Information literacy competencies of university students in science and technology for solving research and development problems

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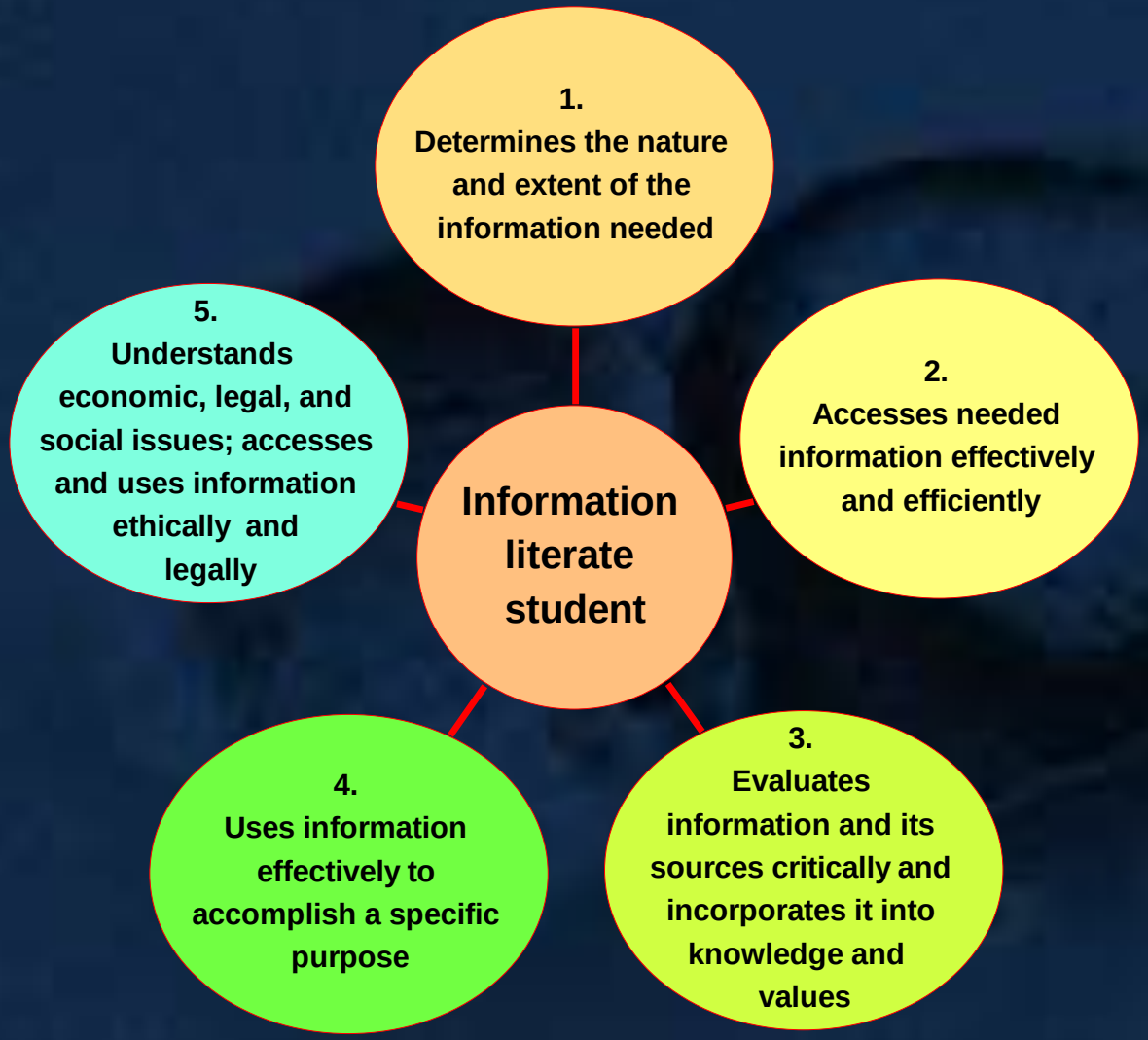
Information Literacy Competency Standards for Higher Education

Association of College and Research Libraries (ACRL), approved in 2000, currently under revision

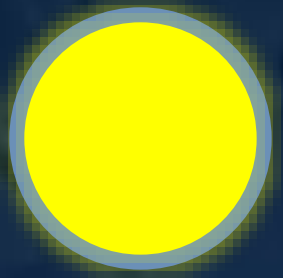
http://www.ala.org/acrl/standards/informationliteracycompetency



Problem:
When not applied in real-life study and research situations, IL competences and skills may not enable higher cognitive levels - such as the use of knowledge, analysis, synthesis and evaluation

Research example: a case study

- Postgraduate programme of scientific and technical informatics
- Combination of heuristic and mathematical-statistical information methods with experimental laboratory work
- Informatics applied in chemistry: microencapsulation technology and applications

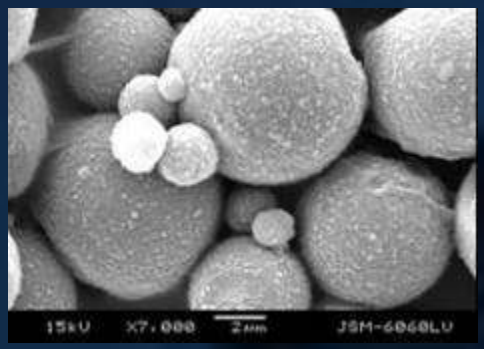


Methodological model

1. Definition of the research field
2. Preparation of profiles for advanced search queries
3. Construction of a specialised in-house information system
4. Analysis, structuring and synthesis of information
5. Design and laboratory verification of selected processes
6 Identification of process parameters - properties relationships
7. Development of a QSPR model
8. Laboratory process optimisation, transfer to industrial reactors
9. Development of new formulations and market products
10. Generalization of the methodology to support R & D activities

Integration of IL competency standards with solving study and research problems in science and technology

(1) Definition of the research field, selection of the priority niche



1. Determines the nature and extent of the information needed

METHODS OF MICRO-ENCAPSULATION

- MECHANICAL METHODS
  - SPRAY DRYING
  - SPRAY COOLING
  - SOLVENT EVAPORATION
  - REVERSE PHASE EVAPORATION
  - LIQUID WALL ENCAPSULATION
  - FREEZE-THAW METHOD
  - SONICATION
  - EXTRUSION
  - CENTRIFUGAL EXTRUSION
  - PAN COATING
  - VACUUM DEPOSITION
  - ELECTROSTATIC DEPOSITION
- COACERVATION METHODS
  - SIMPLE COACERVATION
  - COMPLEX COACERVATION
  - INTERFACIAL COACERVATION
- POLYMERISATION METHODS
  - INTERFACIAL POLYMERISATION
  - POLYMERISATION IN SITU
  - MATRIX POLYMERISATION

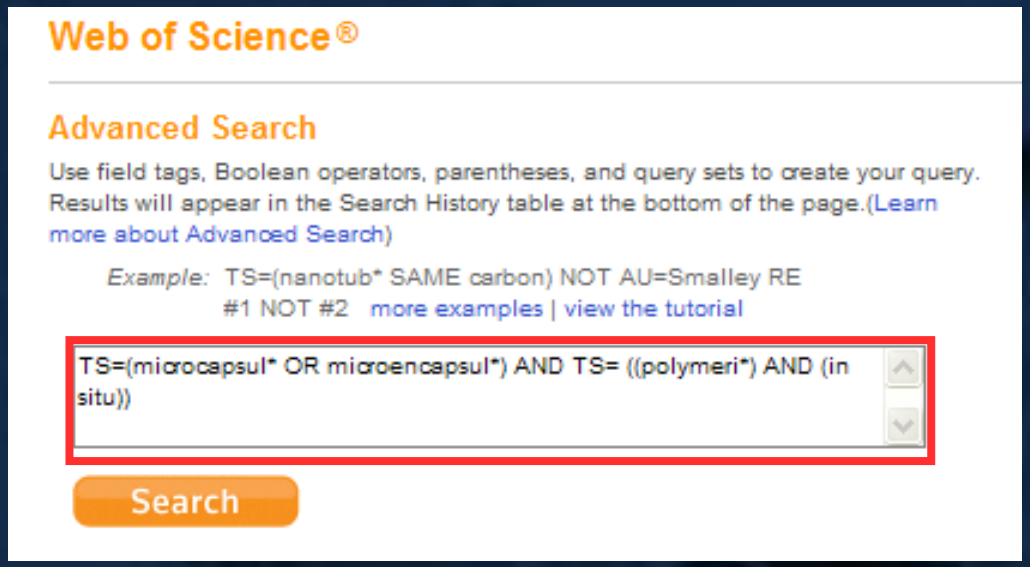
Microencapsulation

Chemical methods (industrially important):

1. **In situ polymerization**

(2) Preparation of advanced search profiles for the acquisition of scientific literature and patents

2.
Accesses needed information effectively and efficiently



Advanced search in WoS
333 scientific articles in journals with IF
Web of Science
http://apps.webofknowledge.com/
basic research

Expert search in FPO
249 patent documents
Free Patents Online
http://www.freepatentsonline.com/search.html
applied research

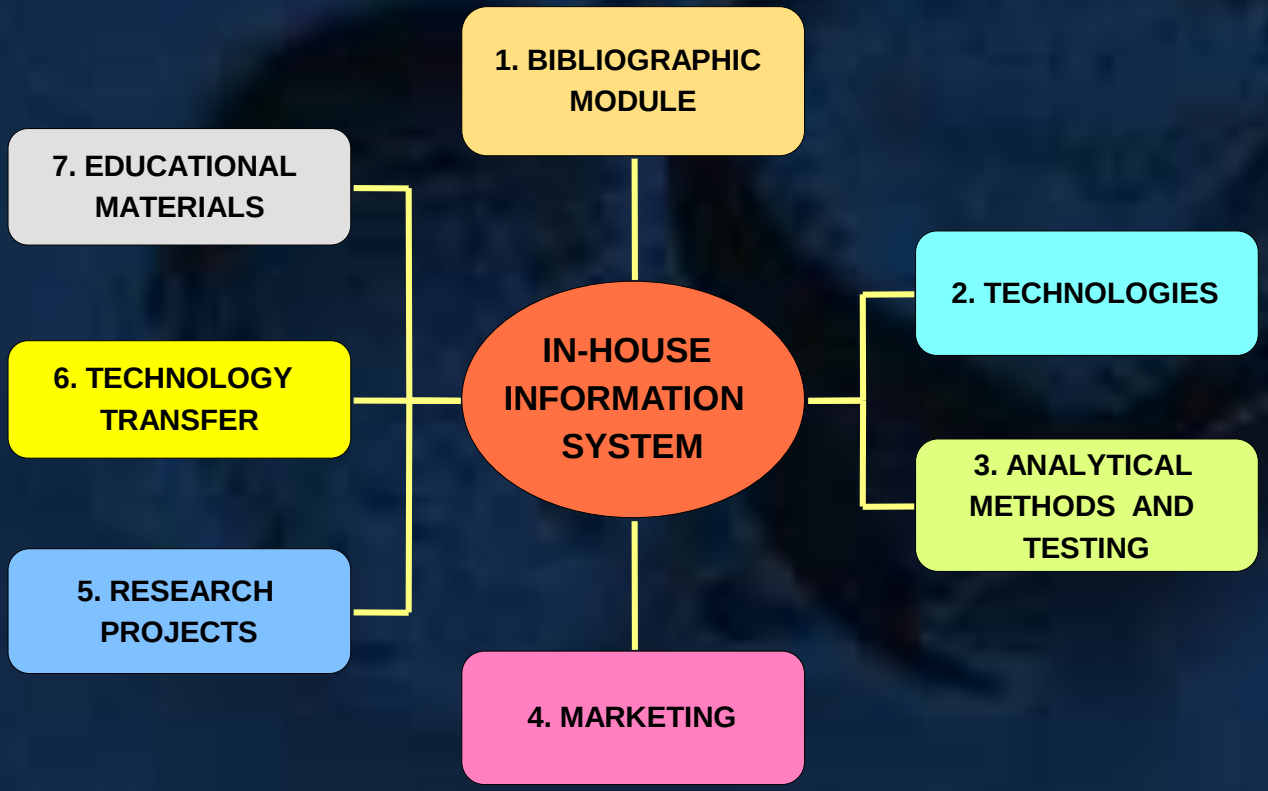
(3) Construction of a specialised in-house information system to support R&D activities

1. Determines the nature and extent of the information needed

2. Accesses needed information effectively and efficiently

3. Evaluates information and its sources critically and incorporates it into knowledge and values

5. Understands economic, legal, and social issues; accesses and uses information ethically and legally

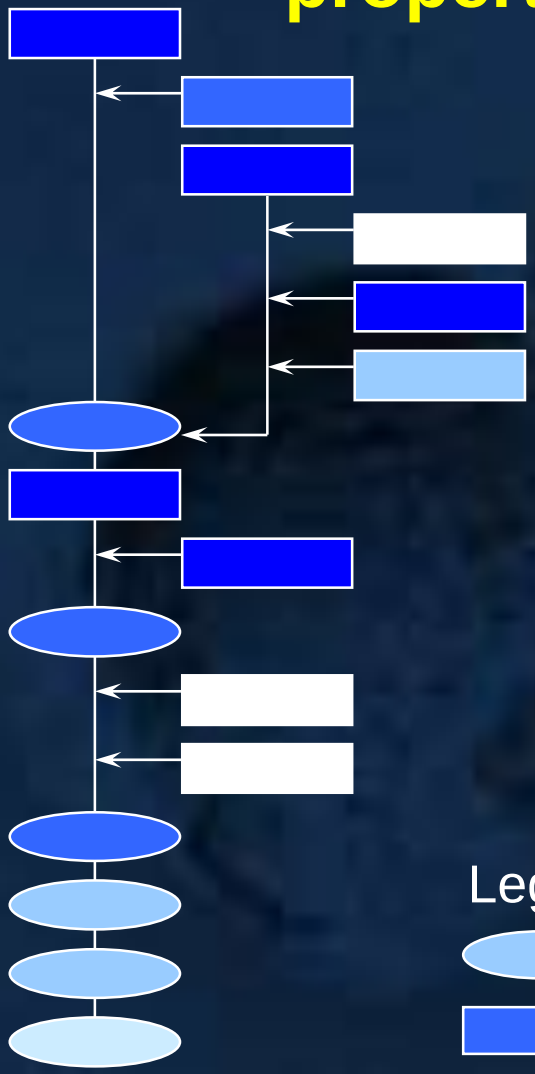


Integrated information system:

specialised bibliographic database

6 factual modules

(4) analysis and synthesis of information from full text documents, to identify relationships between raw materials, process parameters and the final properties of microcapsules



4.
Uses information effectively to accomplish a specific purpose

Analysis of documents
Comparison and overlapping of processes
Result: hypothetical process backbone (for further laboratory optimisation)

Legend
process
raw material

Information density
(predicting probability)

- 80 - 100 %
- 60 - 79 %
- 40 - 59 %
- 20 - 39 %
- < 20 %

(5) Design and verification of selected microencapsulation processes in the laboratory

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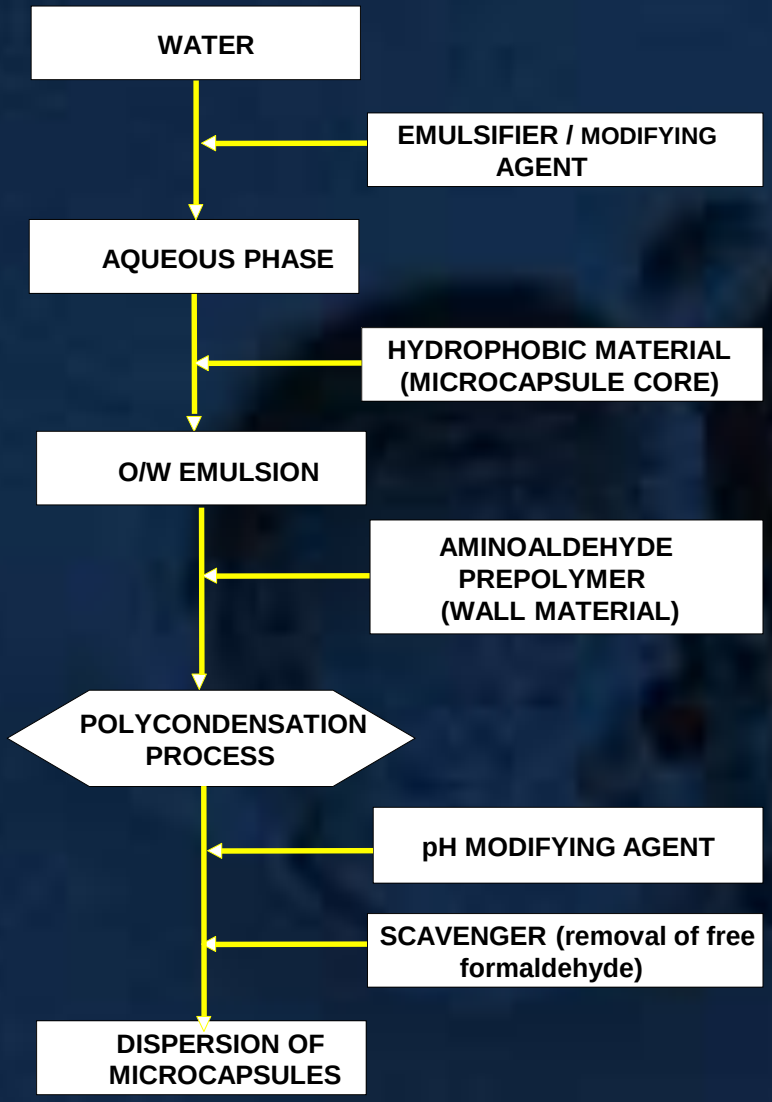


In situ **polymerisation microencapsulation**

(6) Identification of the relationships between the main process parameters and properties of microcapsules, to design a matrix

4.
Uses information effectively to accomplish a specific purpose

PROPERTIES	PROCESS PARAMETERS									
	Physico-chemical properties - core	Physico-chemical properties - wall	Physico-chemical prop. - modifyer	Additives	pH	Temperature	Reactor geometry	Impeller speed	Sequence of operat.	Operation time
MICROCAPSULES:										
Efficacy, yield										
Permeability										
Size										
Size distribution										
Morphology										
SUSPENSION OF MK:										
pH										
Viscosity										
Share of microcap.										
Residual monomers										
Production costs										

Legend

INTENSITY OF THE IMPACT	
1- smallest	
2	
3	
4	
5-biggest	

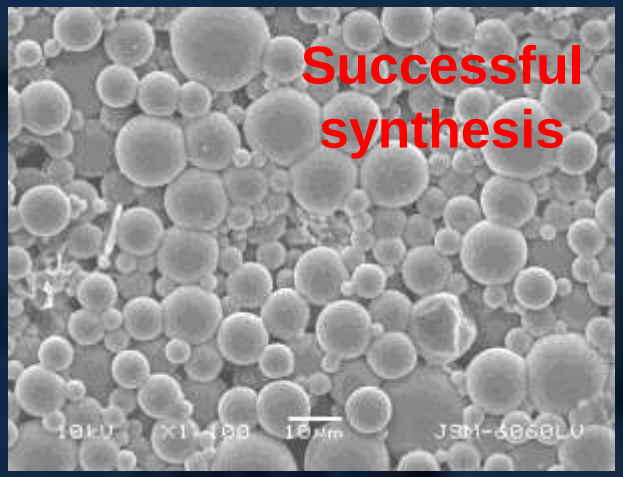
(7) Development of a prediction QSPR (Quantitative Structure-Property Relationship) model to predict the successfulness of microcapsule synthesis

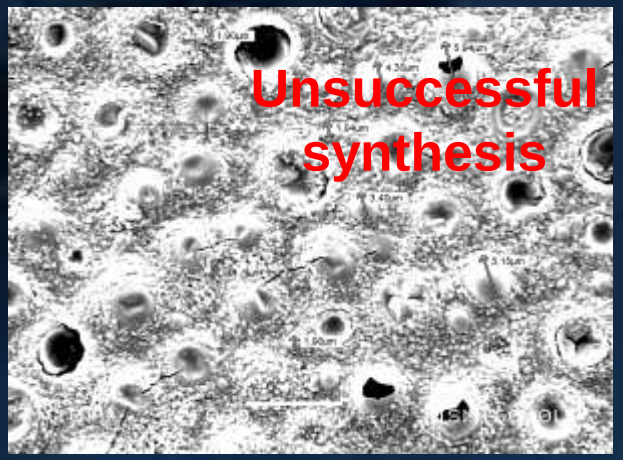
4.
Uses information effectively to accomplish a specific purpose

QSPR Microencapsulation Efficiency Coefficient :

$k\mu = \log P + (\log D/10) + (1-PS/100) + (1-POL/10) + (1-ST/10) + (1-PT/100)$

Legend:
logP (octanol/water); logD (at pH of synthesis); PS polar surface (angstrom^2); POL polarizability (10^-24cm^3); ST surface tension (dyne/cm); PT vapor pressure at 25°C (mmHg).





(8) Laboratory microencapsulation of new materials, and transfer of optimized processes into industrial reactors

4. Uses information effectively to accomplish a specific purpose

5. Understands economic, legal, and social issues; accesses and uses information ethically and legally

Laboratory reactor 1L

Pilot industrial reactor 10L

Industrial reactor 200L

Scaling-up

(9) Incorporation of microcapsules into new formulations and market products;

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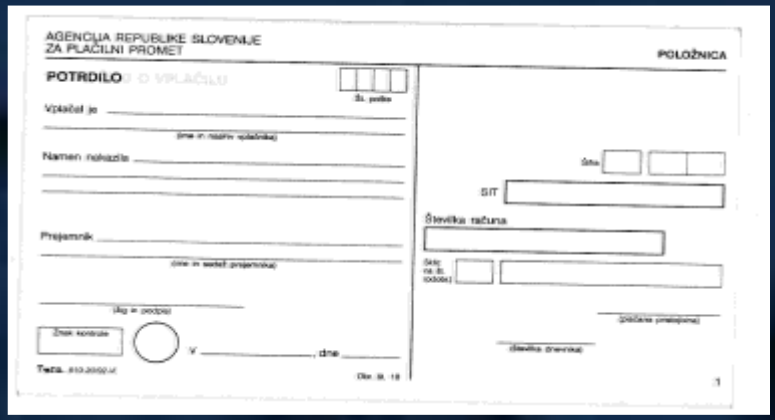
5. Understands economic, legal, and social issues; accesses and uses information ethically and legally



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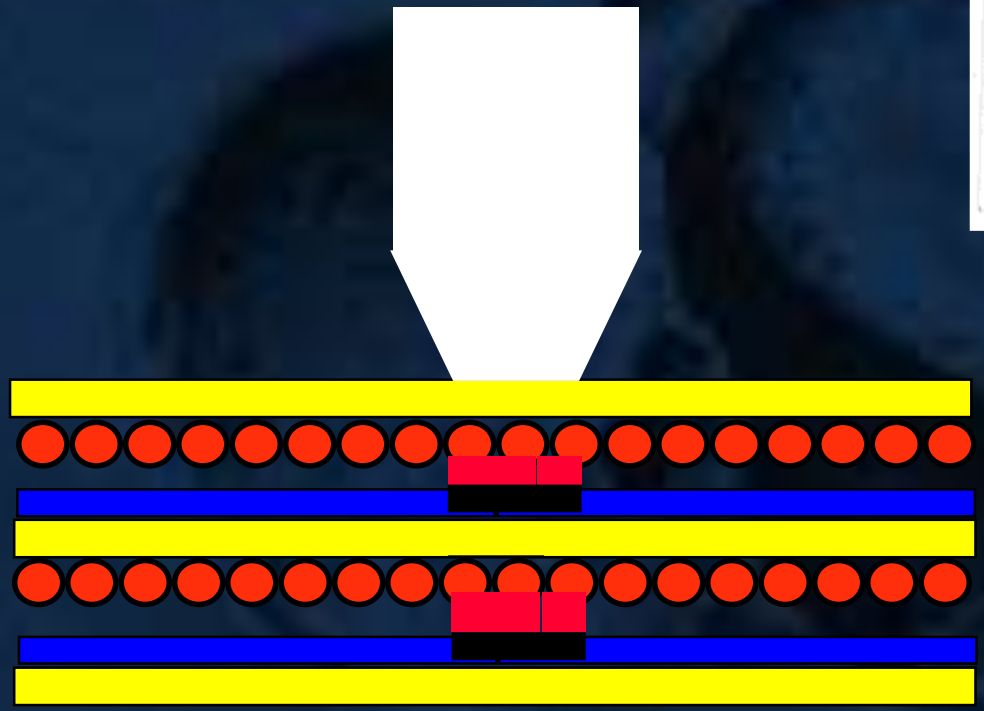


PAPER

MICROENCAPSULATED LEUCO DYE

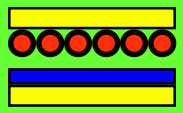
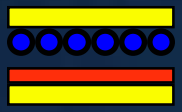
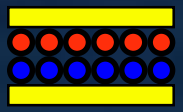
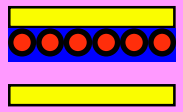
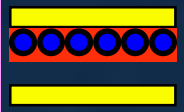
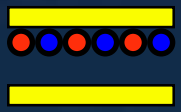
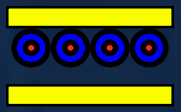
DEVELOPER

Introducing the methodology of data structuring – prediction matrix

PRESSURE-SENSITIVE COPYING PAPERS

- TWO ACTIVE LAYERS
- ONE ACTIVE LAYER
  - SINGLE MICROCAPSULES
  - DOUBLE MICROCAPSULES

4.
Uses information effectively to accomplish a specific purpose

1	2	3	4	5	6	7	8
							
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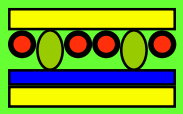	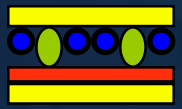		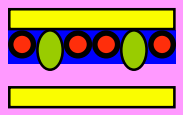	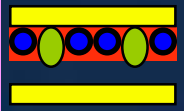	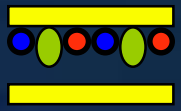		
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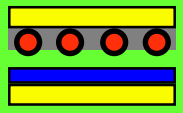	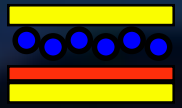		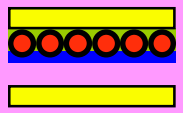	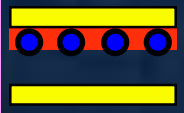			
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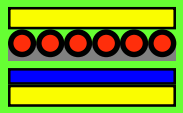			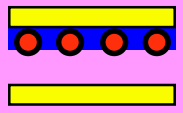	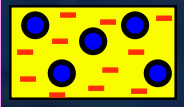			
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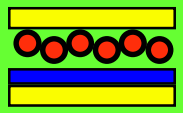
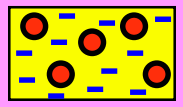
							
US 4339143 GB 2048331			GB 1042596 GB 1042599				

4.
Uses information effectively to accomplish a specific purpose

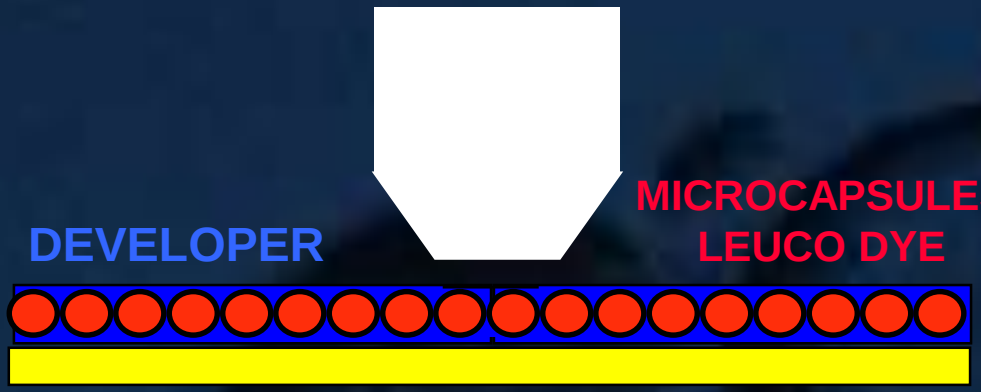
Identifying two systems with the largest number of innovations

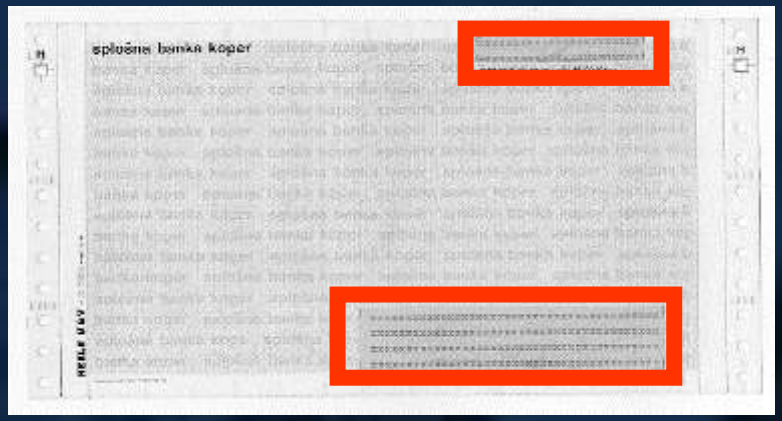
Searching for original patent free niches

New applications and products

4.
Uses information effectively to accomplish a specific purpose

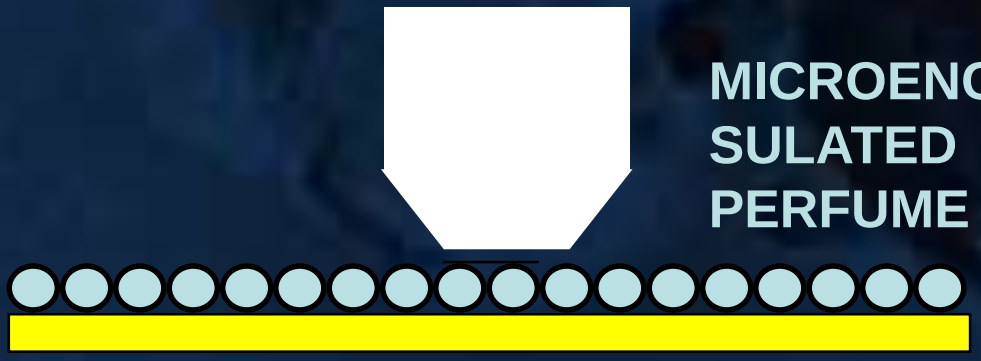
Self-contained printing inks





Bank mailers with printed microcapsules

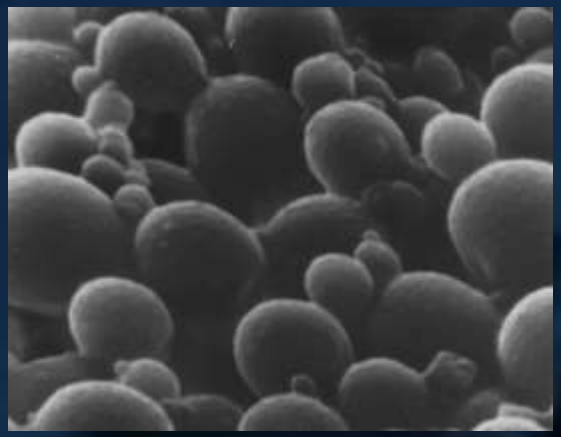
Fragranced papers



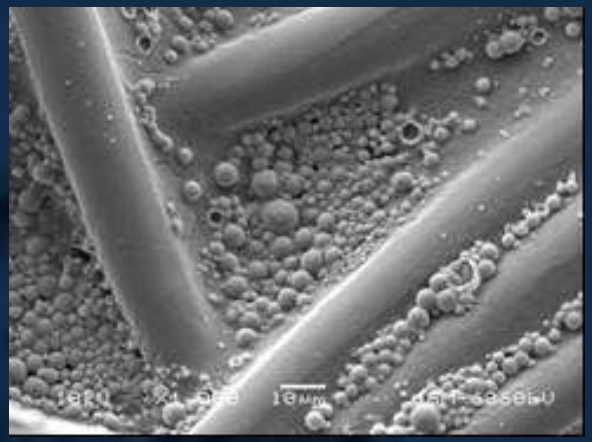
Perfumed paper stickers

New applications and products

4.
Uses information effectively to accomplish a specific purpose



Microencapsulated animal repellents with prolonged activity



Microencapsulated antimicrobial agents for textile shoe insoles

(10) Generalization of the methodology to support R & D activities in academic and industrial environments

1. Definition of the research field
2. Preparation of profiles for advanced search queries
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Outcomes / results

1. Specialised information system to support R&D
2. Scientific and technological innovations - scientific articles, patents, market products
3. Methodological approach for university education in scientific and technical informatics
4. Competent students and researchers

Acknowledgements

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