dawn Model:

◊ CD-Dawn

CD-Deluxe Model:

◊ CD-Deluxe

Glamour (Normal) Model:

◊ Glamour (Normal)

Glamour (PGMFi) Model:

◊ Glamour (PGMFi)

Achiever Model:

◊ Achiever

CBZ Xtreme Model:

◊ CBZ Xtreme

Hunk Model:

◊ Hunk

Subclasses of *HeroBikes* → *Impulse Model*: ◊ Impulse

Subclasses of *BajajBikes* →

CT100 Model: ◊ CT100

Pulsar 135 LS Model:

◊ Pulsar 135 LS

Pulsar 150 DTS-i Model:

◊ Pulsar 150 DTS-i

Pulsar 180 DTS-i Model:

◊ Pulsar 180 DTS-i

Pulsar 220 DTS-i Model:

◊ Pulsar 220 DTS-i

Avenger 220 DTS-i Model:

◊ Avenger 220 DTS-i

Discover 135 Model:

◊ Discover 135

Discover 125 Model:

◊ Discover 125

Discover 100 Model:

◊ Discover 100

Platina 100 Model:

◊ Platina 100

Duke200 Model:

◊ Duke200

Subclasses of *RoyalEnfieldBikes* →

Bullet Electra Twinspark Model:

◊ Bullet Electra Twinspark

Bullet 350 Twinspark Model:

◊ Bullet 350 Twinspark

Bullet Electra EFI Model:

◊ Bullet Electra EFI

Bullet Electra Deluxe Model:

◊ Bullet Electra Deluxe

Royal Enfield Classic 500 Model:

◊ Royal Enfield Classic 500

Royal Enfield Classic 350 Model:

◊ Royal Enfield Classic 350

Thunderbird Twinspark Model:

◊ Thunderbird Twinspark

Subclasses of *YamahaBikes* →

R15 Model: ◊ R15

FZ Model: ◊ FZ

Subclasses of *TVSBikes* →

Victor Model: ◊ Victor

Subclasses of *HondaBikes* →

CBR Model: ◊ CBR

Shine Model: ◊ Shine

Unicorn Model: ◊ Unicorn

Step 3.1: Identify Properties

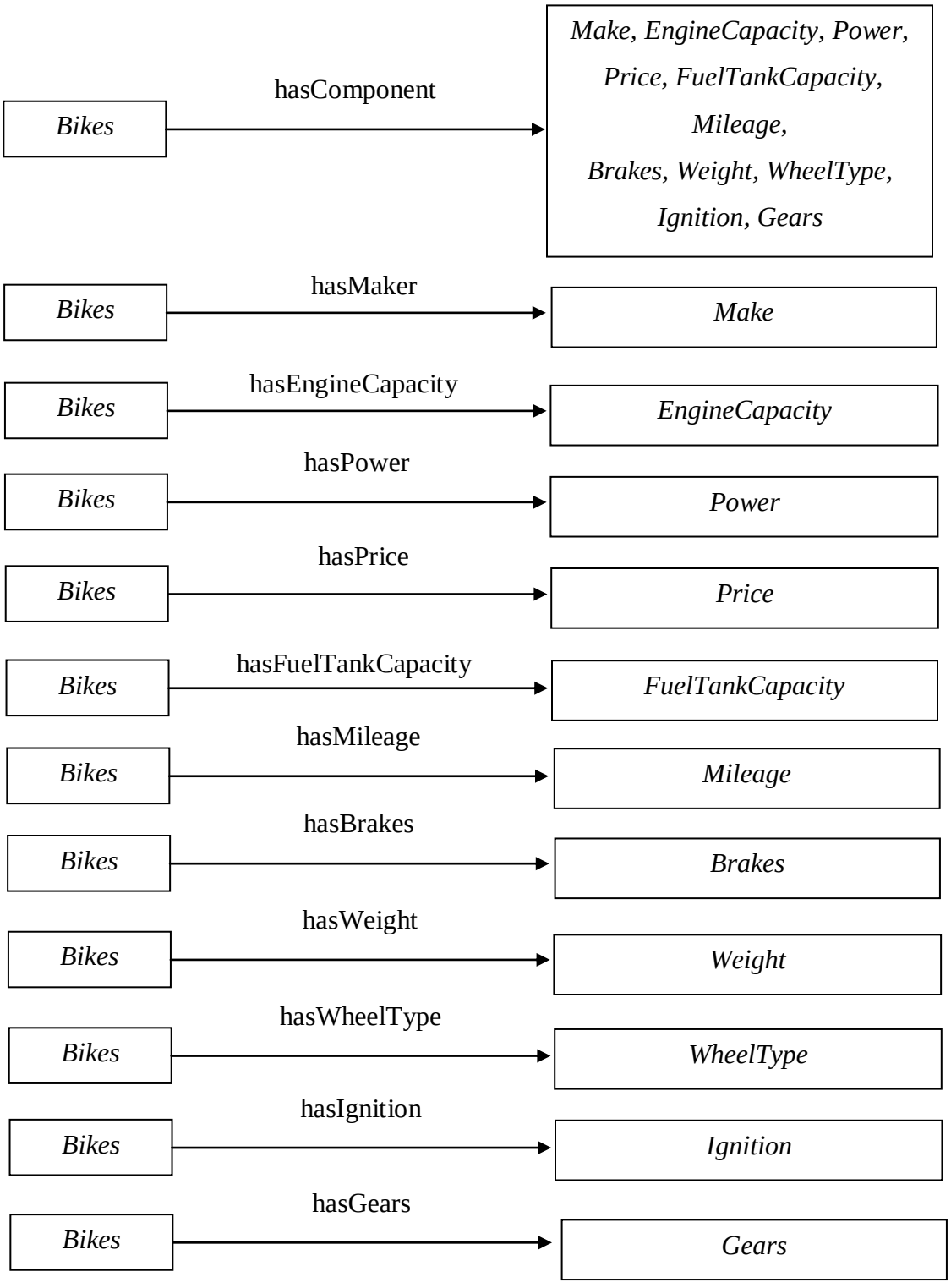
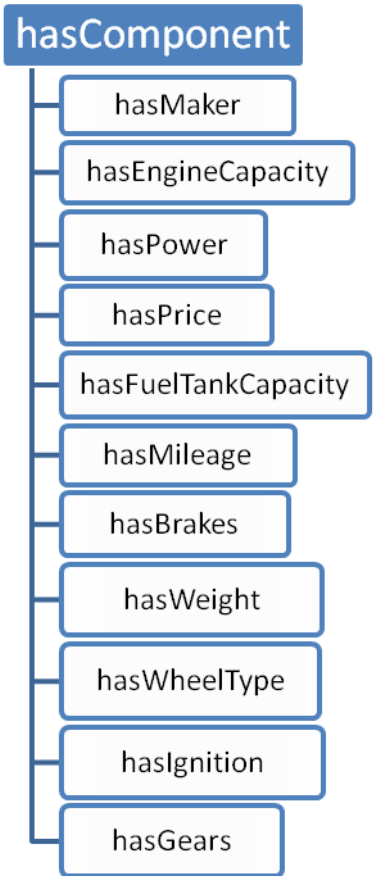


Fig. 19: Properties

Thus property hierarchy is:

Fig. 20: Property hierarchy



Step 3.2: Specify the Domains and Ranges of properties:

Table 2: Domain & Ranges of properties

Name	Domain	Range
hasMaker	Bikes	Make
hasEngineCapacity	Bikes	Float
hasPower	Bikes	String
hasPrice	Bikes	Integer
hasFuelTankCapacity	Bikes	Float
hasMileage	Bikes	Float
hasBrakes	Bikes	Brakes
hasWeight	Bikes	Float
hasWheelType	Bikes	WheelType
hasIgnition	Bikes	Ignition
hasBrakes	Bikes	Brakes

Step 3.3: Identify Inverse Properties

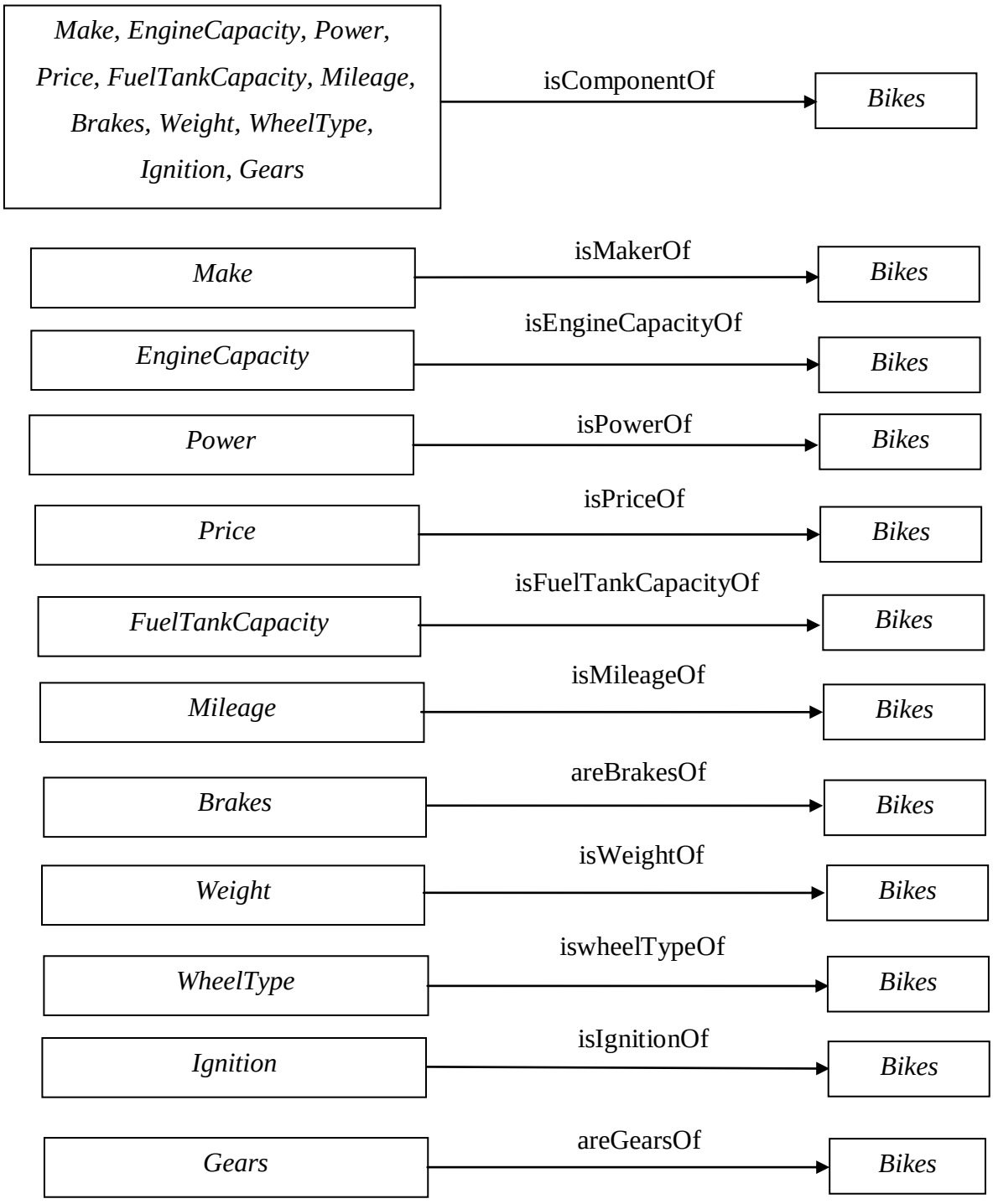
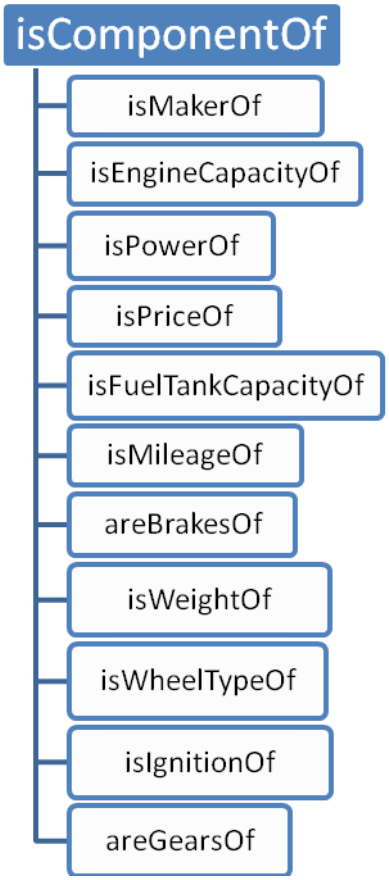


Fig. 21: Inverse Properties

Thus the inverse-property hierarchy is:

Fig. 22: Inverse-property hierarchy



Step 3.4: Specify the Domains and Ranges of inverse properties:

Table 3: Domain & Ranges of Inverse Properties

Name	Domain	Range
isMakerOf	Make	Bikes
isEngineCapacityOf	Float	Bikes
isPowerOf	String	Bikes
isPriceOf	Integer	Bikes
isFuelTankCapacityOf	Float	Bikes
isMileageOf	Float	Bikes
areBrakesOf	Brakes	Bikes
isWeightOf	Float	Bikes
isWheelTypeOf	WheelType	Bikes
isIgnitionOf	Ignition	Bikes
areBrakesOf	Brakes	Bikes

4.4 ONTOLOGY SPECIFICATIONS DOCUMENT

Domain: Automobile/Vehicles/Bikes

Date: 10 May 2012

Author: Mr. Magendra Singh

1. **Introduction**

This document aims at defining the overall requirements for Ontology of Bikes. The final ontology will be having only features/functionalities mentioned in this document and assumptions for any additional functionality/feature should not be made by any of the parties involved in developing/testing/implementing/using this product. In case it is required to have some additional features, a formal change request will need to be raised and subsequently a new release of this document and/or product will be produced.

1.1. Purpose

The purpose of this document is to record the requirements of an ontology of bikes. This document is also the starting point for design phase of ontology development methodology and is also used for testing the ontology when developed.

1.2. Scope

The intended ontology of Bikes will be representation of bikes in the domain of ontology. The purpose of this ontology is to provide information on bikes based on the criteria specified by the users.

- The ontology would hold information to answer queries of customers based on single (/combination of) parameter(s) which are Make, Engine capacity, Power, Price, Fuel tank capacity, Mileage, Brake type, Weight, Wheel type, Ignition and Number of gears.
- Bike manufacturing organizations can use this ontology to identify the bike configurations that are suitable for a particular market and can also use it to analyze current sales and make future predictions. This will guide them to plan their production & inventory.
- This ontology can prove to be beneficial for bike retailers as they can use it to plan their inventory and analyze their sales.

The advantage that this ontology would provide is its capability to answer the queries of the customers across a large information base of different bikes, based on multiple search criteria with complex inter-relations.

1.3. Definitions, acronyms & abbreviations

- Kms: Kilometers
- Ltr. : Liter
- Rs. : Rupees (Indian currency)
- UI: User Interface
- BE: Bachelor of Engineering
- B.Tech: Bachelor of Technology
- OWL: Web Ontology Language
- Customer: A person who either desires to purchase a bike or needs some information related to bikes.
- Bike retailer: An organization who sells bikes to customers on retail in market.
- Make: The name of the company that produces that bike.
- Engine capacity: The capacity of a particular bike's engine.
- Power: The maximum power produced by the engine of the bike.
- Price: The price of 1 unit of the particular bike.
- Fuel tank capacity: The amount of fuel (in liters) that can be held in the fuel tank of the bike.
- Mileage: The distance covered (in kilometers) by the bike in consumption of one liter of fuel.
- Type of brake: The braking mechanism (Drum/ Disk/ Combo) that is employed in a particular model of bike.

1.4. References

Document 1: Format for elicitation of ideas

Document 2: Domain corpus as identified by Expert 1: Mr. Magendra Singh

Document 3: Domain corpus as identified by Expert 2: Mr. Vipin Sharma

Document 4: Domain corpus as identified by Expert 3: Mr. Sandeep Saini

Document 5: Domain corpus as identified by Expert 4: Mr. Kushal Verma

Document 6: Combined domain vocabulary & questions (after redundancy removal).

Document 7: Final domain vocabulary & questions alongwith issues encountered during FAST session (with additions/deletions done during discussion).

Document 8: Domain Vocabulary after review (completeness testing + Removal of semantic heterogeneities) alongwith solutions to issues.

Document 9: Extracted concepts from Domain Understanding & Knowledge Elicitation (after removal of inconsistencies & redundancies).

Document 10: The Conceptual Model of the Knowledge (Reviewed version of Document 9).

1.5. Sources of knowledge

Books:

- Autocar India
- Overdrive

Experts:

- Mr. Magendra Singh
- Mr. Vipin Sharma
- Mr. Sandeep Saini
- Mr. Kushal Verma

Websites:

- zigwheels.com/bikes
- heromotorcorp.com/two-wheeler-motorcycles

- bajajauto.com
- autos.maxabout.com
- http://www.royalenfield.com/motorcycles/motor-cycles-landing.aspx
- http://www.harley-davidson.in/harley-davidson-india-our-motorcycles.html
- http://www.yamaha-motor-india.com/product/index.html
- http://www.priceindia.in/bike/yamaha-bike-price-list/
- http://www.tvsmotor.in/index.asp#
- http://www.tvsapache.in/apache-rtr-160-specifications.html
- http://www.bmwmotorcycles.com/us/en/index.html
- http://www.infibeam.com
- http://www.bikedekho.com

1.6. Overview

Section 2 of this document describes the overview of the system in terms of general characteristics of the ontology, information about the possible users of the ontology, possible constraints on the ontology, functions of ontology and user characteristics.

2. **Overall Description**

There are various vehicles that are being used as a mode of transportation in today's world. One specific type of vehicle is a *bike*, also known as *motorcycle*. There exist many bikes enthusiasts who love bikes. Moreover, it is also one of the most popular modes of transportation which is apparent from the fact that there are millions of bikes being sold each year in India.

The ontology of bikes will be a representation of bikes in domain of ontology. The customers who wish to buy a bike can use this ontology to seek information about the optimal bike for them based on their preferences for different criterion such as price, engine capacity, type of brakes & make of the bike etc.

2.1. Ontology Functions

The ontology will store the following elements:

- Class hierarchy
- Properties
- Inverse properties
- Instances

Based on the above information, the customer can classify bikes according to the following parameters separately or in combination with each other- Make, Engine capacity, Power, Price, Fuel tank capacity, Mileage, Brake type, Weight, Wheel type, Ignition and Number of gears.

2.2. User Characteristics

Users of the system are customers. Assuming that they have very less or no knowledge of using such systems, another layer consisting of UI should be added on top of this ontology.

- Educational Qualification:
  An engineer with BE/B.Tech or equivalent at minimum.
- Experience Requirements:
  The user should have knowledge of basic characteristics of bikes.
- Technical Expertise:
  The user should have knowledge of OWL & Protégé.

2.3. Constraints

The customers will have option to only explore and search from information base consisting of information related to bikes available in India.

// INSERT Ontology Design Document HERE // (10) PAGES

Magendra Singh
M.Tech- Software Engineering
Delhi Technological University

4.6 FORMALIZATION

The ontology was formalized using the Protégé tool from Stanford University [31].

Fig.29: Class hierarchy for Ontology of Bikes

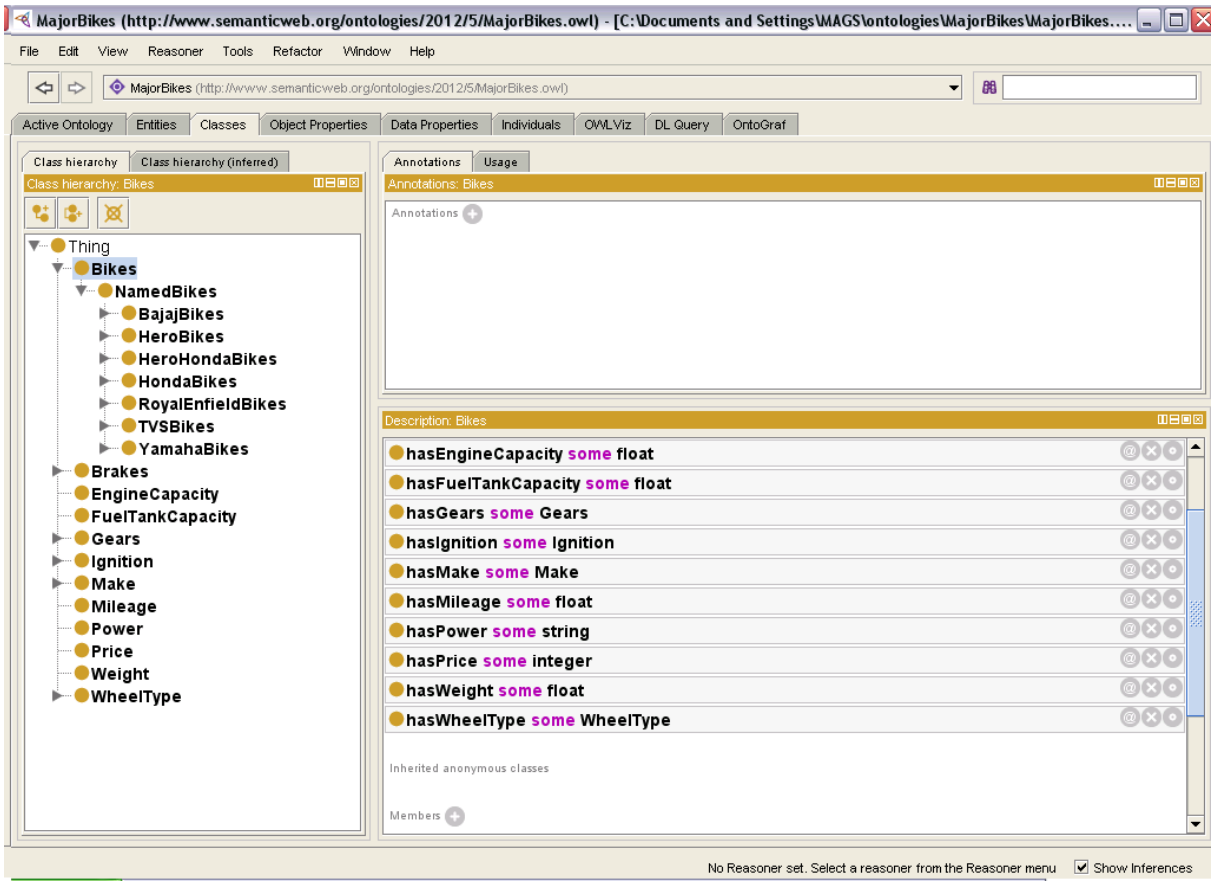


Fig. 30: Object Properties for Ontology of Bikes

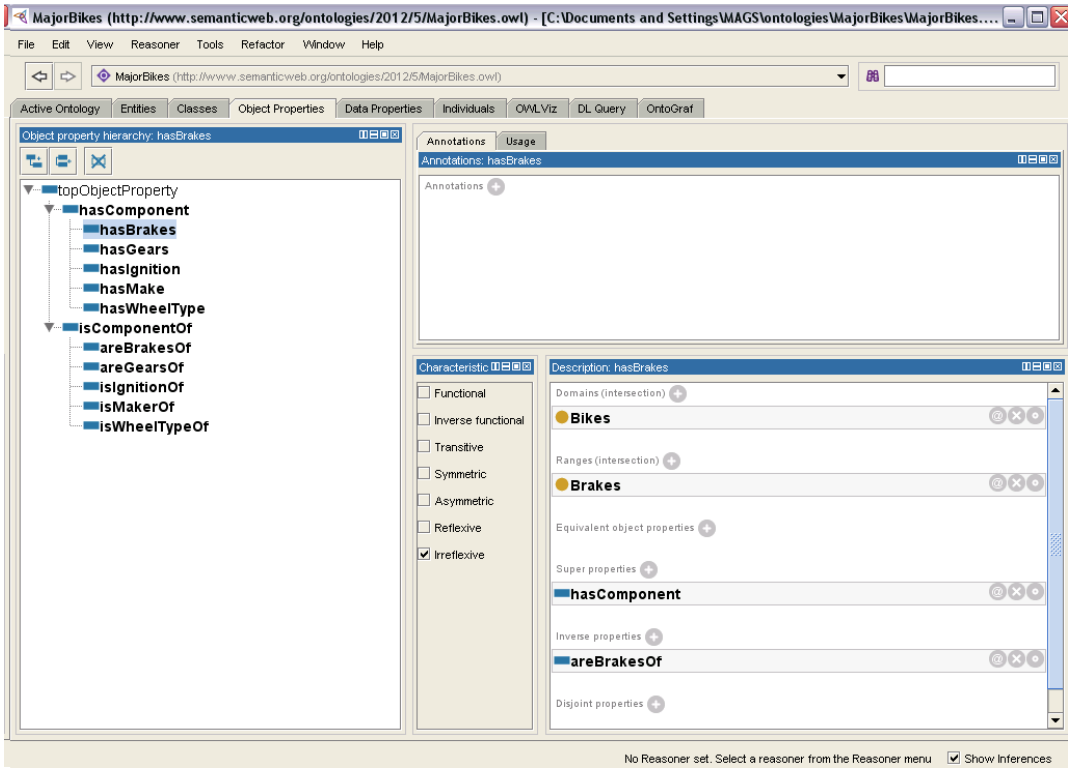


Fig. 31: Data Properties for Ontology of Bikes

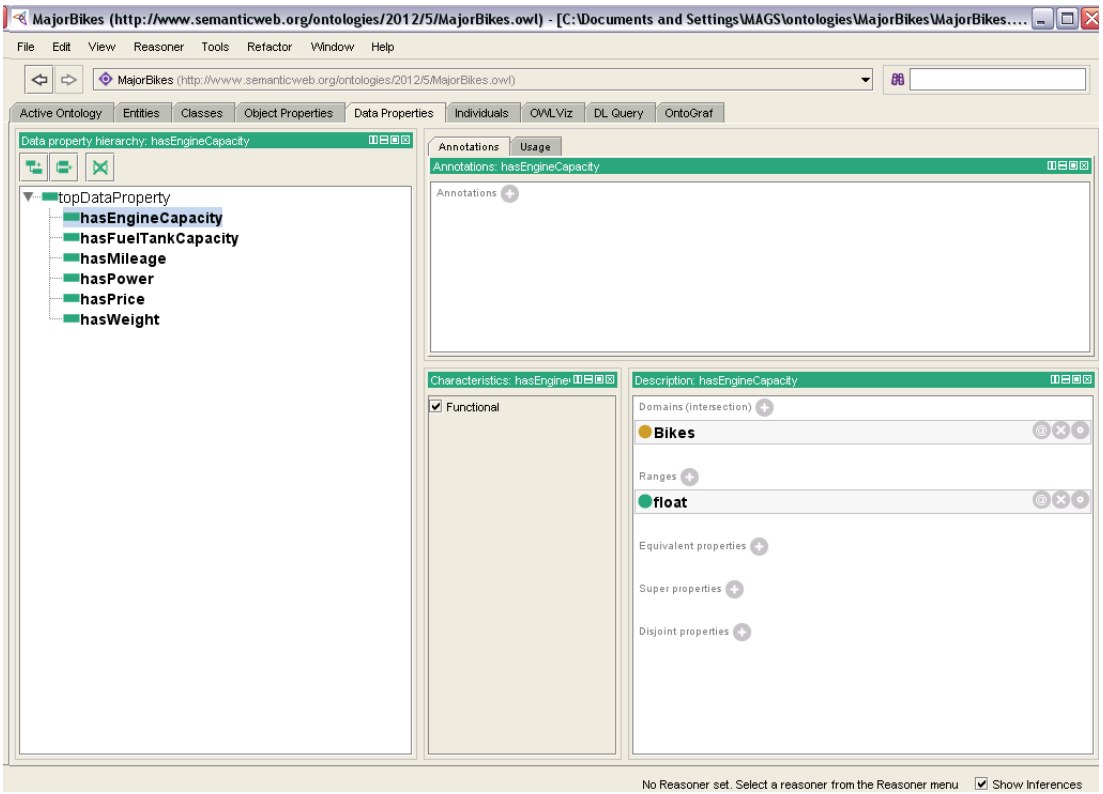


Fig. 32(a): Individuals for various Bikes- Hero Honda Karizma(ZMR)

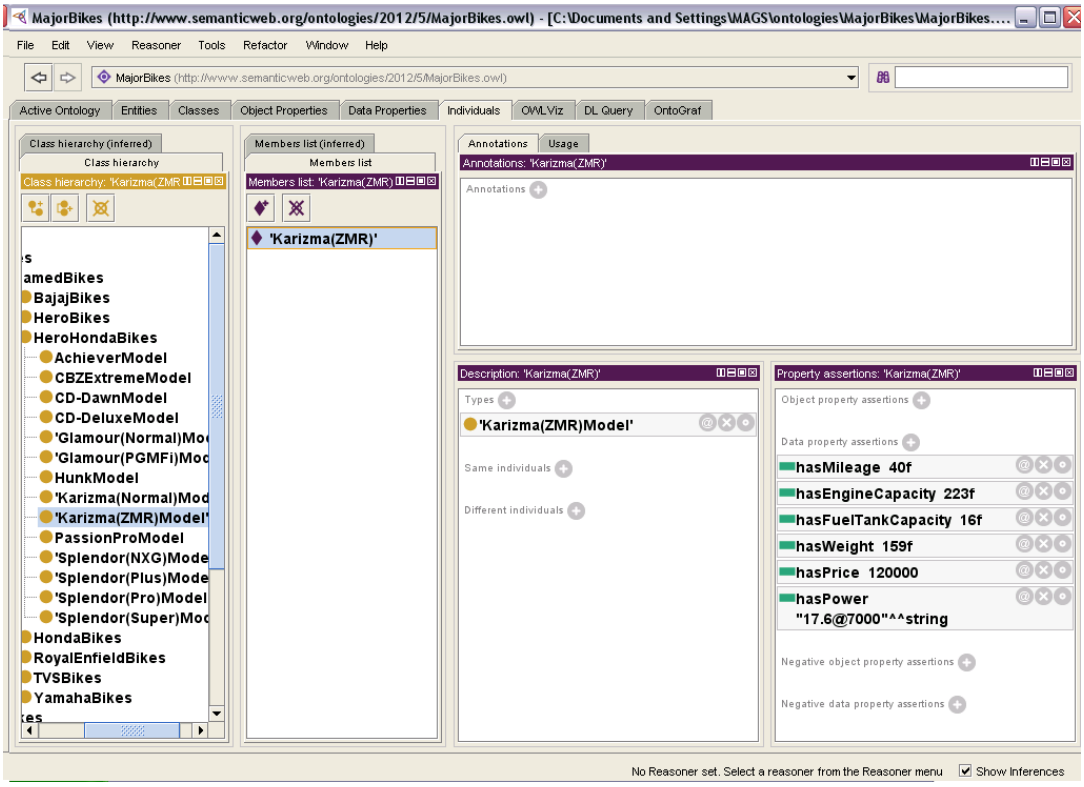


Fig. 32(b): Individuals for various Bikes- Bajaj Duke200