FLEXIBLE TACTICS TO FACE COVID-19 AND SOCIAL OUTBREAK IN CHILE

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ABSTRACT

The COVID-19 pandemic can be considered as one of the world's largest crises in the last century. Its effects are observed in many fields, and tertiary education is no exception. In Chile, its impact has been exacerbated by an ongoing social outbreak since October 2019. This context motivated huge changes in the way engineering courses are taught and how learning is achieved and assessed. The situation is causing difficulties to students and teachers, who still manage to overcome them and advance in the teaching-learning processes. This article describes a set of flexible tactics implemented to manage the general context existent during the first term of 2020 at the School of Engineering and Science of Universidad de Chile. We provide testimony of the situation we faced and guidance for similar courses. The case study corresponds to a compulsory course in the Mechanical- Engineering curriculum. Restricted evidence (self-perception surveys of 24 students) supports effective delivery through increased flexibility in the use of teaching-learning and assessment tools and frequent monitoring of student's attitudes and perceptions. Evidence supports the achievement of the course learning goals. Lessons learned helped designing a new version, still in online mode.

KEYWORDS

COVID-19, Chilean social outbreak 2019, emergency remote teaching, online learning, active learning, Standards: 6, 8, 11

INTRODUCTION

It has been written many times that ours is a period of volatility, uncertainty, complexity, and ambiguity. Without a doubt, 2020 was hard proof of it. The COVID-19 pandemic has been a shock for mankind. Social and economic systems have been battered seriously, and recovery is expected to last several years. Education, as a whole, is no exception. The forced move in tertiary education from face-to-face to online learning is still in its infancy and is certainly a challenge that is leading to a new equilibrium, where traditional methods are being adapted or replaced. The situation presents itself as a crossroads for education, as face-to-face is moving to blended and full online in the long term, on a massive scale. Chile is also experiencing a social outbreak since 2019 (SO-19) that questions the viability of the free-market economic model in place for the last 40 years. COVID-19 and SO-19 are major drivers for growth in delivering enhanced engineering education for the XXI century.

At the beginning of the first term of 2020, Chile was returning from the summer holidays and had few cases of COVID-19. Expectations regarding SO-19, which started in October 2019, were very much present, especially in a public institution like Universidad de Chile. By the third week of March, the University suspended face-to-face teaching. The academic community had

almost no experience regarding Online Learning (OL). In a survey during June 2020, 78% of the teachers (N=228) declared no previous experience in OL (Bravo & Solis, 2020). Teaching at the School of Engineering and Science of the Universidad de Chile was mainly traditional, most courses were based on face-to-face interactions. Many students did not possess broadband internet nor personal computers and/or adequate space for exclusive use at home. SO-19 meant, already for the second term of 2019, a serious disruption to teaching and assessment methods. Most teachers opted to replace traditional exams with homework, hoping for low cheating rates. Many average grades increased significantly compared to regular semesters. As a result, the capacity of the University to warrant the attainment of program-level learning goals required a revision.

The uncertainty given by the social and pandemic context of the country made it difficult to know beforehand how students would react. A part of the student community showed resistance to start a fully online semester. The climate was not the best, and two consecutive student strikes occurred in March and April 2020 to ensure fair conditions to carry on the term. Social, political, and sanitary issues mixed with the academic context, increasing problems related to students' workload and mental health. The picture was not clear at all, and with the inertia of the social outbreak, student representatives wanted to be heard by the School authorities. The need for dialogue and adjustments to unite and meet the needs of the students was becoming more and more evident.

The combination of COVID-19 and SO-19 forced courses' redesign on the fly. The state of affairs made it mandatory. Course redesign in the context of deep uncertainty requires a paradigm that is not based on ordinary conditions ("plan and deliver"), but that aims to prepare and adapt by monitoring how the context evolves and allowing adjustments over time as updated information becomes available. This "observe and adjust" paradigm recognizes the uncertainty surrounding teaching and assessment under changing scenarios. Yet, it is important to respect core educational values that require reflection.

This paper reports the experience faced during the first semester of 2020 in a fifth-year Mechanical Engineering course at the University of Chile. This shows the initial approach to develop the course and how it was adapted as the monitoring process took place. The results obtained from the evidence collected in each one of the interventions, the discussion that came out of that, and the lines of work projected for future semesters are also described.

RESEARCH QUESTIONS AND LITERATURE REVIEW

The forced move to ERT created a course (re)design need. The following research questions were stated for that purpose:

- RQ1: Which teaching-learning framework(s) is/are better adapted for OL?
- RQ2: How to help our students cope with the term in the context of general adversity?
- RQ3: How to assess learning properly in OL without overloading our students?

Before COVID-19/SO-19, the dominant form of teaching was based on traditional synchronous learning (SL). The sudden change from face-to-face to OL creates a non-physical (transactional) distance between learners and the teacher. Moore (2019) presents the classic theory of transactional distance (TD). Garrison (2017) proposed the Communities of Inquiry framework. We selected TD, which is well suited for instructional design for online education and provides a plausible answer to RQ1. TD theory poses that it is not the geographical distance between a teacher and student that impacts learning outcomes, but the cognitive distance. Moore postulates that Individual feedback, dialogue, and autonomy can narrow the

distance. Reducing TD among students and the teacher, and interactions among students enhance the achievement of learning goals.

OL requires higher levels of self-regulated learning (RQ2), as the responsibility of learning is transferred to the student to a greater extent. Self-regulated learning emphasizes control and autonomy by the learner who monitors, directs, and controls actions toward goals of gaining expertise and self-improvement (Paris, 2001). Educators can teach self-regulated learning skills by using strategies such as Problem-Based Learning (PBL) (Hung, 2011), and Project-Oriented Learning (POL) (Beckett et al., 2019; Pascual & Anderson, 2014). Students' use of learning strategies is based on the belief that these strategies are necessary for learning, and are effective for overcoming obstacles (Dweck & Master, 2008). Yet, many of them show low levels of study skills, time management, and coping with stress (Maier et al., 2013). Havenga (2020) implemented PBL in an online class, finding out that a teacher's presence is essential in the process of learning, and working in groups allows active learning and commitment of the students. OL engagement is often achieved using active learning activities in small groups where one or more students act as *champions* (Maier et al., 2013). In such a mode, a student gets control of the class whiteboard and develops, in collaboration with her peers and the teacher, a proposed problem.

Excessive cognitive load (CL) was also a concern in our context (Karaka, 2017). CL is often distributed in traditional face-to-face learning among attending class, homework, and synchronic evaluations (RQ2). With the forced move to OL, a large portion of the load was transferred to homework (including evaluations with extended lead times). Such a situation implicates an increased CL for students, who faced many homework deadlines during the term. Excessive CL negatively affects the students' performance, learning, and levels of anxiety. One way to manage CL is using blended learning (BL). This consists of giving the students class materials to learn the theory beforehand and participate actively in class. BL allows students to learn at their own pace, increasing reflection, and decreasing anxiety. Karaca & Ocak (2017) explores BL and concludes that if well implemented, can reduce CL to the students. Another tactic to reduce anxiety is to gamify the class. Wang & Tahir (2020) provides a review of game-based learning as an effective tool to reduce anxiety.

Another aspect of interest is the stress-coping strategies of the students (RQ2). Visozo (2019) suggests that academic burnout could be prevented by the development of appropriate tactics and improving students' disposition, which positively affects students' performance. Bedewy & Gabriel (2015) identify four factors that affect students' ability to cope: academic self-perceptions, perceptions of workload, pressures to perform well, and time restraints. This list could be negatively affected by the effects of the pandemic context.

Different studies show that grit in college students is decreasing (Duckworth, 2016; Direito et al., 2019). The combination of COVID-19 and SO-19 would affect how students react to adverse conditions. Future engineers are expected to develop technical skills and the ability to adapt to uncertainty. Yet, initiatives designed to address the psychological demands of engineering are uncommon (Pascual et al., 2021). This raises interest in understanding non-cognitive factors and how they are affected by uncertainty. In this line, (Direito et al., 2019) conducts a review on the subject and confirm that studies on this area are still very scarce.
Related to students' non-attendance to online classes (RQ2), Sloan et al. (2019) shows that the modality of the class has an impact on attendance; in order from highest to lowest probability of student attendance: laboratories, seminars, tutorials, and lectures. In OL, students often get the option to check the video a posteriori, instead of attending the live class. If they do so, they miss the opportunity to interact but gain the freedom to study at their own

pace. Such *vicarious* learning mode could mean very poor attendance to the online class, affecting constructive discussions.

Among the student's coping strategies, cheating can increase (RQ3). Academic integrity is a global problem that needs to be faced, especially for OL. For example, a survey in the United Kingdom found that approximately 15% of students recognized cheating, and 40% knew someone who had plagiarised (Maier et al., 2013). The pandemic context has increased the risk of academic integrity issues during summative assessments.

Regarding assessment (RQ3), available video conferencing platforms do not provide supervision capabilities for assessments. Chao et al. (2012) study the impact of synchronous assessments in online environments focusing among other subjects on the extent of cheating and the need for a variety of methods for the different subject matter. In line with our approach to developing self-awareness, Esparragoza et al. (2014) develop a 30-item instrument to assess ethical awareness in Engineering students. Attempting to ensure proper individual learning in OL, Cramp, et al. (2019) describe lessons learned from implementing remotely invigilated online exams (RIOEs). According to the authors, RIOEs require a more systematic and effective design compared to traditional paper-based exams. Successful implementation of RIOEs should be supplemented by early communication with students.

PROPOSED METHOD

High levels of uncertainty related to the combination of the social outbreak and global pandemic impulsed us to move from the traditional "plan and deliver" to "observe and adapt". The change to OL and increased student self-regulation support the use of PBL and POL.
The guiding principle for any adaptation during the term was "To ensure the learning goals while reducing non-core activities and keeping proven techniques to avoid increased student's anxiety and decrease transactional distance".
In this context, selected key tactics (KT) are:

1. Ensuring, with active learning approaches, the achievement of the core competencies described in the course program.
2. Using synchronous assessment to minimize excessive CL and academic integrity issues. For example, limiting the time to answer and using pools of questions.
3. Providing frequent occasions for monitoring climate, increasing dialogue, and reducing transactional distance, creating spaces to build rapport, and show empathy for the difficult times that many, if not all students, were going through. At the same time, provide schemes to reduce student's anxiety.

Below, we describe the tactics that were implemented to put the key tactics into practice.

CASE STUDY

Our case study considers a compulsory course placed during the fifth year of the mechanical engineering curriculum at Universidad de Chile. According to the program, at the end of the course "Operations management", the student must be able to engineer proposals to improve operations in the context of public and private organizations. To do so, the student must be able to analyze operational problems using quantitative modeling tools. Before this course, students have been taught optimization, probability, and statistics courses. The baseline syllabus for the term included an exploration into skills for life and career (this strategy is described in detail in Pascual et al., (2021)). There were 24 students in this class.

KT1: Adapted active learning

We considered the following PBL approach: At each class, a champion leads his peers in developing spreadsheet-based cases with the teacher's facilitation. The screen of the

champion was shared on the teleconference platform. Class videos and source files were uploaded and made available to the students on the same day as the class. We also considered a group project (POL), with a duration of 15 weeks. Partial and final reports and presentations with flexible dates, following the uncertain agenda. The weight for each partial was different (25%, 35%, and 40% respectively). Each group selected its project from a pool of alternatives, providing an opportunity for personalized learning. To facilitate critical-thinking development, a global concept map of the course was collaboratively developed all along with the term. The map included class dates to map class videos to course concepts easily (IHMC, s. f.). To provide a final instance to share knowledge, an open webinar was offered.

KT2: Synchronous assessment

Three evaluations were made, with flexible dates. Each one took two hours, with two questions from a pool. Pools ranged between 9 and 21 questions. We considered that two hours were a reasonable limit to avoid fatigue. Questions were posed in sequential rounds, 1 per hour, with a 10-minute break in between. A third optative question was offered during the next week. If the student used this option, he/she selected which two questions had to be considered for grading. As for the project, the weight for each partial result was different.

KT3: Monitoring, reducing distance, and reducing anxiety

We developed several sequential surveys to monitor climate and adapt tactics, if necessary. We wanted to measure the different learning perceptions and experiences that students have in every instance of evaluation to come up with improvements. The first and second surveys had a total of 19 answers, and the third one had 18 answers. We used a 5-point Likert scale (from strongly disagree to strongly agree). The response rate ranged from 75% to 79%. In what follows we summarize the survey's results and how the teaching team reacted timely.

Data source

After each partial exam, a survey was prepared to gain evidence to adjust the course if necessary. The questions aimed to explore various factors that were not clear at the beginning of the study. As mentioned before, the strategy adopted was to observe things that seemed important at the moment and could add value to improve the core characteristics of the course. The surveys evolved with every intervention, guiding to adapt and improve the course. Also, 7 students were interviewed at the end of the term.

Procedure

Participants completed the questionnaires using an online survey platform. The procedure to collect this data was to deliver the survey to students in a synchronous manner at the end of the class after each partial evaluation. The survey was anonymous.

RESULTS

First survey

The first survey was taken during week 6. Its focus was to know if students had proper access, resources, and fundamental tools to accomplish the exam. Students showed to have the necessary conditions to face it (table 1). 69% of the students said their internet connection did not impede them to complete the test. Also, 69% agreed they have the appropriate equipment to work. On the other hand, 15% did not agree. This raised an alert to explore particularly each case for future evaluations. The 25% said their physical space made the process more difficult compared to the traditional in-classroom tests.

Table 1. First survey. Student’s perceptions.

Conditions during the term	Positive	Neutral	Negative
Internet connection	69%	16%	15%
Equipment (computer, tablet, etc.)	69%	21%	10%
Physical space	58%	17%	25%
Difficulty and alignment with course content	79%	16%	5%
Suitable time of answer	26%	32%	42%
Optative question	63%	26%	11%

A 79% of the students stated that problems on the test were aligned with what was seen in class (Table 1). This supports the hypothesis that in terms of content and difficulty, the evaluation was adequate and that there were external factors that made the experience different from a traditional evaluation. 26% of the students considered that the time assigned to answer each question, allowed them to solve and send/upload them to the platform without problems. 42% mentioned that the time was insufficient. 63% reacted positively to the opportunity to choose which two of the three questions would count for grading. This alternative reduced their anxiety and made them perform better. Also, several commented that keeping the camera on, augmented their anxiety. From this point, it was not mandatory to use a camera for the remaining assessments, the optative question was kept for its benefits, and the time to answer was increased from 60 to 70 minutes.

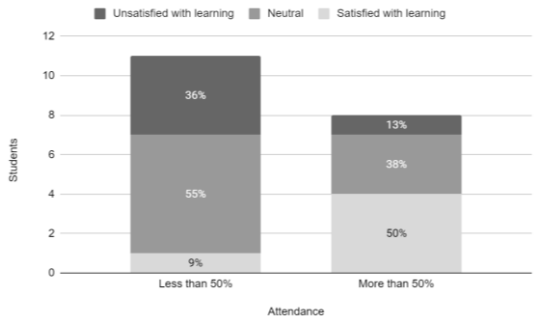
Second survey

The second survey was taken during week 11. 79% of the students agreed that this was their only course with a synchronous assessment. Most students had asynchronous assignments with long deadlines. In practice, this may translate to more time and work dedicated to each evaluation, and potential excess of CL. The main difficulties (Table 2) regarding the test were anxiety (88%) and poor internet connection (41%).

Table 2. Second survey. Main difficulties during the test.

Main difficulties during the test	Agree or Strongly agree
Stress and anxiety	88%
Poor internet connection	41%
Poor feedback from the teacher	23%
Poor skills in Excel	17%

After the first partial exam, attendance dropped considerably (figure 3). It was necessary to understand the perceptions and behaviors, especially of the students who didn't attend. 58% answered that they attended less than 50% of the classes, and 42% of students to 50% or more of them. Only 9% of those who attended less than 50% said they felt satisfied with their learning.50% of those who attended 50% of the classes or more, showed they were satisfied with their learning outcomes (figure 1). Synchronous attendance seems to play a positive role in the learning experience of the students in this course.



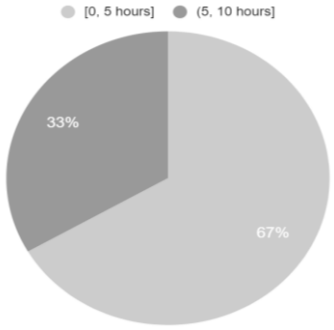


Figure 1. Second Survey. Attendance vs satisfaction with their learning outcomes.

Figure 2. Second survey. Average weekly course dedication reported by 18 students

Students were asked to share their study strategies. 89% of students answered that their main source for studying was watching asynchronously the class videos, followed by solving the study guides (39%) and practicing in class (33%). 56% of the students watched the class videos weekly and 44% watched the videos a few days before the test. In terms of academic workload, for a course of 6 credits like this, it is expected that students may dedicate between 9 and 10 hours weekly to activities related to the course (classes, evaluations, self-study, etc.). In this case, just one student reported occupying the 10 hours required by the course program. 67% of the students reported spending 5 hours or less in activities related to the course. The evidence shows (figure 2) that most of the class spent less than 50% of the time they were supposed to invest in the course. Such a strategy possibly affected their ability to answer the tests in the allotted time, increasing their anxiety.

Third survey

The third survey was taken during week 14. 15% of students stated that they felt more nervous and anxious in the third test than in a traditional face-to-face test. Some reasons declared by the students were related to test duration ("the test could last longer") and time management (they missed having the opportunity to distribute their test time alternately in the question they preferred); 55% agreed that the optional question helped them to reduce anxiety. 67% answered that their attendance to this course was similar or even higher than in other courses they took in the semester. Students recognized that the lack of attendance and participation in class was due to the pandemic context and the stress and workload (of all courses) during the final weeks. Most students preferred to study by watching the class videos. These acted as tutorials and showed them how to solve the problems.

Post-course assessment

Figure 3 shows the attendance of online classes during the term. Before the first partial exam (the orange vertical line), its levels are similar to those perceived as normal to higher for a face-to-face context. As can be seen, attendance fell to about 20% on average after that.

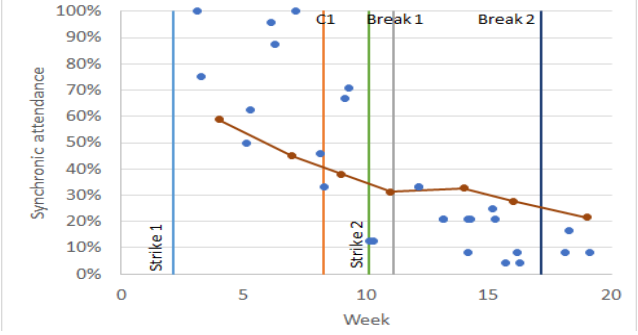


Figure 3. Synchronous attendance. Orange line refers to the first partial test and the brown line to a mean value of 113 courses during the spring 2018 term (Celis and Orellana, 2018).

To obtain more information about the students' perspective on the course and the remote modality, surveys were taken throughout the semester and, after the completion, 7 students were interviewed. This section presents the principal results obtained from their testimonies.

The students reported having an average of 6 courses and 29 assignments, in asynchronous mode, during the fall term. The semester is divided into 15 elective weeks, having an average of 2 home assignments per week. Despite the academic workload due to the assignments, 3

of the interviewees said that having more time for the evaluation was helpful for their learning, giving them more time to think and analyze the topics seen in class.

One of the concerns was how to know if some students were cheating. Students commented that they understood this practice was harmful to their learning. Cheating meant that they were not gaining the necessary knowledge that was part of their training as professionals. They commented that a common practice was to compare the results of problems with their classmates after doing them on their own. They mentioned this as one of the benefits of asynchronous evaluation because they had time to think and analyze each issue.

Also, some students preferred to watch the class videos out of the established schedule. Such a practice allowed them to adapt to the context of their homes. Many preferred to learn in a tutorial (vicarious) mode. This is one of the learnings from the adaptation process experienced during the year 2020. Today the internet allows access to a lot of information on different subjects, and a large part of the population can learn by watching others learn.

Some students said that the PBL methodology made them feel anxious because of the possibility of being champions and not having the skills to achieve it. However, in a survey done by the University at the end of the course, answered by 23 of the 24 students in the class, they valued the innovative teaching style positively. They saw great potential in the method and the results obtained, as it allowed them to put theory into practice immediately.

The school conducted a survey at the end of the term to evaluate courses and teacher's performance, which showed favorable results for this class. Students recognized the role of the teacher in their process of learning and gave some recommendations to improve methodology. For example, create a calendar with the assigned champion for each class to decrease students' anxiety. Also, 83% of 18 students who answered the survey, agreed that the professor promoted a fluid and permanent interaction in the virtual classroom (reducing transactional distance), made available support resources, and linked class contents with previous knowledge. 55% of students agreed that class methodologies motivated their participation, and they were oriented to perform the activities in an autonomous way.

The following are some of the comments made by students in the surveys:

"...In general, I was quite nervous before the mid-term assessment, but seeing that the questions were short and easy to understand, I knew that there was no need to worry too much." (first survey, May 2020)
"All classes are different and dynamic. The online modality is well adapted to the teacher's style of teaching, with a champion who solves a problem in excel and the teacher guiding her..." (third survey, July 2020)
"The problems of the exam are not particularly difficult, since the class itself is not difficult, it is the time given to solve the problems that increase stress…" (third survey, July 2020)
"The teacher was very respectful and very open to dialogue throughout the term, which is very much appreciated in these uncertain times." (end-of-term survey, August 2020)

Few persons had problems with the modality of the summative evaluations. One of the main reasons is they have to share spaces with family, making it difficult to be focused for a couple of hours. The majority of the interviewees could adapt to this modality, and it wasn't a general complaint. The last point was confirmed at the end of the course with the survey carried out by the University. Students declared that the teacher gave the conditions for all the students to

participate in the evaluations. This finding offers the teachers, who are in the process of adapting, the space to try out new things and methodologies not yet tested.

DISCUSSION

Several reflections came to mind after the first term course of 2020:

1. We suspected deficiencies in self-regulated learning and time management in the students. Weekly dedication to the course is close to 50% of what is supposed to be. This could be one of the reasons that made students feel high levels of anxiety during the tests. These observations are consistent with those mentioned by Maier et al. (2013).
2. In the context of OL, In-class interaction is very difficult to assess by the teacher, as most students keep their cameras off. Low attendance existed during the second part of the term. Most students preferred to check the class afterward, at their own pace. This practice reduced dialogue and increased transactional distance, probably affecting learning outcomes. Many students tend to prioritize courses they consider more difficult or have the closest evaluation deadlines. Asynchronous resources play an important role in providing time freedom and serve the student to study afterward, as a video tutorial. Class videos could serve as flipped content for upcoming semesters.
3. The proposed synchronous evaluation system was accepted by most of the students. Dealing this exceptional term with a tactic of measuring and adjusting, allowed to reduce TD via dialogue between the teacher and students as the term progressed. Students felt heard and understood that their feedback was useful to improve the course. Student's attitudes and the class climate evolved positively. All students approved the course.
4. Anxiety and lack of time to solve tests were present, just as in the face-to-face modality. Internet connection problems contributed to increased anxiety compared to traditional exams. Giving more time and offering the possibility to choose the questions students wanted to be graded was well received. The evaluation system served as a valid way to simulate an evaluation environment that was not far from a face-to-face mode. This assessment mode did demonstrate individual learning outcomes.

CLOSURE

This paper describes a practical set of tactics to manage the combined crises of COVID-19 and SO-19 at a senior course of mechanical engineering at Universidad de Chile during the first term of 2020. We summarize how the course was updated to handle the disruptive environment we had to face, exploiting a "monitor and adapt" approach during a volatile term. Results show that the updated version of the course was positively absorbed by a majority of the students. Synchronic exams, if well implemented, can be used to assess learning goals. COVID-19/SO-19 was an opportunity for students to gain skills for the XXI century job market. Self-regulated learning strategies need to be addressed with fresh regard. The move from the classroom to a context where learning may be facilitated in several ways pushes the frontiers of education. Also, after all this situation, working online is a possibility that will be common in the near future. This adaptation process prepares students for a professional future where online interactions will be frequent.

FUTURE WORK

From the results obtained through the reflection of the first term of 2020, the following actions come to mind for the second term and beyond:

1. Increase blended learning by creating a library of content. Use videos and source code files of the first term as tutorial content. Explore during class time to increase available learning material with deeper content and enriched discussions. We hope that using some of the available off-class time will not be an issue as they declared the low

occupation of that time during the first term of 2020, and it will allow them to keep the pace of the class.
2. Incentivize online attendance with increased interactivity, game-based learning (i.e., Kahoot), and bonuses. Use small group activities to increase participation. Create a schedule to inform students who will be champion in each class.
3. Projects will be presented in an open online seminar that includes presentations from industry leaders and academics ((Pascual, 2010) explains the initiative).

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