Ontology evaluation: Table 1

Measures (type)	Measurement functions/methods	Quality principles	Quality parameters
STRUCTURAL	$M = \langle D, S, mp, c \rangle$	–	–
Topology	–	computational integrity and efficiency, cognitive ergonomics, transparency	–
Breadth (related to the cardinality of levels – or "generations" - in a graph)	counting	cognitive ergonomics	-breadth
Absolute breath	$m = \sum_{j}^{L} N_{j \in L}$		
Average breadth	$m = \frac{1}{n_{L \subseteq g}} \sum_{j}^{L} N_{j \in L}$		
Max breadth	$m = N_{j \in L}$ $\forall i \exists j (N_{j \in L} \geq N_{i \in L})$		
Depth (related to the cardinality of paths in a graph)	counting	cognitive ergonomics	-depth
Absolute depth	$\sum_{j}^{P} N_{j \in P}$		
Average depth	$\frac{1}{n_{P \subseteq g}} \sum_{j}^{P} N_{j \in P}$		

Max depth	$m = N_{j \in P}$ $\forall i \exists j (N_{j \in P} \geq N_{i \in P})$		
Tangledness (related to multihierarchical nodes of a graph)	$m = \frac{n_G}{t_{\in G \wedge \exists a_1, a_2 (isa(m, a_1) \wedge (isa(m, a_2)}}$	cognitive ergonomics, computational integrity, efficiency	-tangledness
Fan-outness (related to the "dispersion" of graph nodes)	counting	cognitive ergonomics	-dispersion
Absolute leaf cardinality	$m = n_{LEA \subseteq g}$		
Ratio of leaf fan-outness	$m = \frac{n_{LEA \subseteq g}}{n_G}$		
Weighted ratio of leaf fan-outness	$m = \frac{n_{LEA \subseteq g}}{\sum_{j}^{P} N_{j \in P}}$		
Maximal leaf fan-outness	$m = N_{j \in SIB}^{j \subseteq LEA}$ $\forall i \exists j (N_{j \in SIB}^{j \subseteq LEA} \geq N_{i \in SIB}^{i \subseteq LEA})$		
Absolute sibling cardinality	$m = \sum_{j}^{SIB} N_{j \in SIB}$		
Ratio of sibling fan-outness	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB}}{n_G}$		

Weighted ratio of sibling fan-outness	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB}}{\sum_{j}^{P} N_{j \in P}}$		
Average sibling fan-outness	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB}}{n_{SIB}}$		
Maximal sibling fan-outness	$m = N_{j \in SIB}$ $\forall i \exists j (N_{j \in SIB} \geq N_{i \in SIB})$		
Average sibling fan-outness without metric space	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB-MS}}{n_{SIB-MS}}$		
Average sibling fan-outness without lists of values	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB-LV}}{n_{SIB-LV}}$		
Differentia specifica (related to the "rationale" behind sibling node sets)	selecting properties, counting	transparency	+specific differences

Ratio of sibling nodes featuring a shared *differentia specifica*	$m = \frac{\sum_{j}^{SIB} N_{j \in SIB, \forall x_{x \in j} \exists \rho, \varphi (\rho(x,y) \wedge \varphi(y))}}{\sum_{j}^{SIB} N_{j \in SIB}}$		
Ratio of sibling sets featuring a shared *differentia specifica* among elements	$m = \frac{n_{SIB(DF)}}{n_{SIB}}$		
Density (clusters of classes with many non-taxonomical relations)	clustering techniques	transparency	+patterns
Rationality patterns			
Core-ontology patterns			
Modularity (related to the *asserted* modules of a graph)	counting	transparency	+modularity
Modularity rate	$m = \frac{n_M}{n_S}$		
Module overlapping rate	$m = \frac{\sum_{n} n_{uoap} - \sum_{n} n_{uoadp}}{n_{\{sg_1, sg_2\}} - n_{\{sg_1 \mid sg_2\}}}$		-overlapping
Logical adequacy	applying checkers, and counting	computational integrity and efficiency, cognitive ergonomics, transparency	–
Consistency ratio	$m = \frac{n_{Cons}}{n_G}$	computational integrity and efficiency	+logical consistency

Complexity (generic)	a complexity scale, e.g. the one used for description logics	transparency	+complexity
Anonymous classes ratio	$m = \frac{n_{Anon}}{n_G}$	cognitive ergonomics | transparency	-anonymous classes (cog. ergonomics) +anonymous classes (transparency)
Cycle ratio	$m = \frac{\sum_{k}^{P} N_{k \in P}}{\sum_{j}^{P} N_{j \in P}}$	computational efficiency	-cycle ratio
Inverse relations ratio	$m = \frac{n_{InvR}}{n_R}$	cognitive ergonomics	+inverse rel. ratio
Class/relation ratio	$m = \frac{n_{G \in S}}{n_{R \in S}}$	cognitive ergonomics	+class/relation ratio
Axiom/class ratio	$m = \frac{n_{A \in S}}{n_{G \in S}}$	transparency	+axiom/class ratio
Individual/class ratio	$m = \frac{n_{I \in S}}{n_{GI \in S}}$	computational integrity (for some languages)	-individual/class ratio
Meta-logical adequacy	annotating properties, and counting	–	–
Meta-consistency ratio	$m = \frac{n_{MCons}}{n_G}$	assumed conceptual integrity	-meta-consistency
Qualified density (presence of meaningful conceptual-relation 'dense' areas)	degree distribution, small world, clustering coefficient	cognitive ergonomics	+patterns (dense areas)

FUNCTIONAL	–	–	+precision +recall +accuracy
Competence adequacy	extraction of expertise and matching	compliance with expertise	
Inter-subjective agreement adequacy	experiments on experts		
Resistance to counter-examples	experiments on experts		
User-satisfaction	dedicated polls		
Task adequacy (what tasks must be supported by the ontology)	competency questions (service-specification-based, gold-standard-solution-based)		
Task specifity, based on exploitation plan	competency questions (explicit-task-based)		
Topic specificity, based on exploitation plan	"choose directory and annotate", "reengineer and match", "extract and match"		
NLP adequacy	NLP techniques	compliance with expert language	
Compliance with lexical distinctions	machine learning/dictionaries	compliance with expert lexicon	
Compliance with textual patterns	machine learning	compliance with expert documents	
Performance in question-answering tasks	experiments on experts	compliance with expertise	
Formal description of compliance	extraction of expertise, matching, and counting	functional compliance	
O_Precision (˜ IR precision)	$OP = \frac{n_{TP}^{O_k(L)}}{n_{TP}^{O_k(L)} + n_{FP}^{O_k(L)}}$		

O_Recall, or Coverage (˜ IR recall)	$$OR = \frac{n_{TP}^{O_k(L)}}{n_{TP}^{O_k(L)} + n_{FN}^{O_k(L)}}$$		
O_Accuracy	$$OA = \frac{n_{TP}^{O_k(L)_W}}{n_{TP}^{O_k(L)_W} + n_{FP}^{O_k(L)_W}} \cdot \frac{n_{TP}^{O_k(L)_W}}{n_{TP}^{O_k(L)_W} + n_{FN}^{O_k(L)_W}}$$		
Functional modularity	matching domain expertise with reusable expertise models	–	–
Ontological stratification, granularity (presence of stratification in modules, branchings, or operators)	assessing presence of foundational, core, and domain layers	cognitive ergonomics	
USABILITY-RELATED (presence of metadata)	dedicated polls, metadata schemas, automatic acquisition of structural and functional measurement data	Presence, completeness and reliability of annotations	–
Recognition annotations		Organizational fitness, generic accessibility, compliance to procedures for mapping, etc.	–
Graph measures			+graphs
Logic-type and computational complexity information			+annotations
Lexical annotation of ontology elements			+lexical annotations
Glosses about ontology elements			+glosses
User satisfaction and trust rating information			+user satisfaction
Provenance information			+reliability
Versioning information			+versioning annotations

Lifecycle, methods employed			+ methods employed annotations
Efficiency annotations		Organizational fitness, generic accessibility	–
Application history (task- or topic-specificity applied to a token scenario) information			+application history annotations
Commercial and legal semantics information			+trading, pricing, policy and disclaimer semantics annotations
Organizational design information			+organizational design annotations
Interfacing annotations		Generic accessibility, compliance to procedures for mapping, extension, integration, adaptation	+interfacing annotations