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# K

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## 2 Knowledge Management

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## 11 Synonyms

12 [Knowledge-based methods](#); [Knowledge engineering](#)

## 13 Definition

14 Knowledge management (KM) can be defined as  
15 the approaches (methods, procedures, tools, etc.)  
16 for handling the registrations (writings) in order  
17 to allow their interoperability (the IEEE Glossary  
18 defines interoperability as “the ability of two or  
19 more systems or components to exchange infor-  
20 mation and to use the information that has been  
21 exchanged” (IEEE 1990)) (use as a single piece  
22 of knowledge or combined with other elements).  
23 Knowledge engineering must implement the  
24 different cultural mediations to construct repre-  
25 sentations made to allow the interpretation  
26 (adapted from Bachimont 2004).

27 Thus knowledge management integrates differ-  
28 ent strategies, practices, and tools in the organization

to identify, capture, formalize, and share knowledge, 29  
experience, or know-how, either for human exper- 30  
tise or for organizational practices. Such knowledge 31  
increases in a continuous interaction with the envi- 32  
ronment at all levels of the organization. Knowledge 33 [\[Au1\]](#)  
management is, for the company, a lever support for 34  
innovation both in products, processes and services 35  
and in the organization (Nonaka et al. 2000). 36  
Knowledge management adds value to the 37 [\[Au2\]](#)  
processes of design and production while improving 38  
operational processes and innovation with the 39  
ultimate goal of enabling the company to inherently 40  
learn (Bakema 1999). 41

Knowledge management approaches are 42  
developed in knowledge-based environments. 43  
They provide a set of methods, formalisms to 44  
manipulate the piece of knowledge, depending 45  
on its initial form. The knowledge-based environ- 46  
ments (KBE) define the specifications and the 47  
content of the knowledge-based systems (KBS). 48  
A knowledge-based system can be defined as 49  
a computerized system that uses knowledge 50  
about some domain in order to deliver a solution 51  
concerning a problem (Fasht 2000). 52

It is necessary to formalize and structure the 53  
initial knowledge in a knowledge base, before 54  
using it in a knowledge-based system. 55  
Knowledge management and knowledge-based 56  
engineering give different solutions as to how to 57  
develop this software. 58

## 59 Theory and Application

### 60 History

#### 61 Knowledge-Based Systems

62 The first generation of knowledge-based systems  
 63 was expert systems using a set of facts and rules  
 64 (Ulengin and Topcu 1997). This kind of system is  
 65 composed of essentially two components:  
 66 a knowledge base (KB) and an inference engine.  
 67 It applies specific domain or domain-specific  
 68 knowledge to problem-specific data to generate  
 69 problem-specific conclusions. The next KBS  
 70 generation was the case-based systems. These  
 71 systems use previous solutions to problems as  
 72 a guide to solving new problems. Knowledge-  
 73 based systems are widely acknowledged to be  
 74 the key for enhancing productivity in industry,  
 75 but the major bottleneck of their construction is  
 76 knowledge acquisition, i.e., the process of cap-  
 77 turing expertise before implementation in  
 78 a system (Chan 2000). Some methodologies  
 79 assist the developers in defining and modeling  
 80 the problem in question, such as Structured  
 81 Analysis and Generation of Expert Systems  
 82 (STAGES) and Knowledge Acquisition Docu-  
 83 mentation System (KADS) (an acronym that has  
 84 been redefined many times, e.g., Knowledge  
 85 Acquisition Documentation System and  
 86 Knowledge-based system Analysis and Design  
 87 Support). Moreover, these approaches get  
 88 enriched in order to take into account the project  
 89 management, organizational analysis, knowledge  
 90 acquisition, conceptual modeling, user interac-  
 91 tion, system integration, and design (Breuker  
 92 and Wielinga 1987; Buchanan et al. 1983). Con-  
 93 sequently, knowledge modeling in engineering  
 94 must be based on a rich and structured represen-  
 95 tation of this knowledge and an adequate way of  
 96 user interaction for modeling and using this  
 97 knowledge (Klein 2000). Due to the complexity  
 98 of engineering knowledge, knowledge modeling  
 99 in engineering is a complex task.

#### 100 Knowledge-Based Environment

101 KBE has been defined as being an engineering  
 102 methodology in which knowledge about the  
 103 product, e.g., the techniques used to design, ana-  
 104 lyze, and manufacture a product, is stored in

a special product model. The product model 105  
 represents the engineering intent behind the 106  
 geometric design. The KBE product model can 107  
 also use information outside its product model 108  
 environment such as databases and external 109  
 company programs. KBE has been defined as “a 110  
 computer system that stores and processes 111  
 knowledge related to and based upon 112  
 a constructed and computerized product model” 113  
 (Fath 2000). The encoding of design knowledge 114  
 from domain experts into computer codes that 115  
 can generate complex geometric data has demon- 116  
 strated significant savings in manpower and time 117  
 resources for routine design problems and has 118  
 also provided a high degree of design integration 119  
 and automation in well-defined and complex 120  
 design tasks. The MOKA methodology has been 121  
 proposed to address methodological issues dur- 122  
 ing KBE systems development for our case study. 123

The modeling approach in KBE has to struc- 124  
 ture the engineering knowledge. In terms of 125  
 developing KBE applications, this structuring 126  
 process involves the configuration of the objects 127  
 that model the engineering design environment 128  
 and the rules that control the behavior of the 129  
 objects (Sainter et al. 2000). Current KBE 130  
 systems are based upon a combination of the 131  
 production rules and the object-oriented knowl- 132  
 edge representation. Both elements together offer 133  
 an automated way to introduce design require- 134  
 ments, model design constraints, and provide 135  
 a product description. 136

#### Knowledge Structuring 137

The balance between information structuring and 138  
 use flexibility is not a new problem. Partial 139  
 solutions have been already used, for instance, 140  
 indexes, summary, keywords, or tables of content. 141

For a desynchronized and now numeric trans- 142  
 fer of expertise, the degradation of knowledge in 143  
 data necessitates new navigation tools to correct 144  
 the lack of context for interpretation. The 145  
 multiuser approach of collaborative platforms or 146  
 networks requires a common language between 147  
 experts, to confirm relevance, authority, and 148  
 confidence in resources and the information 149  
 therein. These terms can be defined as follows: 150

- Validity = relevance + authority + confidence 151

- 152 • Relevance = corresponds to my interest
- 153 • Authority =
- 154 • Has been assessed by a mediator I am con-
- 155 fident in
- 156 • Recognized by a large community
- 157 • Could be assumed as proof
- 158 • Confidence =
- 159 • Seems interesting to me
- 160 • Is something I personally trust
- 161 These concepts should help users to assess in
- 162 real time the validity of the observed knowledge
- 163 network. The use of these terms appears progres-
- 164 sively in different tools. The following list is
- 165 composed of similar language-synchronization
- 166 and document-navigation tools illustrating the
- 167 evolution of indexing tools towards a naturally
- 168 valid and dynamic system:
- 169 • Terminology: list of terms
- 170 • Glossary: list of definitions
- 171 • Taxonomy: structured list of definitions (like
- 172 trees)
- 173 • Thesaurus: semantic and structured groups of
- 174 definitions organized in networks
- 175 • Ontology: objective networks of defined
- 176 concepts

### 177 Theory

178 Knowledge management actors can be divided in  
179 three main research groups as illustrated in the  
180 figure below.

- 181 • Actors from science organizations and  
182 change. They theorize on the concept of  
183 knowledge, its states, and its dynamics. They  
184 are in connection with the philosophy point of  
185 view of the knowledge. They guide the  
186 methodologies to carry out the steps of knowl-  
187 edge management.
- 188 • Actors from science and technology of informa-  
189 tion and communication. They develop com-  
190 puting environments in order to model,  
191 capitalize, and manipulate knowledge. It opens  
192 the field of artificial intelligence and decision  
193 support systems. They work for the evolution of  
194 tools and languages that support the automation  
195 of knowledge and its transcripts.
- 196 • Actors from engineering sciences. They work  
197 in the formalization and integration of busi-  
198 ness expertise to optimize a business process

or integrate it into a business environment. 199  
They are developing and deploying knowl- 200  
edge-based environments and synthesize the- 201  
oretical propositions pragmatically, tools and 202  
technologies available, and operational 203  
requirements in the areas of engineering 204  
(Fig. 1). 205

Knowledge Concept in Knowledge Management 206  
Wiig and Alavi (Wiig 1997; Alavi and Leidner 207  
2001) give an introduction to the main concepts 208  
of knowledge management. We propose a short 209  
summary of the different conceptual positions. 210  
For more details, refer to each author proposal: 211

- Grundstein (2002) focuses on the methodology 212  
of capitalization and knowledge management 213  
(Model for Global Knowledge Management 214  
within the Enterprise: MGKME). 215
- Ermine (2003) accepts the capitalization and 216  
knowledge management by integrating inter- 217  
nal and external environment as well as flows 218  
that connect them. 219
- Nonaka and Takeuchi (Nonaka et al. 2000; 220  
Nonaka and Takeuchi 1995) are interested in 221  
the dynamics of accumulation and creation of 222  
knowledge for innovation (SECI model). 223
- Zacklad and Grundstein (2001) are working 224  
on technology cooperation for innovation and 225  
organizational change. 226
- Dieng-Kuntz et al. (2000) addresses issues of 227  
corporate memory. 228
- Wainwright and Beckett (Wainwright 2001; 229  
Beckett et al. 2000) interested in aspects of 230  
enterprise knowledge through research on 231  
industrial performance measures. 232
- Amidon (2003) presents the control of 233  
knowledge through participatory innovation 234  
networks of experts. 235  
Firestone (2000) introduces the knowledge 236  
life cycle with three specific phases: production, 237  
validation, and structuring. These steps give the 238  
procedure for the development of knowledge 239  
bases. These bases are the prerequisite for the 240  
development of software capable of handling 241  
theses imbedded knowledge. 242

243 **Application**

244 During the settling and the use of a knowledge-  
245 based system, the expertise or knowledge goes  
246 from the expert mind to an informatics' environ-  
247 ment before being restituted (presented) to a user.

248 The knowledge management system has to min-  
249 imize the loss of meaning between the initial  
250 expert knowledge proposal and the user interpre-  
251 tation. A knowledge-based environment has to  
252 support three levels of processing:

- 253 1. Capture and reproduce optimally the meaning  
254 contained in the digital information
- 255 2. Automatically process, share, manipulate, and  
256 enhance the trail of knowledge
- 257 3. Connect and monitor as part of expert  
258 networks

259 Three main technologies address these issues:  
260 the semantic web, ontology, and tools specific to  
261 knowledge management.

262 **Semantic Web Tools**

263 The semantic web or Web 2.0 has not yet clearly  
264 defined the contours of its field of activity and  
265 impact. Its tools are global and not formalized.  
266 The major contribution is the integration of intel-  
267 ligent agents able to understand and integrate  
268 various information resources (based on ontolog-  
269 ical approaches). On the other hand, based on  
270 Web technologies, they provide the ability for  
271 users (users) to share, critique, comment, aggre-  
272 gate, and reference information available. Exam-  
273 ples include:

- 274 • Blogosphere
- 275 • Wiki encyclopedia
- 276 • Folksonomies
- 277 • RSS feed

278 **Ontology Approaches**

279 The introduction of ontology in the world of  
280 engineering creates ambiguity with philosophy.  
281 What could be called information system (IS)  
282 ontology corresponds in philosophy to conceptu-  
283 alization. The difference lies in the fact that phi-  
284 losophy seeks a perfect objectivity in ontology,  
285 whereas engineering reaches an intersubjectivity  
286 that becomes the local objectivity of  
287 a community. Local agreements enable

288 multiexperts to reach consensus and smooth  
289 misunderstandings and concept gaps.

290 Ontology gives a metalevel for the global  
291 model in a given domain (models of the concepts  
292 and their interrelations).

293 Research on ontology and attempts to use it as  
294 a knowledge reference in knowledge manage-  
295 ment has led to three main research categories.

- 296 • Consensual vision between different stake-  
297 holders: it is often difficult to make people  
298 agree on common words with common defini-  
299 tions. Definitions are slightly different from  
300 one expert to another, but it is often enough  
301 to stop convergence. The quest for a real  
302 objectivity in a particular expert domain is  
303 unrealistic. An unusable extensive aggrega-  
304 tion of points of view may result from this  
305 approach.
- 306 • Model comparison in computer science: some  
307 methodologies or tools try to allow compari-  
308 son between different models (Amidon 1997).  
309 Ontology is then required to align the models.  
310 Even if it may be easier because of formalisms  
311 used, it then comes back to the previous  
312 difficulty which is to define the common anal-  
313 ysis reference.
- 314 • Decision-making or case-based reasoning:  
315 information concerning previous experiences  
316 is extracted from a marked-up corpus.  
317 Ontology is used as an indexing tag library at  
318 a high semantic level. Here again, the  
319 difficulty consists in the construction of the  
320 initial common understanding. The analyzed  
321 corpus may be formed by very different  
322 sources (Internet) and the difficulty consists  
323 in rebuilding enough contexts to assess infor-  
324 mation validity. Classical modeling references  
325 (static, humanly mastered) usually try to solve  
326 this issue when a breakthrough in dynamic and  
327 fuzzy approaches is required. Different  
328 algorithm strategies already perform well  
329 (e.g., Google, the social-bookmarking service  
330 Delicious).
- 331 Each of these uses may imply different  
332 architectures and interfaces.

333 Specific Tools Developed for Knowledge  
334 Management

335 There are two types of tools:

- 336 • Tools developed specifically matched to specific  
337 methodologies for knowledge management (formalisms and tools are designed to  
338 support the process of modeling, structuring, and exploitation of knowledge)
- 339 • Tools developed to support some of the steps  
340 of knowledge engineering

341 The following gives a (very small) number of  
342 examples of solutions. Many more are available,  
343 so the following is nowhere complete:

344 1. Tools that want to *list the knowledge of the*  
345 *organization* in order to build a corporate  
346 memory or mapping of expertise:

- 347 • REX (Retour d'EXperience – means Feed-  
348 back): capitalizing on knowledge obtained  
349 during the implementation of the activities  
350 of an organization, represented textually to  
351 a user query in natural language. Two  
352 phases: first build a collection of knowl-  
353 edge elements in a set of procedures. Sec-  
354 ond phase, include the collection in  
355 a document management system called  
356 the memory of experience that draws con-  
357 nections between user requests and  
358 documents.

362 2. Approaches that *develop models for the con-*  
363 *trol and sharing* the complexity of the repos-  
364 itory and knowledge sharing within  
365 organizations:

- 366 • MKSM (Methodology for Knowledge  
367 Management System) capitalization of  
368 knowledge in a perspective of knowledge  
369 management in an organization. Evolves in  
370 MASK method (Method for Analyzing and  
371 Structuring Knowledge). This method  
372 involves three phases: the study domain  
373 definition, the cycle of modeling, and the  
374 architecture. The cycle of modeling repre-  
375 sents and structure knowledge through  
376 domain, activities, and tasks models. The  
377 architecture articulates modeling MKSM  
378 with the operational part of the project on  
379 strategic, tactical, and risk analysis.

- CYGMA (Cycle de vie et Gestion des  
380 Métiers et des Applications – means Life  
381 Cycle Management and the Trades and  
382 Applications): creating knowledge bases  
383 specific for a domain. The method proposes  
384 six categories of knowledge (singular,  
385 terminological, structural, behavioral,  
386 strategic, and operational) on which it  
387 builds breviaries knowledge for the domain  
388 and the knowledge bases computable by  
389 the algorithms of deductive reasoning.  
390 The breviary is composed of a business  
391 glossary, a semantic booklet, a booklet of  
392 rules, and an operating manual. This  
393 method has the advantage of distinguishing  
394 between different types of business  
395 knowledge present in the company. 396

397 3. Computer applications to *automate the activ-*  
398 *ities and provide decision systems:* 399

- CommonKADS (Knowledge Acquisition  
400 and Design System): modeling the knowl-  
401 edge of an expert group in order to structure  
402 a knowledge based. It scans the entire cycle,  
403 since the process of acquiring knowledge, its  
404 transformation into a collection of knowl-  
405 edge, and the development of a complete  
406 system. This methodology has several  
407 constitutional principles, including: 408
- Separate the conceptualization phase of  
409 its integration expertise. 410
- Consolidate the knowledge according to  
411 their homogeneity and their objectives. 412
- Get, build, and use blocks or generic  
413 models of knowledge. 414
- Preserve concept maps obtained when  
415 deploying the application. 416
- MOKA (Methodology and Tools Oriented  
417 to Knowledge Engineering Applications):  
418 modeling and representation of knowledge  
419 of engineering. The method describes the  
420 rules, processes, and modeling techniques  
421 and the definition of the steps required to  
422 build a system engineering knowledge  
423 base. As KADS, since it covers the identi-  
424 fication phase of knowledge to the phase of  
425 commissioning of the final application with  
426 an emphasis on structuring and 427

[Au3]

[Au4]

428 formalization. The method uses MML  
429 formalism, adapted from UML (MOKA  
430 Modeling Language), and is divided into  
431 two phases before reaching the final  
432 application:

- 433 • Informal phase: structure the knowledge  
434 base in text form for verification and  
435 validation by the expert. The informal  
436 model is used to structure various blocks  
437 of knowledge in the ICARE model.
- 438 • Formalization phase: builds a formal  
439 model to facilitate the use and integra-  
440 tion of knowledge in the application,  
441 with a structure that is understandable  
442 and computable by the machine. It  
443 defines an object-oriented model for  
444 the product and process design, the  
445 features needed to describe geometric  
446 objects, and concepts of artificial  
447 intelligence to represent the knowledge  
448 associated with design activities.

#### 449 Cross-References

- 450 ► [Decision Making](#)
- 451 ► [Design](#)
- 452 ► [Knowledge Based System](#)

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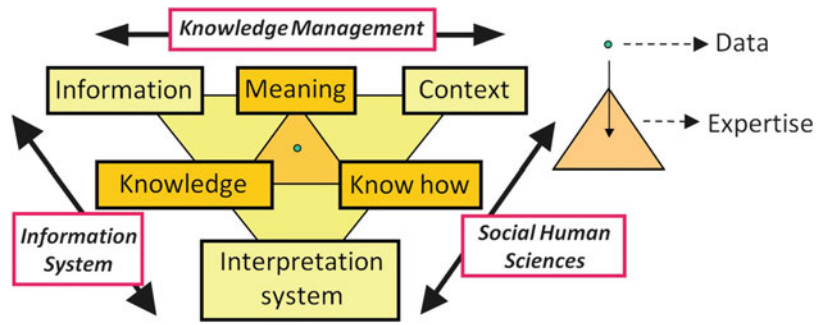
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**Knowledge Management,**  
**Fig. 1** Research domain in connection with KM and their main interest topics



## Author Query Form

Encyclopedia of Production Engineering  
Chapter No: 6458

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AU1	Please check if edit to sentence starting "Knowledge management..." is okay.	
AU2	Please check if edit to sentence starting "Knowledge management..." is okay.	
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