IMS2020 Project

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Rationale

motivation and driving problem

- Need for a deep industrial transformation to meet competitive, environmental and social challenges
- Need to open new opportunities, specially for SMEs, to move from resource (labour and capital) intensive to knowledge intensive manufacturing able to compete in the global marketplace

Background and context

- Stemming from European Technology Platforms (ETPs): need for a new EU manufacturing strategy based on R&I
- IMS initiative (industry-led, international research and development (R&D) initiative established to develop the next generation of manufacturing and processing technologies): innovation in manufacturing
- Need to explore how an innovation-based manufacturing could look like by 2020 to shape a proper strategy: looking at alternative futures
- Need to understand innovation needs from a wide variety of stakeholders (i.e. industry, research and overall citizens) and their willingness to collaborate within the IMS initiative

Objective

- Strengthen international research collaboration under the IMS initiative
- Creation of five research roadmaps towards Intelligent Manufacturing Systems by the year 2020 and beyond, each focusing on one of the following Key Areas (KATs):
  - Sustainable manufacturing (KAT 1)
  - Energy efficient manufacturing (KAT 2)
  - Key technologies (KAT 3)
  - Standardisation (KAT 4)

    - Education (KAT 5)
- Provide inputs for remaining of FP7 and FP8

Focus

- Identify relevant manufacturing research topics and supporting actions which are needed to shape the future of intelligent manufacturing through international cooperation
- Each roadmap shall outline which research is needed to be performed through international collaboration to achieve at a desired vision

Expected outcomes and impact

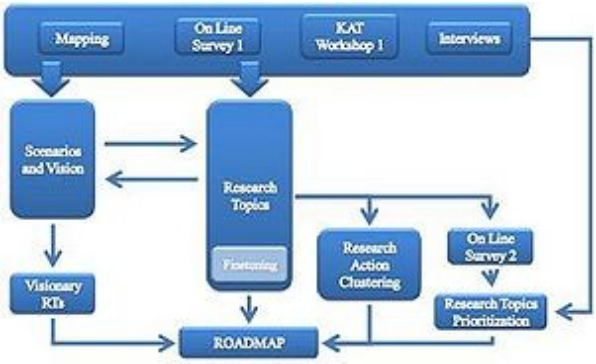
- Product:
    - Agenda setting (understanding of changes, vision): Manufacturing Snapshots (Scenarios) 2025 and IMS 2020 Vision
    - Policy definition (policy options and ideas to be funded initially in FP7): initial roadmaps depart from the implementation of the identified research topics and supporting actions between 2011 and 2013, and show the possible impacts or benefits that these could deliver in a timeline towards the IMS2020 Vision
- Process:
    - Support partners to build a shared understanding of different points of view and based on this a common vision to be pursued
    - Strengthening learning and networking across the IMS initiative (companies and research institutions from the 27 member countries of the European Union, Japan, Korea, Switzerland, and the United States of America participate in this initiative. Other regions are encouraged to join)

Design considerations

- Duration of exercise: 2 years
- Cost: 2.860.930 Euros (2.000.000 EC funding)
- Project team: partners within consortia (15); IPTS leading the methodology design
- Client not directly involved in the design but consulted in regular periods of time to check milestone achievements and adjust the process
- Users: client (DG RTD Directorate G - Industrial technologies) as well as industry and researchers
- Approach: bottom-up (identification of manufacturing research topics and supporting actions) and both product-oriented (roadmaps) and process-oriented (strength international collaboration)
- Participants: selected within and by the consortia considering existing networks and emphasising the need to depart from industry needs; online surveys open to anyone

The Roadmaps had to ensure the highest relevance to input coming from the industrial community as well as to ensure the international (IMS Regions) relevance to the results

Process design and implementation



STEP 1: mapping, interviews, online survey and industry workshop

- The work kept into high consideration previous research and projects done both at European and International level (particularly the IMS region) on proposing scenarios and roadmaps in the field of manufacturing
- A total of 754 Research Topics were identified through:
    - Mapping (01/2010 ? 04/2010): 20 worldwide existing scenario and roadmap projects and 13 ongoing research projects
    - Interviews (02/2010 ? 05/2010): 106 interviews with industry representatives
    - Open online survey (02/2010 ? 05/2010): 261 participants

Both interviews and online survey were asking participants to outline 2 to 3 innovation ideas needed for Intelligent Manufacturing Systems by the year 2030, highlighting to which KATs it relates to, and to illustrate which future changes in society are needed so that such an idea can become a reality by 2030.

STEP 2: consortia workshop for brainstorming and initiate scenario building (04/2010)

- A two day workshop took place to discuss findings of STEP 1 and to begin the scenario building process
    - Outcome 1: need to cluster and refine identified Research Topics
    - Outcome 2: definition of scenario framework and of snapshots to be developed
- Scenario building process

1. Based on results of mapping (STEP 1) and in connection with objectives of the project, to select the main impact dimensions which influence all KATs to build a framework ? selected dimensions: sustainability and industrial international R&D collaboration (related directly to project objectives); and knowledge society and policy and governance

2. To define the main features of selected impact dimensions and their possible behavior (i.e. extremes they can fall in)

3. To build a framework and position snapshots to be developed within such a framework ? during the workshop the initial idea was to develop the snapshots falling at the edges of the framework (i.e. figure 1) but after

discussing these the final decision was to develop in detail four snapshots according to figure 2

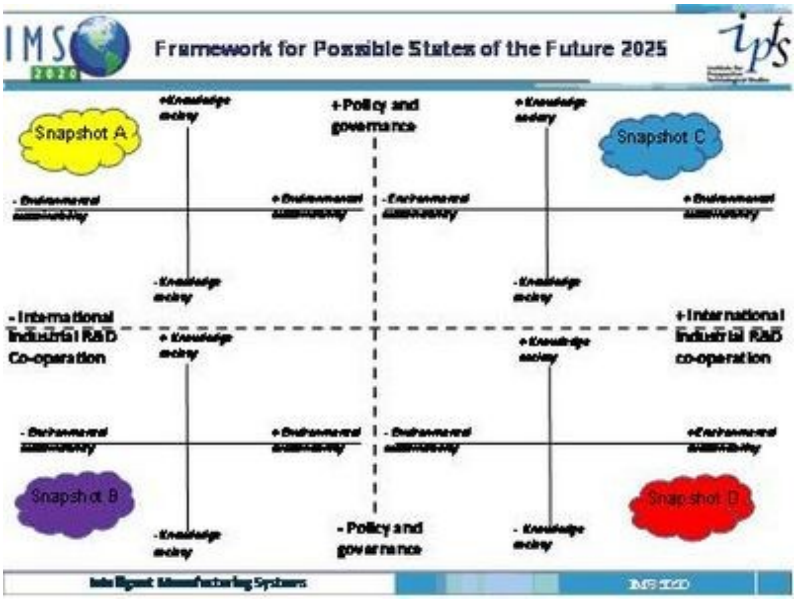


Figure 1: Initial Position of Snapshots

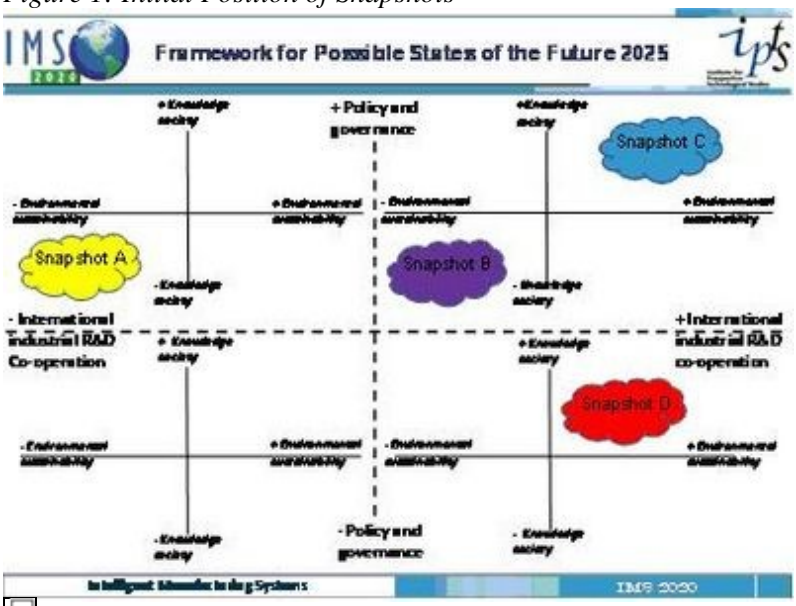


Figure 2: Final Position of Snapshots

The main reasons behind the shift between the initial position of snapshots to its final position were:

- Snapshot A: difficulty of the group to picture a world in general and manufacturing in specific where environmental sustainability was negative but society was highly interconnected and functioning as a knowledge society
- Snapshot B: the dark scenario where all impact dimensions were negative seemed only possible to the group if there would have happened either a major natural catastrophe or war
- Snapshot C: this was the only snapshot which did not change from its initial position, and it was interesting to see that for most partners it seemed to be a lot easier to picture a positive future. In fact, partners thought of discussing snapshot C during the First KAT Workshop (04/2010) as it would become the IMS2020 vision. However, an agreement was achieved after JRC-IPTS explained that at the snapshots

(scenario) exercise was important to try to picture different possible futures rather than the desired future, and this was also why the timeframe selected was 2025. This would be critical when defining later on the IMS2020 vision since it would take into account that the world could evolve in different ways, and by considering this in the definition of the IMS2020 vision would therefore make it more robust and realistic

- Snapshot D: the difficulty here was similar from that in snapshot A, or that the group could not picture a world that does not function as knowledge society having a positive environmental sustainability

STEP 3: scenario and vision building (04/2010 ? 08/2010)

01. Develop the selected snapshots highlighting how their main features interact within each possible state of the future by 2025 (04/2010 ? 06/2010). This entailed:
i) The definition of the main characteristics or behaviour of each snapshot feature
ii) The development of a storyline explaining the interactions between these features

The whole group was then divided into four so that each snapshot would be further developed within different groups, and a responsible assigned for each group. This work took a month and a half approximately and each group organised itself and met accordingly to finalise their work within this timeframe. JRC-IPTS coordinated the whole work and supported all four groups in developing the four snapshots

After the snapshots were developed within each of the four groups they were circulated to all project partners and IMS regions for refinements and to ensure that these would take into consideration not only an European perspective, but rather an international one

02. For each snapshot feature identify both the desirability and likelihood of having such behavior in 2020 (06/2010)

After approval of all snapshots description by partners, those groups responsible for developing the snapshots had to assess all features within each snapshot on the likelihood and desirability of these becoming reality by 2020. A Likert scale of 1 to 3 was used for this exercise, 1 being not desirable or not likely, and 3 being desirable or likely to happen by 2020

The results of this exercise were then used as an input for the development of the IMS2020 Vision during a vision building workshop, and special attention was given in the discussion to those features which were desired (desirability = 3) and somehow likely to happen by 2020 (likelihood > 2)

03. Discuss the above findings in a vision building workshop to define the main characteristics or behaviors that should constitute the IMS2020 vision (07/2010)

Another group or vision building task force was created to support the development of the IMS2020 Vision before the actual workshop took place. This group had partners representing each of the previous groups working on the snapshots as well as partners responsible for each of the five KATs

The first exercise required from each member of the task force was to prepare a statement (maximum one page document or five minutes presentation to be delivered at the vision building workshop) on how manufacturing and the world would look like in 2020 would all research topics identified within each KAT become a reality (using here the results of STEP 1 or mapping, interviews, online survey 1 and KAT 1 workshop which took place in 04/2010)

This material was circulated among members of the vision building task force. The task force met then on

07/2010 to discuss and develop the first draft of the IMS2020 Vision

The above mentioned vision building workshop was structured around the inputs on the likelihood and desirability of features from snapshots A to D as well as the statements prepared by KATs 1 to 5 on how manufacturing and the world would look like in 2020 considering all research topics identified within each KAT would be implemented. The results of the discussion were captured using a mind-map software

04. Circulate both the developed snapshots and the IMS2020 vision to all project partners for final refinements and to secure it encompasses all IMS regions

Based on the results of the vision building workshop a first draft of the IMS2020 Vision was developed by JRC-IPTS and circulated for refinements and to ensure it would capture the views from all project partners and IMS regions, and that it would reflect all five KATs in line with the selected impact dimensions. The IMS2020 Vision was circulated first to the members of the vision building task force and later to all project partners and IMS regions

The Final IMS2020 Vision towards which the 5 KAT roadmaps are being developed was described in detail through the same features of the four developed snapshots. It can be summarised in three main statements:

1. Rapid and adaptive user-centred manufacturing which leads to customised and 'eternal' life cycle solutions

2. Highly flexible and self-organising value chains which enable for different ways of organising production systems, including related infrastructures, and reduces the time between engaging with end users and delivering a solution

3. Sustainable manufacturing possible due to cultural change of individuals and corporations supported by the enforcement of rules and a proper regulatory framework co-designed between governments, industries and societies

STEP 4: development of roadmaps (08/2010 ? present)

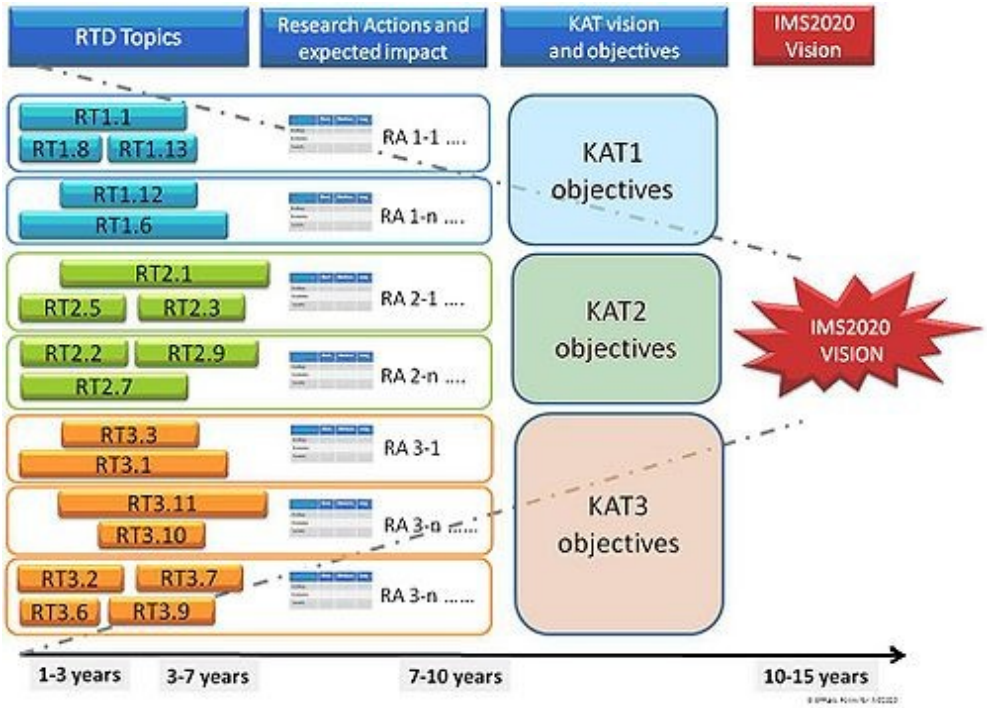


Figure 3: Roadmaps

- Once the IMS2020 Vision had been approved by all partners, each KAT developed an overall major objective by 2020 and refined the identified Research Topics in line with this
- In total 62 Research Topics comprising all 5 KATs were defined as critical to be implemented in order to achieve the IMS2020 Vision
- These topics have been shared and fine-tuned with the input of the community and partners' networks through an online wiki that had more than 2500 visits up to now
- The development of the Roadmaps has been supported by collaborative tools shared with all the Roadmapping Support Group, a growing community that currently counts with 254 participants mainly from 108 industrial organizations
- Finally the Research Topics have been prioritized through a second online survey looking both at the importance of each Research Topic and at participants (IMS regions) interest to work in collaboration (collaborative research projects). The survey had 359 participants
- Three roadmaps have already been developed (i.e. on sustainable manufacturing, energy efficiency and key technologies) and the other two are still being developed (i.e. education and standards) in connection with the first three. The overall process can be captured in figure 3

Learning so far

- The main difficulty encountered along the process was to convince partners on the need to look at alternative futures before devising a vision to be pursued
- During the selection and development of snapshots looking at 2025 partners started understanding the benefit to think about the future in an open way without having to select at an early stage their most desired future
- When looking together at the four developed snapshots partners recognised in all of them elements which were desirable and probable, and this was of upmost importance in the learning process

- The definition of the IMS2020 vision could accommodate different perspectives and is believed to be much more in line both with what is desirable and likely to happen if certain aspects are met (i.e. identified Research Topics are implemented) than it would have been otherwise (which would have been to define the most positive scenario snapshot as the selected vision even if this would have many elements which would be unlike to happen)
- The approach selected for scenario and vision development worked very well under the constraints of the project (number of workshops that could be undertaken), but the process of learning could have been faster would there be room for more face-to-face encounters