Dimension	Measure	Metric	ORKG Realization	How could be measured in ORKG?	KGMM Level	Relation to KGMM
Completeness	*Instance completeness*	AI / RI Range [0-1] AI = available instances RI = required instances Required instances can be either determined by a sample of representative classes, or some user evaluation or a gold standard	ORKG templates must follow a predefined structure. Predefined property ranges ensure data can only be added within the specified range, which addresses semantic accuracy on a shallow level. Further efforts to guarantee semantic accuracy include human validation and curation of the entered data	The comparison reviewer e.g., can say 2 contributions are enough	Level 2: Completeness	The completeness of the KG gives meaning to the data. So all properties and instances of a KG must be complete to satisfy the data consumers' needs.
	Property completeness	IP:nP = IP/nP Range [0-1] IP = incomplete properties nP = number of available properties The ratio of incomplete properties divided by the number of properties in a given KG	The properties are completed with the help of the reviewers' suggestions. Only the comparison author can decide whether to add a certain suggested property or not.	The comparison reviewers e.g., can say 2 properties are enough		
	Documentation completeness	DR / TR Range [0-1] DR = documented resources and properties TR = total resources and properties The ratio of documented resources and properties Automatically measured	How many resources, properties are complete	The comparison reviewers can say whether the resources, and properties descriptions, that are used in the comparison are descriptive or not	*Not mentioned in this version*	
	Linkability	IL:nI = IL/nI Range [0-1] IL = instances with links to external ontologies...e nI = total of instance How much a resource is linked? It is a ratio of instances that have links to externa	External authoritative sources can be referenced everywhere throughout the ORKG. For example, comparison reviewers can to nominate external ontologies to be linked for the specified comparison	two or more values do not conflict with each other	Level 5: Linkability	The level of linkability means that the data is published, complete, represented, and stable. If this is the case, the data is trusted and could be linked to other data sources.
	Trustworthiness	It could be calculated using the median value of the usres who provided comments like that: median (Uc)=Uc (Ut+1)/2 Ut = is the number of users who believe a dataset is trustworthy Uc = is the set of users who provided comments The proportion of users who believe a dataset is trustworthy compared to all users who provide comments on its source can be used to determine the dataset's trustworthiness. If a dataset has a genuine and distinct reference (e. g, DOI) as its source, that could potentially be a sign of its trustworthiness. and/or DOI for example	The data is trusted when it has a source or/ and the comparison reviewers confirm the data is trusted	What the users say about the data?	Level 2: Completeness	Even if KG properties and instances are completed, it will not be useful to the customer if it is not a source of trust for them. We can say that the data should be complete and trusted by the data consumer to be beneficial for them.
	Population Completeness	N = the total numbers of properties in a KG nE = number of properties in a KG nO = number of resources in a KG N b/nO = Nc+b/nO the fraction of entities to all other objects in the world	We enforce population completeness by providing cardinality restrictions on the property level within templates. The user interface enforces data input to only accept the specified cardinality			The same as property, and instance completeness
Accessibility	*Dereferencability*	dR:nrR = dR/nrR Range [0-1] dR = number of dereferencable resources nrR = number of nonereferencable resources The ratio of dereferencable resources vs. nonereferencable resources	Every created resource on ORKG has a unique URI to ensure dereferenceability.	Focus on how the machine can access the data	Level 5: Linkability	Dereferencability allows other data sources to be connected. We recommend that the data be referenced only if it can pass the previous KGMM levels.
	Queryability	0,1 either it is possible or not	For simple querying, ORKG offers a SPARQL endpoint.	Focus on how the machine can access the data	Level 4: Stability	The stability level is mainly concerned with making the data available in different formats to consumers. Queryability using a SPARQL endpoint, for example, facilities the data availability to the consumer.
	Searchability	0,1 either it is available or not	ORKG provides a search functionality that allows the user to search any property or recourse saved in the graph	Focus on how humans can search the data	*Not mentioned in this version*	Not mentioned in this version
	Responsiveness	Rt = n/r Rt = the average response time n = is the number of concurrent users accessing the same KG r = is the number of requests per second the KG receives The responsiveness time is the time between a resource being requested until it responds with some data	A high performance graph database (i.e., Neo4j) is used for data storage. RDF dumps are automatically generated at predetermined intervals. To optimize the loading times of the curation interface, asynchronous data loading is leveraged	The system is seperated into two tires (front, and backend)., which allows good reponse time	: Published	The level published is the first level of maturity that requires at least the KG response in a reasonable time. It is an essential requirement that a given KG responds with some data to the data consumer in the best possible way.

Dimension	Measure	Metric	ORKG Realization	How could be measured in ORKG?	KGMM Level	Relation to KGMM
	Easiness	It could be calculated using the median value of a number of clicks like that: median (x)=x (c+1)/2 c = is the number of clicks x = is the set of clicks The number of steps needed to access or curate a resource or a property in a given KG.	The curation interface has been designed specifically to accommodate users without data modeling skills. Via the easy-to-use form-based user interaction, the knowledge is populated and curated. Additionally, jargon is avoided and tooltips are provided to guide users through the interface	The ideal number of clicks recommended by Google: ttps://www.youtube.com/watch?v=zyQbNGUycX8&t=1930s	Level 1:	Easiness is an elementary requirement for a mature KG. So, the KG cannot leverage to the next maturity level unless it is easy to navigate through
Coherence	*Consistency*	It could be calculated using the median value of the total number of resources like that: median (R)=R (t+1)/2 t = is the total number of resources R = is the set of resources the percentage of such inconsistent resources detected by each semantic characteristic to the total number of such resources within a certain KG.	The consistency of the entered data is maintained using ORKG templates.		Level 3: Representation	The representation level is concerned mainly with how the data is represented to the consumer. So the data should avoid any sort of redundancy to make the best of it for the consumer.
Findability	*Findable*	If a given URI for a specific resource is valid, and an HTTP request to the given resource responds with code 200, then the data is findable. It might be quantified as 0 or 1. (Either the resource is found or not)	Each resource and property in KG has a unique and valid URI for it		*Not mentioned in this version*	Not mentioned in this version
	Identifier stability	A particular identifier is stable if it is distinct and exclusively refers to one real-world object (for example, a DOI, ORCID, etc). Otherwise, the identifier is not stable.	Once content in ORKG reaches a certain maturity level, we enable the persistent identification of this content through versioned DOIs	Assign DOI to a comparison	Level 4. Stability	If a KG has a stable identification system for each resource, then the KG data is available and ready for use by the consumer.
Interoperability	*Trackability*	1,0 either the resource could be referenced with another ontology or not	Content from outside the ORKG (e.g. papers, authors) is referenced via persistent identifiers such as DOIs and ORCIDs. DOIs are also used internally by the ORKG to make mature content trackable, for less mature and volatile content we use stable URIs to identify content and track changes. In particular all user contributions are versioned and associated with the contributor IDs to facilitate trackability			If the user can track the available data source, then the data is much more valuable for them.
	Provenance	1,0 either the data have a traceable provenance or not	ORKG comprises fully traceable provenance metadata, e.g. via integration with Crossref to retrieve original paper metadata and keeping track of all changes and user contributions to the ORKG data		Level 2: Completeness	When the user knows the source of the data, it lends more credibility to it. In that regard, the data sounds complete to the consumer and could be used.
Reusability	*Reusability*	Any given data source must have at least one access mechanism (such as the JSON format) in order to be perceived as reusable. The reusability could be in the range of 0, which indicates that it is not reusable at all , to an unknown number of ways. The more reusability ways the a given KG has, the better the KG is reusable.	ORKG facilitates reusability through a number of means, such as various data access methods, a Python/Jupyter interface, various export formats (such as LaTeX, CSV, RDF) as well as persistent identification via DOIs.	The ease of use of data collected for one purpose to study a new problem	Level 3: Representation	Representing the published and completed data in different formats allows the data consumers to use it in the best way that fits their needs. If the data were presented to the consumers in different formats but it was still not complete, it would not be beneficial for them.
Accuracy	*Syntactic accuracy*	iP / AP Range [0-1] iP = invalid properties AP = available instances ratio of the total number of values for a particular property to the number of invalid values for that property	Syntactic accuracy is guaranteed on the application level by limiting user interaction using predefined forms. KG data ingestion and curation is validated on data entry, preventing users from making syntactic errors	How the data syntax is correct?	Level 1: Published	Syntactic accuracy could be a difficulty and a source of confusion for both humans and machines. So a mature KG should, at the first level, guarantee a certain level of syntactic accuracy
	Semantic accuracy	A = 1- ER Range [0-1] A = the data accuracy ER = the error rate in a KG. It could be calculated from the below equation ER = OV - AV / AV * 100 OV = observed value AV = actual value It is the degree to which data values accurately depict phenomena in the real world,	Data organized in ORKG templates must follow a predefined structure. Predefined property ranges ensure data can only be added within the specified range, which addresses semantic accuracy on a shallow level. Further efforts to guarantee semantic accuracy include human validation and curation of the entered data.		Level 2: Completeness	Semantic accuracy is a quality measure that lets the data consumer construct meaning from the data. For example, when observing data in a KG, the consumer found these: { "Movie: Avatar, Director: Frank Darabont}, and {Movie: The Shawshank Redemption, Director: James Cameron."}. So the data consumer would get the wrong director name for the movies, which means this data is still not complete and not beneficial.
	Timeliness	It could be calcuated using the following equation Timeliness = (Data delivery time - data provided time)+ (Data provided time-Ocuurence time) The duration between when information is anticipated and when it is immediately usable can be used to measure timeliness. Source: book- Data Quality: Dimensions, Measurement, Strategy, Management, and Governanc	We strive to integrate the ORKG directly in the scientific workflows (e.g. in the data analysis, authoring and peer-review stages) to ultimately achieve timeliness.	Is the comparison outdated (new research results could be compared)		If the KG is complete but, the data is incorrect or not at the right time, it is useless. The correctness, and timeliness guarantees that the data makes cognitive sense to the consumer.

Dimension	Measure	Metric	ORKG Realization	How could be measured in ORKG?	KGMM Level	Relation to KGMM
	Correctness	The crowedsource could vote for the data correctness, and then the correctness could be calculated using the bayesian average: Ra = WR + (1−W) R0 Where: Ra= averaged ('bayesian') rating R= individual rating: average rating for this item. R0= a priori rating: global average rating, for all items in a KG. W= weight factor: it should tend to 0 if this items has few votes, and it should tend to 1 if it has many.	Correctness in the ORKG is facilitated in various ways: the increased transparency and peer-review of content contributes to establishing correctness. In addition automated techniques can be plugged-in via the API to discover, mark (for human validation) or also fix incorrect representations.			For example, if a consumer searches for news about Mohamed Salah (who is currently a Liverpool soccer player). If the results show that he is still playing for Rome F.C (his former club), then it is not complete because it is incorrect and timely irrelevant.
License	*License*	*1,0 either the data has a valid access licence or not*	*Correctness in the ORKG is facilitated in various ways: the increased transparency and peer-review of content contributes to establishing correctness. In addition automated techniques can be plugged-in via the API to discover, mark (for human validation) or also fix incorrect representations.*		Level 1: Published	*Without a valid license, the data cannot be reached.* *Hence, the licenses should be at the first level of a KG maturity*