

APPLYING THE SCRUM METHODOLOGY TO THE OPERATIONS AND TECHNOLOGY STRATEGY SUBJECT OF THE UNIVERSITY MASTER IN BUSINESS ADMINISTRATION (MBA)

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Abstract

The objective of this article is to present a process of applying the SCRUM methodology to practical lab classes in the Operations and Technology Strategy subject of the University Master Degree in Business Administration (MBA) at the Higher Polytechnic School of Alcoy, which belongs to the Universitat Politècnica de València (UPV). To do so, the MBA Degree was globally analysed. Next the teaching programme was proposed for the corresponding subject. This contextualised the subject in the syllabus underway by focusing on skills, and on coordinating and organising the subject and teaching-learning methodologies. Next the syllabus, the teaching programme of theoretical/practical classes, the material resources and the evaluation system were proposed. The SCRUM methodology was applied to encourage the relative efficiency of practical lab classes, whose ultimate objective was to develop a collaborative project to create the operations strategy of a new business idea.

Keywords: SCRUM, operations strategy, business administration (MBA), collaborative work.

1 INTRODUCTION

Since academic year 2014-2015, the Higher Polytechnic School of Alcoy (EPSA), which belongs to the Universitat Politècnica de València (UPV), has offered the University Master Degree in Business Management (MBM). The Operations and Technology Strategy subject forms part of the core subjects that make up the MBM syllabus.

MBA intends participants to acquire global knowledge about company management in an international environment, which allows them to develop the essential management skills required to lead different business projects in all kinds of organisations. In this way, MBB intends to respond to real and current business world needs. MBA's main objective is to train future managers and businesspeople so they are qualified to manage and lead organisations in today's global environments, characterised by their high complexity, dynamics or uncertainty. MBA intends to confer knowledge to students so they are capable of creatively analysing and solving complex situations in the company management domain, supported by developing and using theoretical-practical, methodological and information analysis tools. Indeed it intends students to acquire advanced knowledge in these fields: organising and managing companies; accountancy; finances; marketing; leadership, management skills and teamwork; company tax systems; analyses of the environment; operations strategy and management tools for decision making.

Apart from training in technical aspects, transmitting greater sensitivity to the ethical aspects of business operations to students is also considered important to evaluate companies not only in the economic terms, but also in the social and environmental terms that characterise them.

To complete this Master, it is necessary to attend classes/lectures and pass 90 ECTS, distributed in two courses (3 4-month periods) as follows: 42 core ECTS, 36 optional ECTS and 12 ECTS from the Final Master Project (FMP).

The Operations and Technology Strategy subject forms part of the Company Operations Management theme. The description of the contents of this theme include: the content and process of the operations strategy: sustainability and risk; capacity decisions, supply networks and the process technology in the operations strategy; conceptual thinking and analytical models for organising and developing the operations strategy; the performance measurements of the operations strategy. Therefore, the overall objective of the Operations and Technology Strategy subject is to present the strategic perspective of the operations function in a company or organisation. Special attention is paid to the holistic view of manufacturing, operations-related performance objectives, and to connections with other company functions. With the results obtained from learning this subject, it is worth stressing

that afterwards students possess improved theoretical and practical knowledge in strategic operations management, and should be capable of analysing the role of the operations in the corporate strategy and of devising a consistent operations strategy. The subject also evaluates transversal skills, such as application and practical thinking, design and project, and planning/managing time.

The teaching methods used mainly in the teaching programme for the Operations and Technology Strategy subject are: inverse class, case study, discussion groups, simultaneous dialogue, oral presentations and practical lab classes based on the SCRUM methodology. The planned tutorials, which students attend to voluntarily, supplement the teaching methods combination used in this teaching programme.

The SCRUM methodology is selected here as a framework within which students can deal with complex adaptive problems, while productively and creatively delivering products of the highest possible value [1]. This framework has been used to manage the development of complex products since the beginning of the 1990s. It is not a process or technique to build products, but is a framework within which several processes and techniques can be used.

The rest of the paper is organised as follows: Section 2 describes the SCRUM methodology. Section 3 shows how the SCRUM methodology is applied to the Operations and Technology subject. Finally, Section 4 provides the conclusions and provides further research.

2 METHODOLOGY

SCRUM is particularly indicated for projects run in complex environments, where quickly obtaining results, requirements that either change or are poorly defined, and innovation, competitiveness, flexibility and productivity are fundamental [2]. In SCRUM a project can be run in short and set time blocks (iterations that normally last 2 weeks, but can last 3 and up to 4 weeks in some teams, which is the maximum feedback and reflection limit). Each iteration has to provide a complete result, an increase in the end product that is susceptible to being delivered to the customer when required by investing the minimum effort.

To this end, the main SCRUM methodology elements are the Team, made up of people with different roles defined by the methodology (product owner, SCRUM master and development team); Artefacts, which correspond to the tasks to be performed by each group member to generate the final deliverable product; and Events or Sprints, which correspond to the time periods during which increments in the developed product are generated. These sprints are linked so they begin immediately after the previous sprint ends and the product generated by it. The time sequence of a SCRUM Sprint is shown in Figure 1.

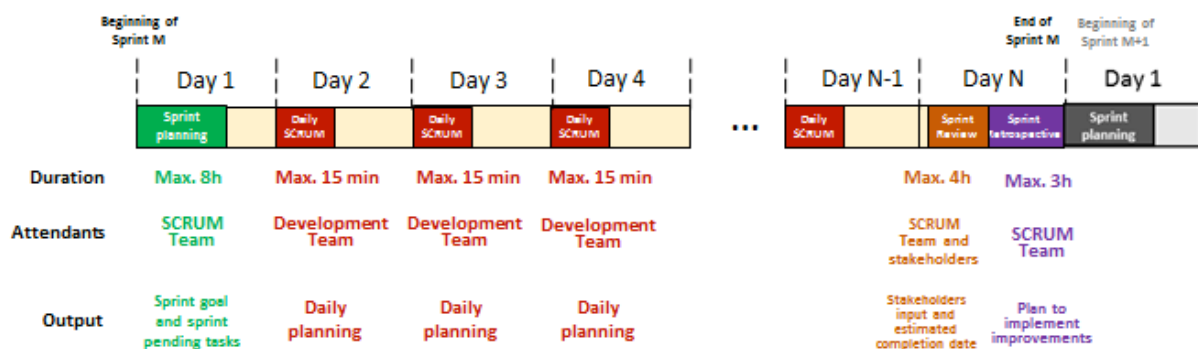


Figure 1. SCRUM phases

3 APPLICATION

The Operations and Technology Strategy subject is arranged according to the ECTS (European credit transfer system) as part of the syllabus implemented at the Higher Polytechnic School of Alcoy, as indicated in Table 1:

Table 1. ECTS distribution.

Type of ECTS	Number of ECTS
Theoretical credits	2.5
Master class	2.0
Seminar class	0.5
Practical credits	2.0
Classroom practices	0.5
Field practices	0.4
Laboratory practices	1.1

The 2.5 theoretical ECTS correspond to attending master classes, which implies transmitting theory, models and approaches, and credits obtained from seminars, where specifically introduced cases and themes are dealt with, in this case by external or professional teachers in this field. The 2 practical ECTS are divided into 0.5 ECTS for classroom practices in which case studies are mainly done by collaborative work. The 1.1 ECTS for lab practices contemplate considering and solving a project to be carried out by the SCRUM methodology. Moreover, the ECTS that apply to field practices imply visiting companies.

3.1 Theoretical classes

The teaching methodology proposed in this subject is based on student-centred learning in both theoretical classes and classroom practices. The subject's theoretical development uses the inverse class method, based on giving classes according to a model that includes the flipped classroom and blended learning methodologies, plus technologies to produce teaching contents. Videos are used so students can view and study at home. Notes and supplementary bibliography are also provided, and the case studies to be studied in class are put forward. Students must attend class and have properly prepared videos and other materials to discuss them. The time that students spend in class is to look closely at these contents, debate about them and apply these contents to case studies in class with their classmates and the teacher. With this methodology, the division between theoretical classes and classroom practices is barely noticed. It is worth stressing that participative master classes and studying short cases are used in the first session, which corresponds to the unit that introduces the subject.

3.2 Practical classes

Classroom practices or laboratory practices are based on the SCRUM methodology, in which partial and regular final project deliveries are made, prioritised by the benefit they provide the receiver of the project with. Indeed three partial and normal deliveries from the final project are made: the decision-making area of capacity, locating capacity and selecting suppliers, and the direct and indirect technology process selection. These deliveries are supplemented with an initial part to define the business idea and performance objectives, and with a final organisation and development part to complete the project.

The practical works to be done must be carried out as teams, which must include four people. Groups are freely made up of students. These three practical works actually consist in partial project deliveries to be done in the subject, and they coincide with the sprints to be done according to SCRUM. During each sprint, all the students will play a different role in the work team, and roles will be rotated among group members throughout the course. Students work as groups to design a newly created company or business model's operations strategy by means of three partial deliveries and the final project devised according to them. The group is recommended to obtain related information from primary sources (existing companies) and secondary sources (press publications, books, journals, the Internet, reports, catalogues, SABI, etc.). Writing a report is compulsory for each sprint that corresponds to the partial deliveries and the final project. During the lab sessions organised for this purpose, groups offer an oral presentation of their work. This presentation should not last longer than 5 minutes for works and 10 minutes for the project, and is followed by a questions/answers session.

More specific orientations about preparing and presenting reports and oral presentations are provided by the teacher during tutorials and after initial corrections, with which students have the chance to improve delivered work.

As the course involves a considerable interaction among students and also between students and the teacher, it is vital that students take on responsibility in the team and the complete class. All members of each team are expected to present an aliquot part of each oral presentation, and teams equitably distribute work among team members. To control this, deeds signed by the work team members are delivered with each report at the end of the sprint review. The teacher controls any possible plagiarism in the report prepared with the Turnitin application.

3.3 Teaching programme of theoretical and practical classes

Here all the sessions shown in Table 1 are considered; that is, classroom theory, seminar theory, classroom practices, field practices and laboratory practices. This is because these sessions tend to be included in the MBA schedule taught at the Higher Polytechnic School of Alcoy.

- **Didactic Unit I: Introducing the operations strategy**

Estimated Duration: 3 hours.

Contents: The company as a system. The operations subsystem. Operations management. Operations strategy. Market perspective. Resources perspective. Combining both perspectives.

Results of learning: by the time the theme ends, students should be capable of: having an overview of the subject's objective; identifying a series of previous concepts: company, production, operations, production management and operations management; understanding the operations strategy concept; identifying the importance of the operations strategy in the business world; knowing some examples of operations strategies in the business world; understanding the importance of the market perspective within the operations strategy; identifying the performance objectives that result from the company's competitive position in the market; understanding the importance of the resources perspective within the operations strategy; identifying existing decision areas in view of a company's resources.

Teaching methods: Participative master class, case study, discussion groups and simultaneous dialogue. As learning activities, students will learn and debate as groups different short cases related with the operations strategy's principles and concepts from market/resources perspectives.

- **Didactic Unit II: Operations strategy's content and process**

Estimated Duration: 3 hours.

Contents: Introduction. The operations strategy's content. Performance objectives. Quality. Speed. Reliability. Flexibility. Cost. Decision areas. Capacity. Supply networks. Process technology. Organisation. The operations strategy's matrix. The operations strategy's process.

Results of learning: by the time the theme ends, students should be capable of: knowing well the peculiarities of the operations strategy; understanding the main parts which the operations strategy's content is made up of; comprehending the different existing performance objectives; identifying the series of existing decision areas in operations; knowing the importance of the operations strategy's matrix and its main components; understanding the established process to define and maintain the operations strategy.

Teaching methods: inverse class, questions, case studies, discussion groups and simultaneous dialogue. As learning activities in class, students as groups study and debate the various proposed cases. As non-face-to-face activity, work teams must consider the new business model to be dealt with in the theme's project as regards the five performance objectives set out (quality, flexibility, speed, reliability and cost). These comprise the starting point for Laboratory practice 1, Academic work 1 and the Project.

- **Didactic Unit III: Capacity decisions**

Estimated Duration: 7.5 hours.

Contents: Introduction. Capacity strategy. Capacity measures. Three decision levels. Overall capacity level. Number and size of plants. Location of capacity. Scheduling change in capacity. Magnitude of the change in capacity. Change in the location of capacity.

Results of learning: by the time the theme ends, students should be capable of: understanding the importance of capacity as a decision area as part of the operation's strategy content; identifying the decisions that affect the overall capacity of operations resources; knowing the principles and ideas that determine how operations shape their capacity; understanding the dynamics of capacity decisions with time as regards the nature of their reshaping; applying analytical models to define the capacity strategy (decision trees, Game Theory); applying mathematical programming models to locate plants.

Teaching methods: inverse class, questions, case studies, discussion groups and simultaneous dialogue. As learning activities, students as groups study and debate the various proposed cases studies.

- **Laboratory Practice 1:** the capacity strategy's planning process (Sprint 1).

Estimated Duration: 3 hours.

Contents: applying the seven capacity strategy's planning process steps [3].

Activities for students to perform:

Academic Work 1: applying the seven capacity strategy's planning process steps to the new business model to be proposed by the work team from the project undertaken in the operations strategy of this business model. In this laboratory, students analyse the data from each work team, and prepare their reports, presentations and discussions.

- **Didactic Unit IV: Supply networks**

Estimated Duration: 7 hours.

Contents: Introduction. The supply network strategy. Relations among the operations in supply networks. Vertical integration. Market-based supply. Collaborative supply. Supply network performance. Supply network perspective. Supply network dynamics. Supply network management.

Results of learning: by the time the theme ends, students should be capable of: understanding what a supply network means; learning the alternative ways of individual relations with customers and suppliers in supply networks (a numerical example); understanding the dynamic performance of supply networks; coordinating the supply chain.

Teaching methods: inverse class, questions, case studies, discussion groups and simultaneous dialogue. As learning activities, students as groups study and debate the various proposed case studies.

- **Seminar theory:** Presentation of the operations strategy of an important company from the industrial sector.

Estimated Duration: 4 hours.

Content: Description of the operations strategy of an important company from the shoemaking sector by its Operations Manager.

Activities for students to perform:

Attending the seminar and studying an illustrative article about the Bullwhip Effect [4].

- **Laboratory Practice 2:** Plants and suppliers' planning process (Sprint 2).

Estimated Duration: 3 hours.

Content: suppliers' seven selection process steps; plants' five planning process steps [3].

Activities for students to perform:

- 1 The oral presentation of Academic work 1 done in groups by students.
- 2 Academic work 2: applying the plants' five planning process steps to the work team's project. Applying the suppliers' seven selection process steps to the work team's project. In this laboratory, students analyse the data of each work team and prepare their reports, presentations and discussions.

- **Didactic Unit V: Process technology**

Estimated Duration: 13.5 hours

Contents: Introduction. Direct process technology characterisation. Characteristics of the market's technology and requirements. Information technology. Indirect process technology characterisation. Process technology trends. Process technology evaluation. Process technology implementation.

Results of learning: by the time the theme ends, students should be capable of: understanding the process technology term; distinguishing between process technology and product/service technology, and between direct and indirect process technology; comprehending the meaning of the term CIM and the characteristics of SFF as an example of direct process technology; identifying the technical and management characteristics of both process technology types: direct and indirect; knowing the evolution of ERP systems until e-business as an example of indirect process technology or information technology; understanding why and how operations invest in process technology.

Teaching methods: inverse class, case studies, questions, discussion groups and simultaneous dialogue. As learning activities, students as groups study and debate the various proposed case studies

- **Laboratory Practice 3:** Planning process of both the process technology strategy and information technology (Sprint 3).

Estimated Duration: 3 hours.

Contents: process technology (6 steps to generate a process technology strategy). Information technology (3 steps to generate an information technology strategy) [3].

Activities for students to perform:

- 1 The oral presentation of Academic work 2.
- 2 Academic work 3: applying processes to generate process technology and information technology strategies to the work team's project. In this laboratory, students analyse the data of each work team, and prepare their reports, presentations and discussions.

Field practice: Visit to an assembly/supplier company from the automobile sector.

Estimated Duration: 4 hours.

- **Didactic Unit VI: Organisational structure, improvement and development of the operations strategy**

Estimated Duration: 6 hours.

Contents: Introduction. The operations strategy's organisation. The development and improvement of the operations in the operations strategy. Business processes and policies. Development of the organisation capacities of operations.

Results of learning: by the time the theme ends, students should be capable of: understanding how the company's organisational structure influences the operations subsystem and the operations strategy; understanding the organisational design objectives; knowing the commonest organisation structure types; comprehending how the operations function relates with the outer environment; knowing the main strategies used to improve processes.

Teaching methods: inverse class, questions, case studies, discussion groups and simultaneous dialogue. As learning activities, students as groups study and debate the various proposed case studies.

- **Didactic Unit VII: Performance measurements of the operations strategy**

Estimated Duration: 5 hours

Contents: Introduction. Systems to measure performance. Benchmarking. The importance-performance approach. Performance measurements. ABC (*activity-based costing*). Balanced scorecard.

Results of learning: by the time the theme ends, students should be capable of: knowing which approaches are the main ones to manage the improvement cycle; understanding the factors that should be included as performance measurements; understanding how performance objectives must be measured; knowing how to compare real performance with that estimated with the performance objective; knowing the usefulness of both benchmarking and the importance-performance matrix; defining performance measurements; applying the ABC approach; designing a balanced scorecard.

Teaching methods: inverse class, questions, case studies, discussion groups and simultaneous dialogue. As learning activities, students as groups study and debate the various proposed case studies.

- **Laboratory Practice 4:** Practice developing a balanced scorecard.

Estimated Duration: 2 hours

Content: Introduction. A balanced scorecard description. The design phases of a balanced scorecard. Balanced scorecard implementation. Computer tools for the balanced scorecard.

Activities for students to perform:

- 1 The oral presentation of Academic work 3.
- 2 Defining the operations strategy and performance indicators required to design a balanced scorecard.
- 3 Implementing a balanced scorecard using computer tools.

Final project: Develop the final project of the operations strategy with the previous partial deliveries and by incorporating the organisation and development decision area (Sprint 4). During the last subject session, the projects proposed by students are presented orally, which contain the development of a newly created company's operations strategy according to the matrix of Slack and Lewis [5], and to the analytical models of Beckman and Rosenfield [3]. Figure 2 shows the scheduling of the didactic units and sprints during the semester.

Weeks	W1	W2	W3	W4	W5	W6	W7	W8	W9	W10	W11	W12	W13	W14	W15
Didactic units	DU1	DU2	DU3	DU3	DU4	DU4	DU5	DU5	DU5	DU5	DU5	DU6	DU6	DU7	
Sprints				SP1		SP2					SP3		SP4		
				oral presentation						oral presentation		oral presentation		Final project oral presentation	

Figure 2. Scheduling didactic units and sprints

3.4 Material resources

The inverse class teaching method is supported by readings, videos and presentations using a computer, which are made available to students on the subject's website. The subject's email, website and forum are also used to supplement communication between the teacher and students.

A convenient practice session is for students to be able to seek and find information about a given content for the subject, or to work more in-depth on a certain case study or practical problem set out, and in any informative means, but preferably in scientific databases like Web of Science or Scopus so they can discover the real applications of the theoretical contents that they are learning. Thus searching for information and presenting it orally in theoretical classes and classroom practices are teaching methods that are considered particularly useful.

3.5 Evaluation system

The continuous evaluation of the level at which general and specific skills are acquired from the subject contemplates the evaluation system set out below:

- Two test-type exams that group the main contents of the subject's themes. An average minimum 4-point mark between both these test-type exams is required.
- Three practical work sessions done in groups with a maximum of three students who propose different parts to develop a company's operations strategy or business model that students propose. A report must be delivered and an oral presentation must be given.
- One project done in groups with a maximum of three students that also contemplate the three previous works in a coordinated manner to develop a company's operations strategy or business model that students propose. A report must be delivered and an oral presentation must be given.

- One self-assessment test in which students, who form groups, indicate their judgement of the project undertaken where the performance criteria have been previously set out and negotiated based on a proposal put forward by the teacher to the students.

In order to pass the subject with the continuous evaluation system, it is necessary to attend all the practical laboratory sessions and to obtain a minimum total mark of 5 points from all the evaluation actions taken.

Those students who do not pass the subject with the continuous evaluation system can opt to sit a final exam (written and/or test) which allows them to retrieve the contents they failed. This residual test contemplates the same evaluation tests in the continuous evaluation system.

Table 2 shows the self-assessment card that students use to correct their projects.

Table 2. Self-assessment card to classify projects.

NAME:	DATE:		
	Mark (from 1 to 10)	Weight	Total
OPERATIONS AND TECHNOLOGY STRATEGY: SELF-ASSESSMENT CARD.			
CASE STUDY. Score a top mark if:		20%	
- The considered case study reliably adapts to reality		5%	0
- The considered case study is clearly contemplated with a high level of detail		10%	0
- The work methodology to obtain data has been clearly explained		5%	0
Operations strategy proposal. Score a top mark if:		50%	
- The subject contents have been correctly applied in the proposal		5%	0
- The performance objectives are defined in detail		5%	0
- The decision areas have been clearly explained		5%	0
- The operations strategy matrix is consistent (contains no contradictions)		10%	0
- The highly critical, critical and secondary aspects have been identified in the operations strategy matrix		5%	0
- The operations strategy has been clearly explained		10%	0
- The operations strategy is correctly justified		5%	0
- Time and budget planning is included to develop the operations strategy		5%	0
Report. Score a top mark if:		30%	
- The work title fits the work content		3%	0
- The report's structure is suitable according to the practical work instructions		6%	0
- Writing and spelling are correct. No spelling mistakes. Written in the third person.		3%	0
- Despite being an academic report, it is professionally oriented.		3%	0
- The number of used bibliographic references exceeds five		3%	0
- The bibliographic references cited throughout the text match the facilitated format		3%	0
-The oral presentation was fluent and concise, and included the most relevant aspects		3%	0
- All the group members intervened in the public presentation		3%	0
- The presentation's structure and format were professional		3%	0
Overall mark (sum of the column)			0

It is noteworthy that from the very first subject session, students are informed about the project structure and contents, and they can develop the project progressively during the different laboratory practice sessions with the support of the planned tutorials, given weekly. Students are also informed about three partial deliveries with short periods (2-4 weeks) in accordance with the SCRUM methodology.

Regarding evaluations of the level of acquiring the transversal skills assigned to the subject as a control point, we find:

Application and practical thinking.

- Activities performed to acquire the skill:
Case studies, laboratory practices, writing reports and oral presentations.
- Detailed description of activities:
Several case studies are worked on as groups in both the classroom practice and laboratory practice sessions. The latter encourage reports being written and oral presentations.

- Evaluation criteria:

Various practical works are dealt with in which students in groups apply theoretical knowledge to a practical work. The results of these works are presented in written reports, and also in oral presentations whenever necessary. To evaluate this skill, the proposed practical work part is considered.

Design and project.

- Activities performed to acquire the skill:

Group activities, oral presentations and writing reports

- Detailed description of activities:

Several sequential works are carried out as groups towards a final work that consists in designing and developing a company or an organisation's operations strategy proposed by students. Writing reports and oral presentations are encouraged.

- Evaluation criteria:

The evaluation made of group works bears in mind the complexity and description of the problem to be dealt with, how its contents are worked on, and the format and structure that the oral and written presentations take. Students are provided with a rubric to self-assess the last work, which encompasses and coordinates the results from previous works.

Planning and managing time.

- Activities performed to acquire the skill:

Case studies, practical works, laboratory practices and oral presentations.

- Detailed description of activities:

Case studies are carried out during both classroom and laboratory practices sessions. During the latter sessions, oral presentations and written reports of practical works are encouraged.

- Evaluation criteria:

Works that require reports being written and oral presentations are carried out. The dates to undertake and deliver practical works are followed up.

4 CONCLUSIONS

The MBA degree is a Master Degree with 90 ECTS to which students preferentially access from Social Sciences and Legal Sciences. In the Higher Polytechnic School of Alcoy syllabus, core subjects are taught about: Analyses of the Global Environment, Company Operations Management, Statistical and Simulation Tools for Decision Making and Management Skills. This article presents the syllabus for the MBA's Operations and Technology Strategy subject which considers the following aspects: skills; organising the subject; teaching-learning methodologies; theoretical and practical classes; bibliography; material resources and the evaluation system. For the teaching-learning methodologies, the application of the SCRUM methodology is stressed when giving laboratory practice classes. It is worth stressing the following as the main advantages when applying SCRUM: (1) students being able to conduct a complex work incrementally, who play different roles throughout the project, which might coincide with their different professional tasks in the future; (2) in general terms, students feel motivated as they can generate and design the operations strategy of a business' own idea while they see how it materialises at the end of each sprint; (3) work groups' self-management to distribute tasks and manage conflicts. The main limitation is the excessive workload, identified as students' partial deliveries or sprints because, although this methodology is applied to different MBA subjects, the activities among them are not coordinated. This fact may give way to future educational research lines about applying SCRUM as projects shared by different subjects to improve practical and collaborative learning.

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