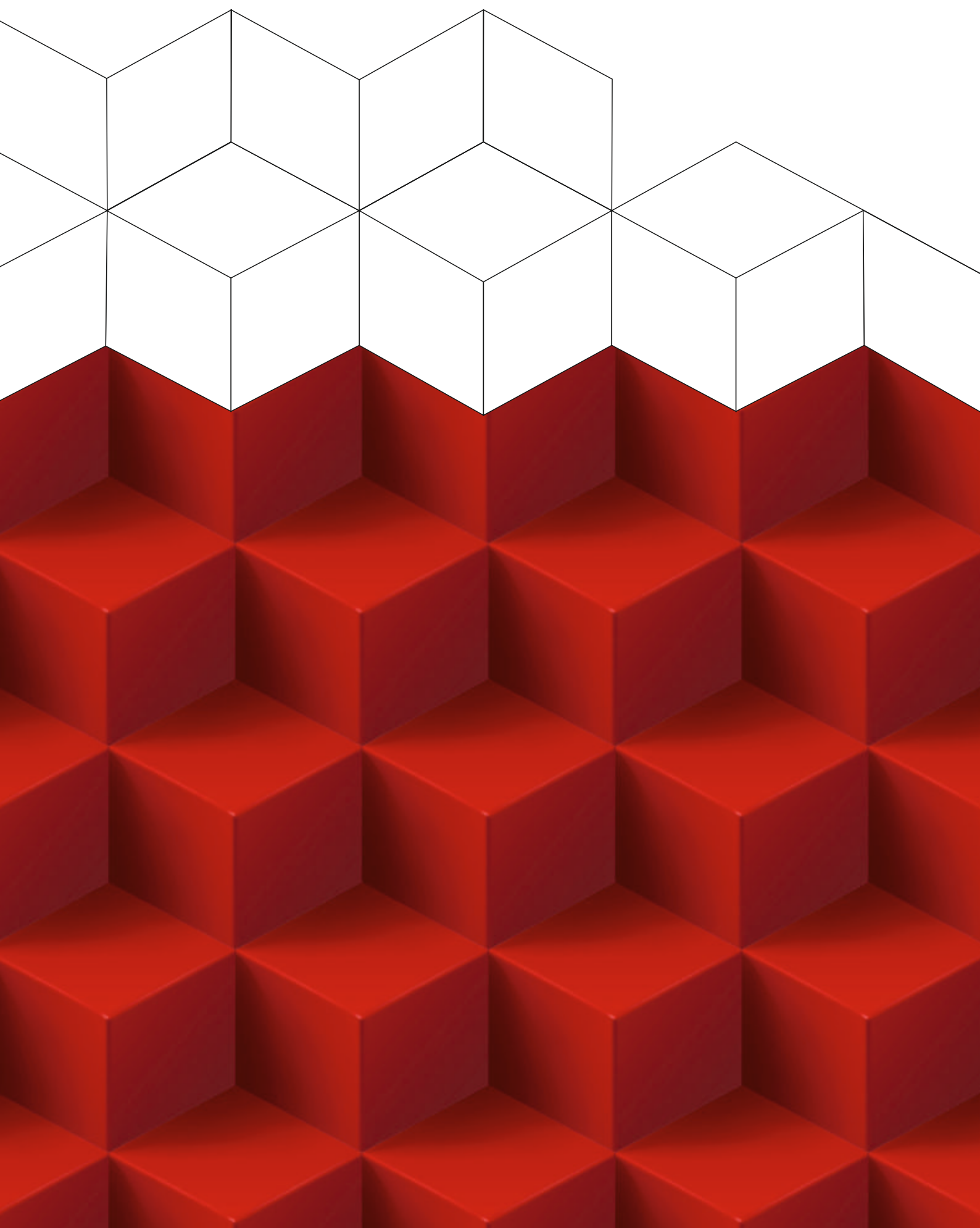


# HANDBOOK

FOR RUNNING A SUSTAINABLE  
EUROPEAN STUDY GROUP  
WITH INDUSTRY







# HANDBOOK FOR RUNNING A SUSTAINABLE EUROPEAN STUDY GROUP WITH INDUSTRY

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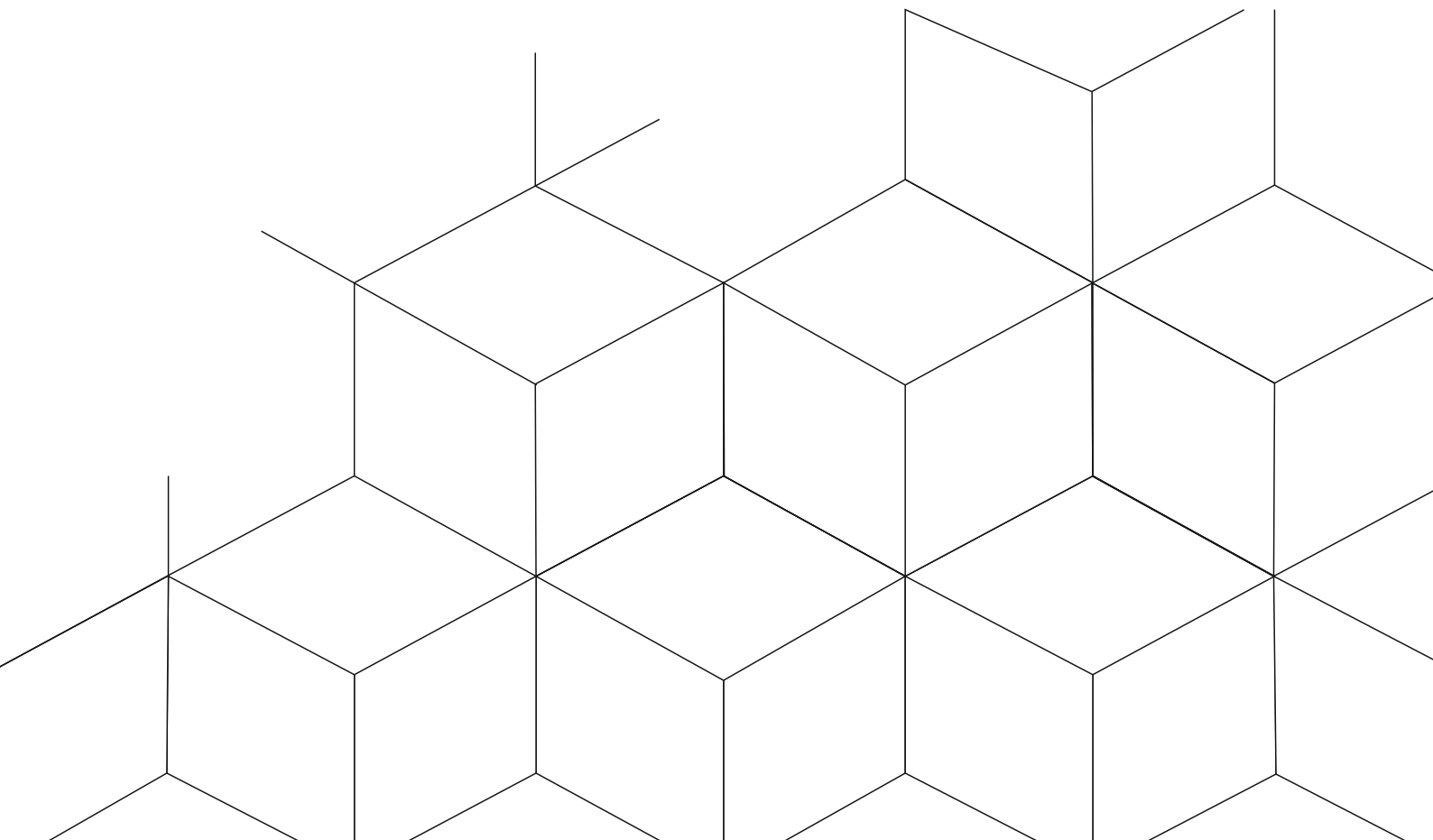
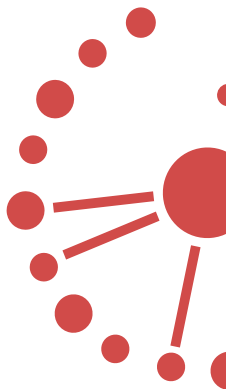
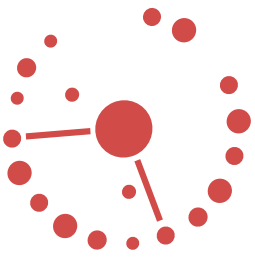
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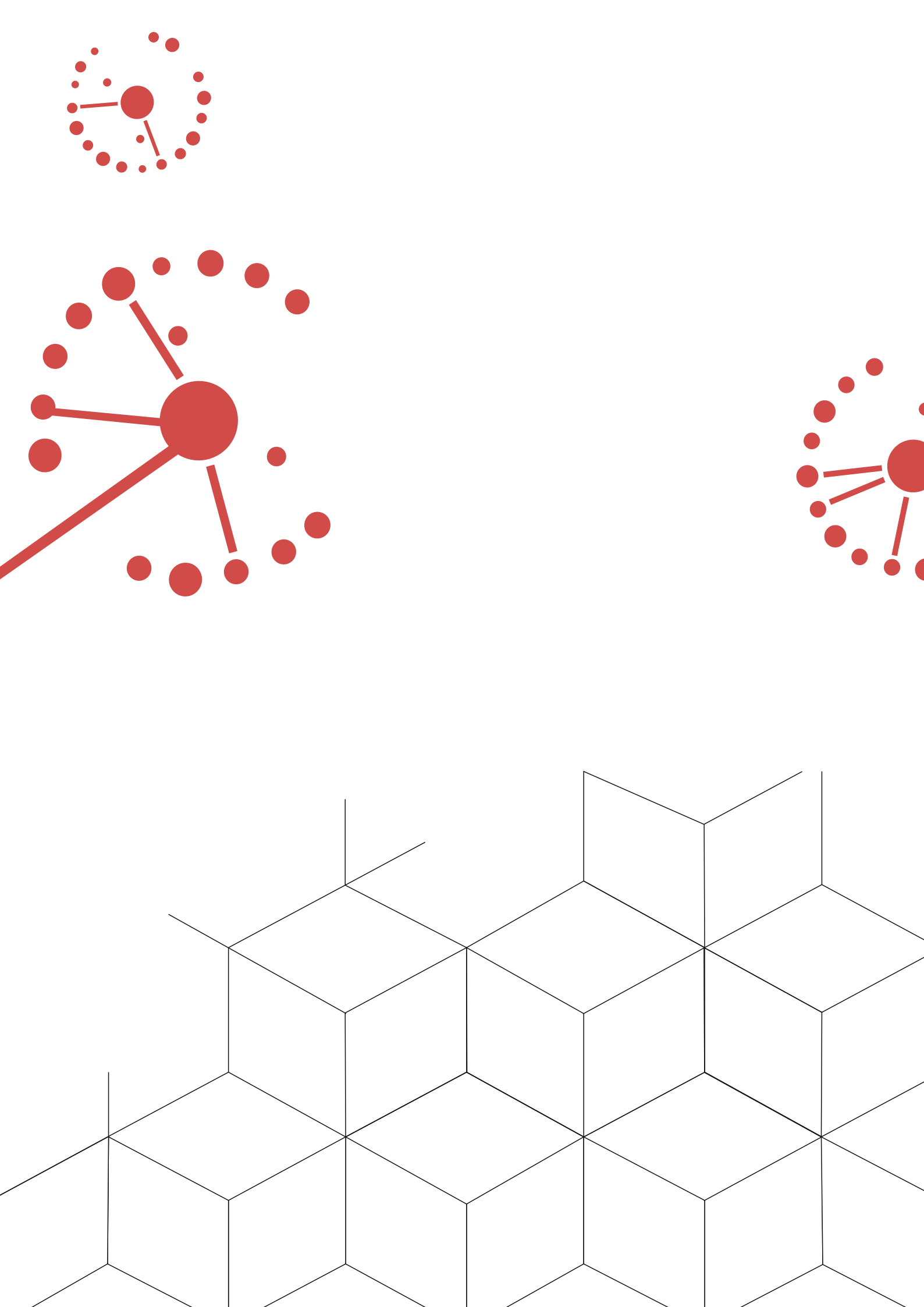
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## APPENDICES



# 1 EUROPEAN STUDY GROUPS WITH INDUSTRY

In recent years, numerous reports [1,2,3] and studies have demonstrated that **mathematics is an essential tool to improve industrial innovation**. Here, as in [2], we use the term “industry” to denote activities outside the realm of education and academic research, such as business and commerce (including financial services and healthcare), research and development laboratories, government and charities, plus commercial and not-for-profit research as well as development and production facilities.

The European Study Group with Industry format is an internationally recognised **problem-solving forum for knowledge exchange** between mathematical scientists and industrialists [4]. This handbook aims to guide users through the process of setting up, managing and delivering a Study Group in a systematic way, so that all parties can get the most value from this activity.

## HISTORICAL NOTE

European Study Groups with Industry (ESGI) originated in Oxford in 1968, under the name of Oxford Study Groups with Industry [5]. The concept has proved particularly effective in creating links between mathematical scientists and industrialists in Europe, and has been adopted by many other countries. Similar types of workshops are now organised all over the world, including in Australia, China, the US, Canada and South Africa. In Europe, the European Consortium for Mathematics in Industry (ECMI) [6] oversees and enumerates the sequence of ESGIs (see Section 4).

## A STANDARD MODEL

Study Groups are intensive **week-long, team-based, problem-solving workshops** that provide a **unique opportunity for collaboration** between mathematicians, scientists, and industrialists.

A typical Study Group format is outlined below.

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
Participants arrive	Problem Presentations	Work	Work	Work	Group Presentations
	Groups form Work begins	Work	Work Progress Summary	Work Report preparation	



**During the first morning**, industry representatives present the problems. It is important to note that the problems presented are usually not mathematical problems to begin with. Typically, they are descriptions of a complicated industrial process that is not well understood from a scientific point of view. Usually, there is a specific question such as “How can we prevent this from happening?” or “How can we maximise/minimize this effect?”. In more recent years, companies have presented more data-driven problems. These are very suitable for the Study Group format, as different aspects of data sets can be explored in parallel. Even though the problems are sometimes vague, they can almost always benefit from a mathematical approach that can crystallise the problem; highlighting the important factors and providing a first step towards its quantification. Once all problems are presented, each problem is assigned a room for the week, and the academic participants select the problem(s) they would like to work on.

**During the afternoon** of the first day, subgroups of the academic participants meet with each industry representative and ask more detailed questions. Ideally, by the end of the day, the group should have defined, in broad terms, the approximate goals for the week. It is important to realise that in some cases, a successful outcome by the end of the week might be a properly formulated mathematical problem (i.e., the correct mathematical question).

The industrial partner may or may not attend all sessions, although it is **strongly encouraged** that they do so as being physically present at the actual discussion maximises the value of the Study Group for the industrial participants, keeps the problem solution process focused on the applicability for the presenter, and for the academics it can be frustrating if the industrialists are not available. They should, in any case, be easily contactable during the whole week as additional information may be required.

**Mid-week** (Tuesday or Wednesday) oral brief summaries are used in some Study Groups as an interim update on the groups’ progress. On the last day, all groups present their results to the industry representatives and to the other academics.

**A few weeks after the study group**, a technical report is written describing, in detail, the work of each group and given to the corresponding industrial partner. This can be accompanied by an onsite oral presentation by academics from the host institution.

There are over 500 **technical reports** on the Mathematics in Industry Information Service (MIIS) website [4] on problems as diverse as optimising the layout of car parks, reducing vibrations in aircraft landing gears, and improving fraud detection. Study Groups have attracted companies from all sectors and of all sizes, including household names such as Philips, Unilever, IBM, and Kodak. These workshops also provide a convenient and low-risk forum for small and medium-sized enterprises (SMEs) to access academic expertise. In addition, themed Study Groups, designed to promote collaboration between mathematicians and life scientists, have been successful in the UK.



# 2

## WRITING A BUSINESS PLAN

### WHY A STUDY GROUP?

The immersive nature of the Study Group maximises their impact for all participants. At the same time, it provides an excellent forum for mathematicians and scientists – from students to professors – to develop and apply their problem-solving skills to real-world challenges. Finally, it is an unrivalled opportunity to build long-term relationships between mathematicians and industrialists.

### MISSION STATEMENT

The mission of a Study Group is to build a gateway for industry to access the world of mathematics, thus creating a market for mathematicians in a commercial setting. At the same time, Study Groups increase the visibility of mathematics in the business community, affirming mathematicians as valuable partners for industry.

### SPECIFIC GOALS

It is best practice to explicitly define the objectives of the upcoming Study Group. This is particularly useful when presenting the idea to colleagues (recruitment phase) and to potentially interested companies.

As described in [4], a Study Group is an effective interface between mathematicians and industrialists for:

#### Problem scoping

- Clarifying and clearly formulating a problem;
- Bringing new perspectives and fresh ideas;
- Brainstorming different mechanisms and methodologies.

#### Problem solving

- Exploiting the expertise of leading mathematical scientists to find solutions to industrial problems using known techniques (knowledge transfer);
- Finding state-of-the-art solution procedures.

In addition, a Study Group provides added value for both academia and industry.

#### For Industry

- Raise and investigate research issues of long-term significance;
- Access to state-of-the-art mathematical techniques and ideas;
- Better awareness of mathematics and its potential to solve industrial problems;
- Knowledge transfer from mathematics to industry;
- Establish lasting and productive links with research mathematicians;
- Widen employment opportunities and company profiles with postgraduate students.





### For Academia

- Access to new, interesting, problems that can seed new projects, contracts or research directions;
- Increase the interaction between different fields of mathematics, strengthen the links between community members and give new insights into different mathematical areas;
- Engage more students in real-world applications of mathematics;
- Involve students in industrial problems by means of internships, Masters or PhD projects, expanding employment opportunities and company profiles with postgraduate students;
- Access to expert industrial knowledge and data to inform research;
- Insight into what problems are important in the “real world”;
- Create more job opportunities in industry (in addition to teaching or research);
- Improve communication skills, to include a broader audience, as well as their ability to translate industrial problems into relevant branches of mathematics.



# 3 PARTICIPANTS AND THEIR ROLES

## LOCAL ORGANISING COMMITTEE

The members of the organising committee should ideally be from various mathematical disciplines. It is recommended that there is representation from at least one early-career researcher (PhD student or postdoctoral researcher) on the committee. In addition, administrative support and marketing expertise prove extremely useful.

For each of the following tasks, there should be a person within the committee responsible for:

- Overall coordination;
- Finances;
- Communication with academic community;
- Communication with funding organisations;
- Logistics (catering, hotel reservation, registration, rooms, WiFi);
- Marketing (including website, printed materials, social media, and press releases);
- Scientific proceedings (after the ESGI);
- Popular proceedings (including finding a professional writer).

In general, **all members** should be involved in problem acquisition, actively contacting companies to encourage them to provide a problem to be presented at the Study Group.

**Recommended:** Participate in an ESGI the year before hosting, in your country or in another European country. To get in contact with other ESGI organisers from Europe, please contact members of the management committee of MI-NET (COST Action TD1409) [7] or the person in ECMI responsible for the coordination of ESGIs [6].

## PERMANENT COMMITTEE

As a **long-term strategy**, it is recommended that each country establishes a permanent committee, as is the case in the Netherlands [8]. This permanent committee will oversee the compilation of information across all Study Group editions. This will allow the new Local Organising Committees to benefit from past experience on topics, participants, problems, solutions, reports, and contacts.

## COMPANIES

In **exchange for a fee**, companies are invited to present a problem at the Study Group. The company representative will be responsible for:

- Scoping and developing the problem together with the organising committee;
- Presenting the problem to the Study Group participants on the first day of the workshop;
- Working with the academic participants on the first day, clarifying aspects of the problem as needed.

They are also expected to be available to provide more information and answer questions during the whole week of the Study Group. This is ideally in person, but can be done remotely by phone or Skype. From experience, it has been found that the more time in person the company representative is able to give to the workshop, the better the outcome.

## ACADEMIC PARTICIPANTS

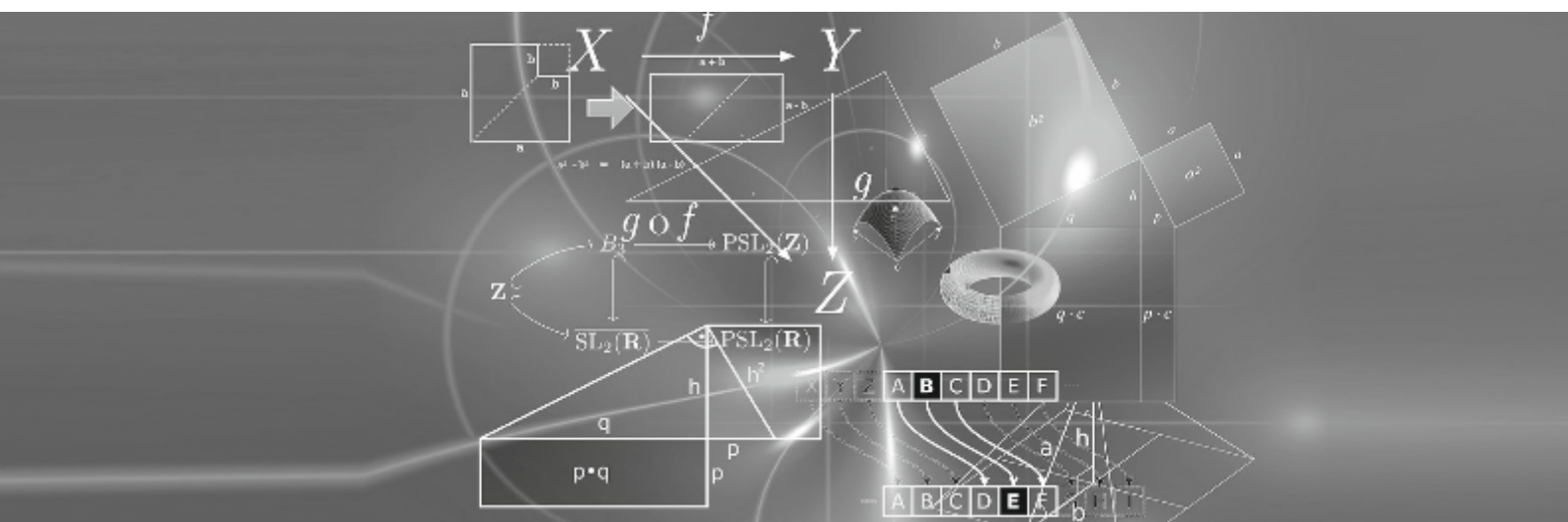
All academic participants are expected to:

- Attend the workshop for the whole week;
- Attend all presentations by the invited companies;
- Select the problem(s) they wish to work on;
- Actively participate in team work to brainstorm ideas and develop solutions;
- Assist in presenting the results of the week on the last day to all participants;
- Assist in producing a written report of the results within a month of the workshop.

## ENCOURAGING STUDENT PARTICIPATION

In a Study Group, delegates are confronted with real applications of mathematics and must focus on getting significant results quickly. Therefore, the first Study Group attended can be an overwhelming experience, particularly for students. For this reason, specially designed student training events – typically known as Modelling Weeks, see for example [9] – are often organised before a Study Group. The goal is to familiarise students with the concept of a Study Group, and with some of the standard techniques and ideas that commonly arise.

To achieve this, experienced mathematicians run sessions where they present several past (and generally simplified) study group problems, playing the role of the industrialist. Using solutions previously obtained, it is possible to guide the students and help them rediscover the results. However, it is not unusual for students to come up with alternative methods and new insights! Working in groups with other students, the students all contribute to the final result and this constitutes an excellent first contact with industrial problems.



## WORKING GROUP COORDINATORS AND RAPORTEURS

Each working group should include:

- At least one **academic expert** – usually, members of the Local Organizing Committee or invited participants – who will be assigned initially as group coordinators in order to ensure the progress of each working group;
- A **rapporteur** – typically a representative from the host organisation – who is responsible for note-taking during the week and the timely completion of technical reports; this person should not write the entire report but rather be an editor and collect LaTeX contributions from group members.



# 4

## PRELIMINARY ACTIVITIES

### SET UP ORGANISING COMMITTEE

Please see Section 3 for roles and responsibilities.

### CHOOSE A DATE

It is important to start planning the Study Group **at least 12 months in advance**. Deciding the date early on is important for two reasons: there are several events of this kind organised in Europe each year so it is important to secure the participation of key external academic participants; the process of getting companies on board is rewarding, but time consuming, particularly when companies have not worked with academics before, or do not know about Study Groups.

When deciding on the date of the Study Group, to maximize the level of local participation take into account teaching timetables, research schedules, conferences and meetings in your country, holiday weeks, etc. Avoid clashes as much as possible.

### REGISTER YOUR ESGI

Each European Study Group with Industry is allocated a number. To obtain a number in the ESGI series you should **contact ECMI** [6]. They will ensure your Study Group is issued with a number, displayed on the MIIS website [4], and help you with any other queries.

### IDENTIFY AND SELECT PROBLEMS

#### Problem acquisition

A general template text to promote the ESGI to companies can be seen in Appendix 1. Please take into account that a **proactive approach to contacting company representatives in person** is much more successful than mass mailing, which gives little to no response.

At the first meeting of the Local Organising Committee, compile a long list of possible industrial contacts, including:

- Existing industrial collaborators;
- Companies who have participated in an ESGI before;
- Personal contacts in industry, including alumni; as well as ways in which you can reach potential new partners. This can include contacting:
  - Colleagues (not necessarily scientists) from other disciplines who have strong industrial links (it is advisable to invite them as well, to demonstrate that you are aiming to add value to the existing collaboration, not steal the contact!);
- Your institution's Research, Business Engagement, or Technology Transfer Office;
- University business incubators;
- Your institution's alumni and/or student placement department;

- Your local and/or national enterprise board;
- Chambers of Commerce;
- Local companies via business networking or knowledge exchange events.

**When contacting companies,** the aim is to secure a face-to-face meeting – by either offering to visit them onsite or inviting them to the university for an exploratory mini-workshop – in order to find out more about their challenges and to promote the benefits of Study Group participation. If you receive no reply by email, follow up within 1-2 weeks with a phone call.

**When visiting a company,** take fliers, popular proceedings (i.e. booklet with the description of the problems aimed at a general audience), and scientific proceedings, to showcase previous editions. Also, a short high-level presentation, including success stories and positive testimonials, is recommended (see Appendix 2 for a flier template).

**Once a company has committed to present a problem** (this may take more than one visit) – which the organising committee approve – and agree on payment, confidentiality and Intellectual Property Rights (see below), send the company a first draft of the problem statement (typically no longer than one page). Ask them to edit and improve the statement, and keep iterating until both sides agree. It is worth investing time in this pre-processing step, to ensure all parties are clear on the problem to be addressed.

**Once the problem description is finalised,** upload it to the web page, inform the registered participants, and contact further academic experts if needed.

This process should be followed in parallel for every possible problem, rather than sequentially. Keep actively pursuing problems until you have enough definite confirmations.

## Problem selection

Where possible, choose problems so that taken together they will require **a range of different mathematical disciplines**, in order to keep all academic participants interested. Before you decide to select a problem, you should take the following aspects into consideration.

- Is there a good mixture of data-driven and physics-based problems?
- Is the expertise to tackle the problem available in your country? Is it possible to secure commitment from local experts to participate in the ESGI for the whole week? If necessary, invite experts from other countries.
- Are the problems from different industrial areas? Try to have a balance between SMEs, local, and larger companies.
- The problems need to be formulated in such a way that good progress can be made during the workshop but also not too easy so as to keep the participants working all week.
- If a data-driven problem, does the company have relevant data sets which they are willing to share?
- Is the problem good for marketing the ESGI? Potential target topics include social networks, police, public transport, health, food, etc. The “Initiation of Guinness” in Ireland, the “Incubation of penguin eggs” in the UK, as well as “Building a mountain” in the Netherlands, have all attracted positive media attention. See [4] for the reports.

- Has the company participated in an ESGI before? Companies are welcome to participate in multiple workshops, and experienced company representatives also require minimal induction! However, keep in mind that initiating at least 1-2 new companies each time broadens the reach of Study Groups.

The number of problems should be chosen in order to ensure around 10-15 academic mathematical scientists per industry problem.

**Important:** Do not select a problem where a company representative cannot commit to attending at least the first day of the Study Group, and being contactable for the whole week

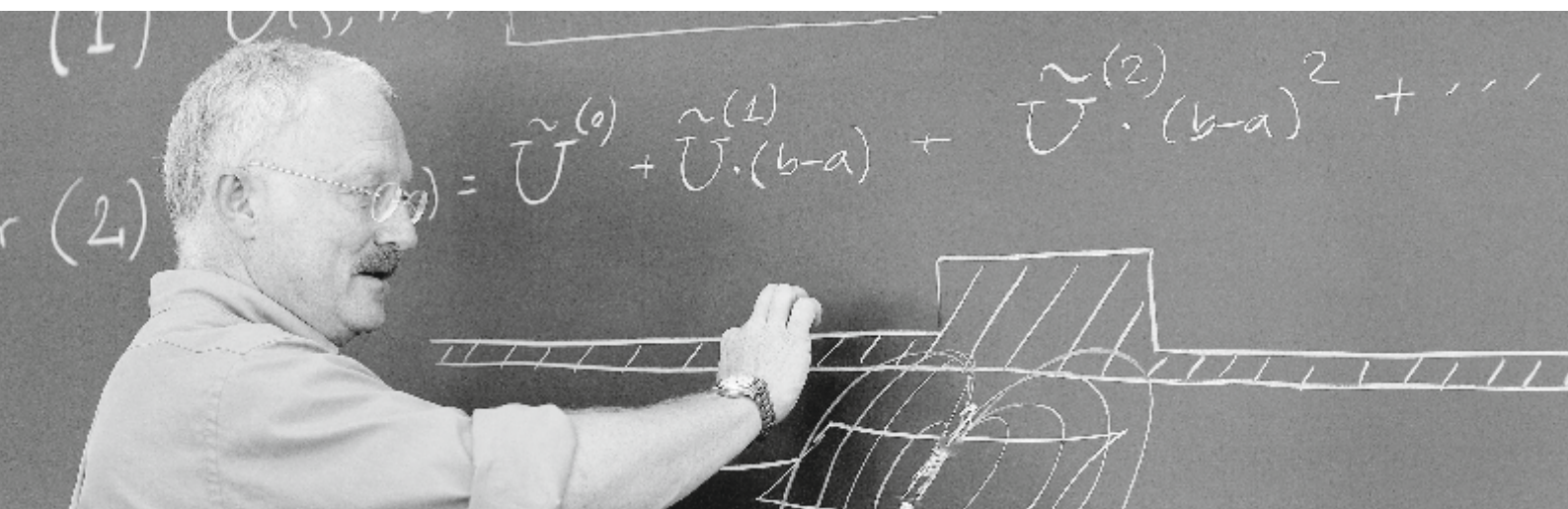
## CONFIDENTIALITY AND INTELLECTUAL PROPERTY RIGHTS

ESGIs are designed as “open innovation” forums, and the price of participating, compared with the vast expertise companies are able to access during the week, reflects this. Due to the number of participants from different institutions attending a Study Group, a Non-Disclosure, or Confidentiality Agreement (NDA) with all parties is not practical and would be very difficult to enforce. The ESGI model also expects a report to be made publicly available after the workshop; this body of reports then forms a valuable resource for the future [4, 6].

### Possible workarounds and reassurances

- Ensure the company representative is aware that they will need to approve all material (including the problem statement, report, and any media story) before it is made public, and that they have the right to remove any confidential details, for example real parameter values.
- If companies are concerned about data confidentiality, one workaround is for a NDA to be set up between the local organising committee and the company to cover all pre-processing work. In this way, the organisers can view the original data, and help anonymise it so that no confidential details (for example names or addresses) are available to all participants.
- In exceptional circumstances, if it is an excellent problem which you are particularly keen to accept, you can offer the company a delay of up to one year on publishing the report, and/or the cover of a pseudonym.

If none of the above gives the company the peace of mind they are looking for, then a standard Study Group forum is not appropriate. You can always offer them an in-house closed workshop instead at a mutually convenient date – for the same fee – just with participants from your own institution. Then an NDA, using your institution’s standard contract is straightforward. The downside here is that they do not get to access the same breadth of expertise – from all around the world – which is found at an ESGI. Any follow-up work, initiated at a Study Group, can be carried out under contract.



## FINANCIAL MANAGEMENT

### Company participation fee

To participate, **companies pay a fee**, which will be used to cover the local expenses of the event (lecture/study rooms with equipment, catering, marketing etc.) as well as accommodation and subsistence expenses for the academic participants. The fee is also important in ensuring companies are committed to the Study Group. This fee can vary, but the maximum amount depends on the country, and other sources of funding available. You should aim to at least break-even (see Appendix 3 for a budget template).

As the forum is very well established in the UK, companies are typically charged £7,500 (values as of 2017) . In Ireland, a typical fee is €5,000 (values as of 2017). Small and medium-sized enterprises (SMEs), public institutions, or problems that are really interesting or have high marketing potential could be charged lower fees, at the discretion of the organising committee. SMEs may be eligible to apply for a national enterprise board “Innovation Voucher” scheme, or similar, and should be encouraged to do so.

### Academic registration

There is typically **no fee for academic participants**, who are dedicating their time to work for free on industrial problems. All participants should be provided with coffee/tea breaks as well as snacks, lunch, and dinners during the Study Group week. Where possible, and depending on the amount of funding available, bed and breakfast accommodation should be provided to all individual participants who need it. Participants, with the exception of invited experts, are expected to organise and fund their travel to and from the place of the event.

Budget permitting, it is a good investment to invite experienced academic Study Group participants, and/or individuals with particular expertise in the selected problems, and to offer to pay their travel costs. These individuals are ideally placed to become natural group leaders. It is recommended that you set a deadline for academic registration, and have in mind how many individuals your budget can accommodate. If you are concerned about a large number of registrations, you can set a date for registration, and a date for when you will let participants know whether the organising committee has approved their registration and/or accommodation request. It is advised to prioritise individuals who can commit to participating for the whole week.

### Fundraising

This should start as soon as possible, ideally more than 6 months before the event. This includes applying for grants from national and European scientific institutions (such as MI-NET COST Action TD1409), from local universities, from mathematics and statistics associations, from national tourism agencies, and from any other sources who might be interested in sponsoring this event.

## COMMUNICATIONS

### Announcements to participants

- Prepare and send out announcement to mathematical institutes, participants of previous years, other local email lists (send reminders 2 months and 1 months before the ESGI). See Appendix 4 for an announcement to participants' template.
- Announce on relevant mailing lists.
- Send an email to registered participants with info about the ESGI (venue, programme, website).
- Invite all sponsors.
- Invite contacts from funding bodies and enterprise boards.
- Invite industrial representatives who are not participating this year but who wish to find out more about the workshop for the future.
- Invite a high profile external individual, such as a minister for research and innovation, to open the event.
- Invite members of your institution's senior management team – such as the Pro-Vice Chancellor / Vice President for Research (or equivalent) and the Dean – to attend the opening ceremony.

### Website and social media

- Prepare website: Study Groups description/explanation, registration (including accommodation details), problem descriptions, list of participants, venue information, and travel information.
- Upload the problem descriptions on the website as soon as these become available.
- Hire, or designate, a photographer to take photos at the event to put on the website and use in future promotion.
- Consider which social media channels you could use to promote the workshop.

### Prepare a poster with the announcement of ESGI

- Put an attractive, relevant, photo on it.
- Send it out 4 months before the event.
- Send it to as many mathematical departments at universities and research centres as possible.

### Marketing

- Make press announcements.
- Contact your university marketing office to help with writing and promoting the press release.

### Preparing company representatives in advance of the ESGI week

- They must prepare a presentation on Monday (20-30 minutes, make sure it is on a laptop beforehand or test their laptop) which is suitable for a non-specialist audience.
- They must be present at ESGI (or available by phone and e-mail) during the week.
- They must ensure relevant material is available (data sets, background information, etc.).
- If possible, they should attend the group presentations on Friday, and provide the Study Group participants with their feedback.



## PRACTICAL ORGANISATION TIPS

### Organization

- Draft your own event checklists (see Appendix 5 for templates).
- In the six months preceding a Study Group, hold local organising committee meetings on a fortnightly basis.

### Academic participants

- Ensure there are enough “experts” for problems requiring special expertise, and make sure there are enough participants by sending extra announcements.

### Accommodation

- Hotels or on-campus accommodation: make deals with hotels and/or use existing ones. Reserve rooms for participants that are not local.

### Logistics

- Organise coffee/tea, soft drinks with snacks in a common area so that different groups can meet and interact informally.
- Reserve one larger room (up to 100 people) for Monday and Friday and smaller rooms for the different groups (which if possible can be locked so laptops can be left unattended). These rooms should be close to each other.
- Ensure there is access to WiFi and printing for non-local participants.



# 5 THE STUDY GROUP WEEK

## DRAFT PROGRAMME

A typical ESGI programme takes the following format:

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday
9.00						Coffee & tea
9.30		Registration with coffee/tea	Group work	Group work	Group work	Presentation and discussion #1
10.00		Welcome				Presentation and discussion #2
10.30		Companies present problem #1, #2 and #3 (20'+5' per company)	Coffee/tea break	Coffee/tea break	Coffee/tea break	Presentation and discussion #3
11.00						Coffee & tea
11.30		Coffee & tea	Group work	Group work	Group work	Presentation and discussion #4
12.00		Companies present problem #4, #5, and #6 (20'+5' per company)				Presentation and discussion #5
12.30						Presentation and discussion #6
13.00		Lunch and group formation	Lunch	Lunch	Lunch	Closing and lunch
13.30						
14.00			Group work	Group work	Group work	
14.30						
15.00		Group work with company representatives	Coffee/tea break	Coffee/tea break	Coffee/tea break	
15.30			Group work	Group work	Group work	
16.00						
16.30						
17.00		Workshop reception (including e.g. drinks and dinner) NB This could take place on Sunday evening		Plenary Talk (optional – should be entertaining, engaging, and suitable for an academic and industrial audience)		
17.30						
18.00			Regular dinner		Pizza / Regular dinner and preparation of final presentation	
18.30	Welcome drinks reception					
19.00				Workshop dinner		

Scheduled progress update presentations during the afternoon (where each group summarises the work done so far and discuss their approach with other groups) are optional. Informal discussion at breaks can be more constructive, and does not take away time from problem solving.

The plenary sessions on Monday morning and on Friday are held in a large lecture room. For the remaining time, six smaller discussion rooms close to each other are needed (one for each group). Provide a key to the group coordinators so that they can lock the rooms over lunch and at night.

## USEFUL TIPS

### On Monday

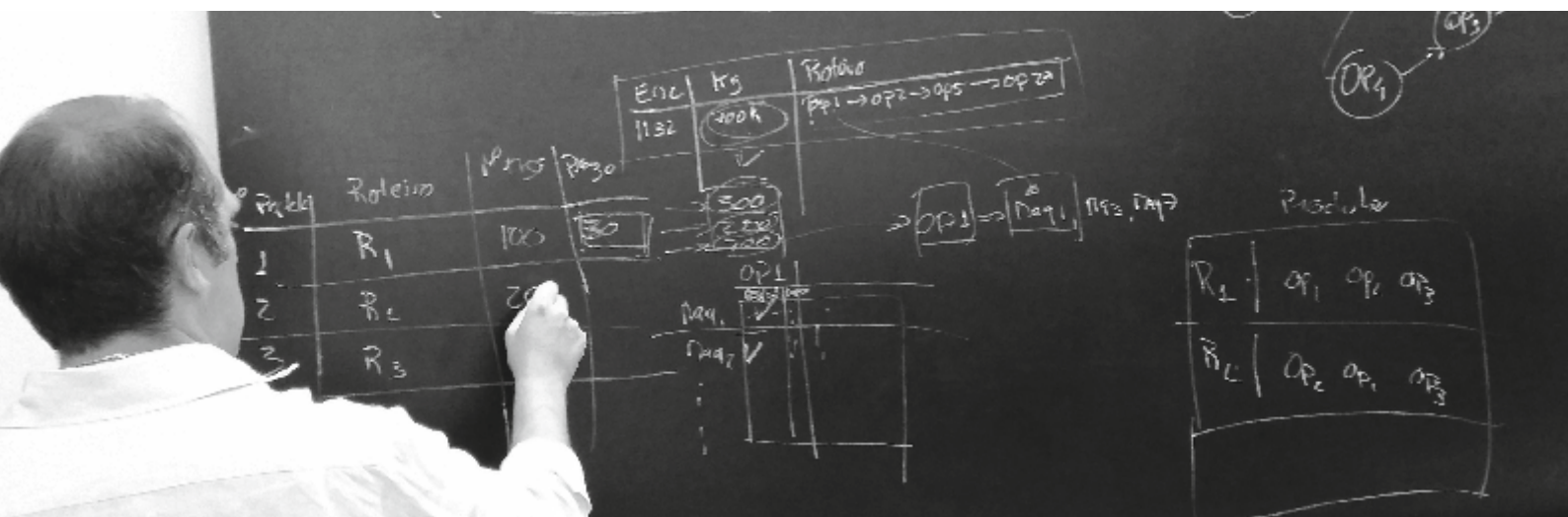
- At the opening, introduce all members of the Organising Committee so that people know whom to contact with questions.
- Have a diligent chairperson on Monday to finish the talks after 20 minutes. There should be time for questions.
- For the group formation on Monday: it is the responsibility of the local organising committee to make sure that all groups have sufficient participants. One mechanism is to provide forms at lunch so people can mark their problem participation preference.

### During the week (before Friday)

- Ensure each group is progressing adequately. If other expertise is needed, get support from members of other groups, and facilitate swift communications with the company representatives.
- Send an email to all participants to notify them of the order and length of the Friday presentations. These should run for no more than 20 minutes (+ 10 minutes for questions).
- Ask the company about preferences for the time schedule on Friday (they are encouraged to attend).
- Inform the company that they will be asked to provide a few words to the audience as a response to the Friday presentation that is relevant to their company.
- Inform participants about the final report and obtain the name of one contact person, rapporteur, in each group who will coordinate the writing process of the report. Email the LaTeX template, other requirements (format, figure files etc.), instructions and deadline to the rapporteurs. Encourage all participants to work on the report during the week itself.

### On Friday:

- After every presentation, ask the company representatives to provide some informal feedback to complement the presentation.
- Distribute feedback forms to all academic and industrial partners (see Appendix 6 for templates).
- Final words (thank participants, companies, and funding).
- Announcement about final reports.
- Give details of next or upcoming ESGI.



# 6 AFTER THE STUDY GROUP

## FINAL REPORTS

To increase the likelihood of long-term collaboration, final reports – capturing the findings of the week – should be completed as soon as possible after the Study Group. It is important to have a contact point, rapporteur, who is responsible for the timely submission of the report. Reasonable time for completion of a report is at most 1 month and organisers are encouraged to enforce a tighter deadline. A common pitfall is for academics to continue working on problems after the workshop has finished, thus delaying the report. From experience, the sooner you can send the report to the company, the best chance you have of securing some follow up work!

Bear in mind your audience when writing your report. Your priority should be in ensuring that your industrial partner can understand the findings, and the report should include an executive summary as well as a practical recommendations section. In addition, reports should also be uploaded to the MIIS eprints database [4]. It is important that the incumbent company representatives have access to the draft of the final report **before it is published**, so they can agree its publication. The Organising Committee may provide a template for reports.

In some cases, reports – with a bit of re-working – are also suitable to submit to an appropriate peer-review journal, such as Maths-in-Industry Case Studies [10]. Alternatively, the Organising Committee can publish a proceedings booklet independently (see Appendix 7 for a success stories' template). It is also a good practice to collect the final reports in a brochure (scientific proceedings). If so, it may be a good idea to design a cover for the proceedings- or have it made by a designer- and to contact a printer agency.

## FOLLOW-UP AND BUSINESS DEVELOPMENT OPPORTUNITIES

For most participants, the Study Group is officially completed after the week of intense work. However, with some additional but rewarding efforts, the impact of the week can be greatly increased. When the report has been finalised, a meeting with the industrial representatives, including senior managers, should be set up onsite at the company. At this meeting, an oral presentation, which complements the report, should be given by a representative who worked on the problem. If there are any researchers interested in proceeding with the work initiated at the Study Group, those interested should identify specific goals and potential collaboration mechanisms. Scientific papers, Masters/Ph.D. opportunities, scientific advisory board membership, or new research or consultancy contracts are the most common outcomes. There is a need to define clearly what resources may be allocated to further developments, and to consider reasonable deadlines and milestones as companies will need to know about timeframes for progress, as well as associated costs. Presenting these future work opportunities as a “menu” in the last section of your talk is a good way to establish new grounds for future work. Any follow-up work can be carried out under contract or a confidentiality agreement.

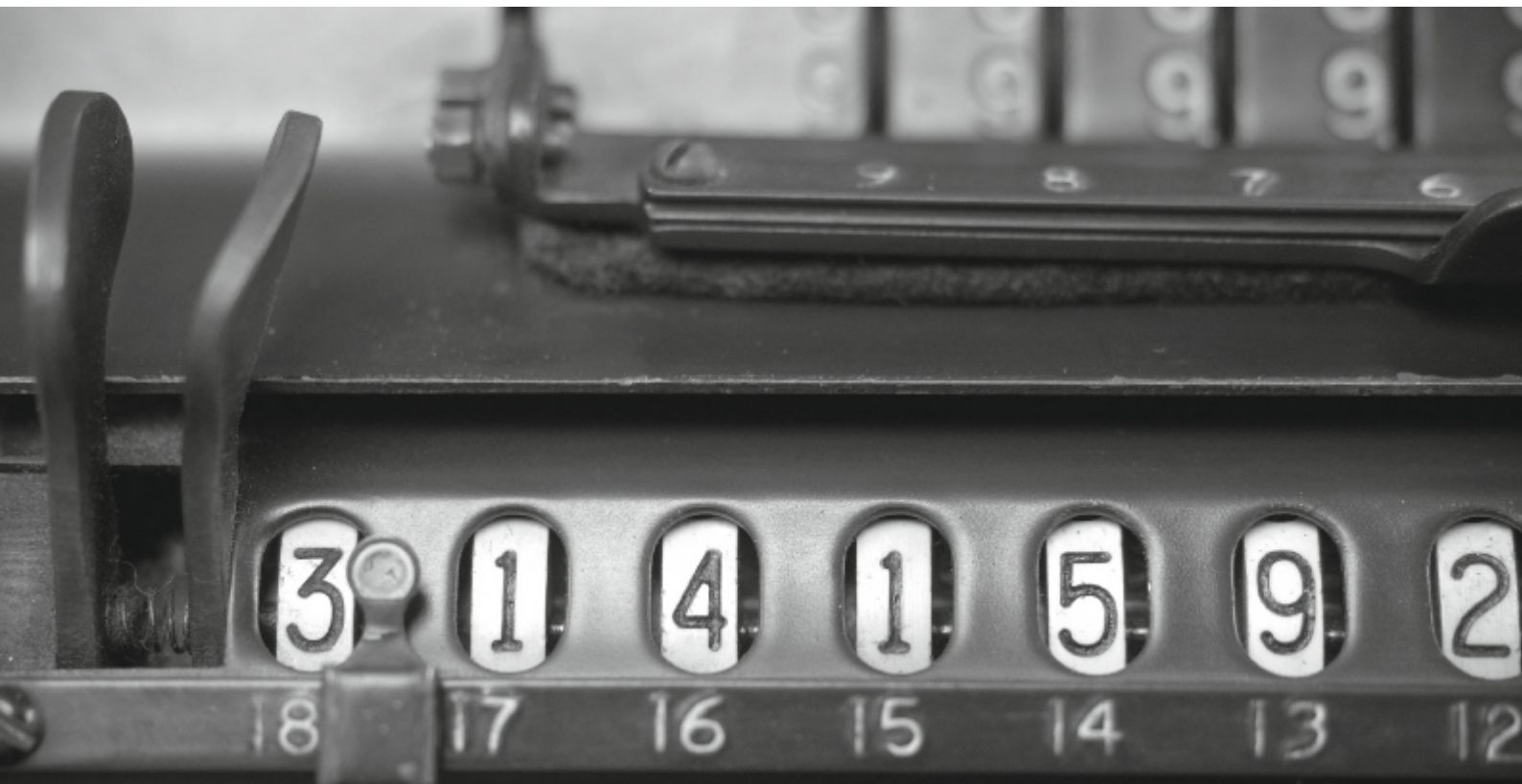


## WRITE SUCCESS STORIES

One of the most relevant problems that mathematicians face is that many companies do not know the real impact that mathematics can have in tackling industrial problems. One way to overcome that weakness is to write success stories of the best mathematics in industry case studies. The format used by European Service Network of Mathematics for Industry and Innovation (EU-MATHS-IN) [11] or ECMI is a good template to work from. See Appendix 7 for the success stories template used in [12]. Remember that the audience for success stories is often individuals with little mathematics knowledge. As such, write them with a focus on the practical achievements of the project, be concise, and if possible, try to include a short testimonial written by the industrial counterpart on how participation in ESGI and collaboration with mathematicians benefitted their company. Also, be sure to have approval from the industrial partner, in writing, on the content of the success story to safeguard confidentiality.

## DISSEMINATION

Disseminate the past success stories as often as you can. It will be excellent if you can do it through an industrial audience, instead of the traditional academic/scientific audience. Newspapers and industrial associations may be good means to achieve this goal. Also, besides the ESGI scientific proceedings, a more compact version, such a brochure version (popular proceedings) to be delivered to industrialists – at industrial days or when visiting industry, among others – may be of great help. As for the scientific proceedings, it is also common to design a cover – or have it made by a designer – and to contact a printer agency. If you have enough financial resources, a professional advertising video is something that might generate impact.





# 7

## MAKING YOUR ESGI SUSTAINABLE

### PERMANENT COMMITTEE

This section assumes that a series of ESGI will take place under some common organisation. One mechanism could be to establish a permanent committee in each country that will benefit from lessons learnt, shared experiences, contacts, templates and, most importantly, the company recommendations based on experience from previous editions. This committee may host a permanent website, keep mailing lists and any social media channels up to date, support and complement a local organising committee and, at the same time, learn from their initiatives and ensure success in the forthcoming editions. With this in mind, a scheme taking the ESGI to a new institution, or rotating around a number of institutions, has the advantage of engaging more researchers, local organisers and many more new local companies. The permanent committee may also evaluate the submissions for the next local organising committees.

### UPDATE MAILING LISTS

The maintenance of researchers, academics, students and industrial partners' mailing lists is very important to deliver the Study Groups' messages to the target audience. That maintenance is easiest if managed by the permanent committee that lends it every year to each of the local organising committees.

### PUBLIC FUNDING

Public funding is a good way to ensure a reliable financial contribution and to allow you to have some mid-term strategy, as some companies may register for a Study Group very close to the workshop itself. It is also helpful for securing accommodation and travel bookings. If available, a recurring commitment, for example from a national research council, will take some budget pressure off the local organising committee, allowing them to be more focused on the quality of the problems, instead of on the number of problems and their revenue.

### PERMANENT CONTACTS

#### Within industry

**Industry relationships and ambassadors.** It is important to maintain strong relationships with industry contacts in between Study Groups. A team of ambassadors could be recruited from the industrial participants of previous ESGI workshops. These ambassadors can help communicate the advantages of ESGI to senior managers and colleagues.

**Keep the call for problems permanently open.** The existence of a Permanent Committee allows the call for problems for ESGI to always be open. This increases the formulation of new problems over the entire year, especially if there is a good advertising scheme with newsletters, brochures, and other marketing tools.

**Industry days.** These one-day meetings aim to bring together academic and industrial researchers and practitioners to exchange ideas. Usually they are devoted to a particular mathematical technique or a certain type of industry sector and they may be seen as a warm-up for more long-term relationships between industry and academia. ESGIs may be a natural way to proceed with collaboration between academia and industry after an industry day. See for example KOMSO's Challenge Workshops [13].

**Contact with industry sector associations.** Short sessions explaining what an ESGI is in industry sector associations (congresses, meetings) or through some short texts in industrial newsletters/mailling list may be a good resource to engage new companies in Study Groups.

### Industrial mathematics networks

Use all available industrial mathematics networks to advertise the Study Group, and as a valuable resource for help in any questions that arise, as they may put you in contact with experienced organisers of Study Groups. Although there may be other networks of interest, the following should be in your contact list: ECMI [6]; EU-MATHS-IN [8]; MI-NET; National Industrial Mathematics Networks (see the EU-MATHS-IN website for an updated list).

### Academia

An ESGI is an important way to engage new researchers in industrial mathematics. Look to engage Postgraduate Coordinators with ESGIs organisation, and arrange a convenient date, in order to encourage their students to participate. One efficient option that you may want to consider is to host a Modelling Week the week before the Study Group, in the same location.

## PERMANENT ADVERTISING MATERIAL

There should be budget allocated to build good advertising material such as brochures, success stories and/or ESGI institutional videos aimed at an industrial audience. Ask mathematicians who collaborate with industrialists to take them to meetings or industrial events. It is also of utmost importance to keep social media channels active. Social media and the ESGI website should work seamlessly together to promote the online brand.

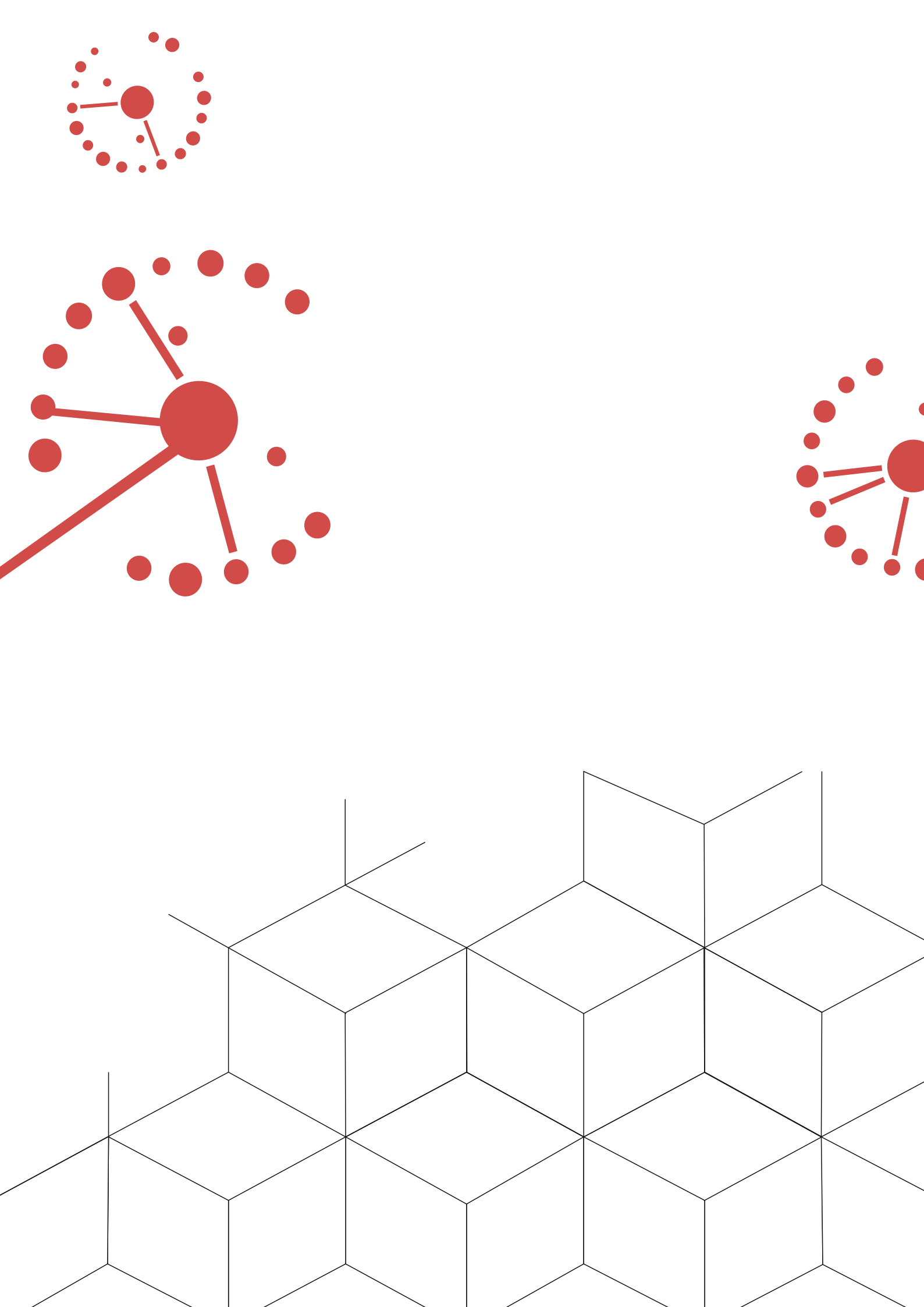
The image features the words 'GOOD LUCK!' in a large, bold, sans-serif font. The word 'GOOD' is in a dark red color, while 'LUCK!' is in a lighter, pinkish-red color. The letters are slightly overlapping, with 'LUCK!' appearing to be in front of 'GOOD'.

Organising an ESGI is a hugely rewarding experience!

# 8

## REFERENCES

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**Sample template for promoting ESGI to companies**

Invitation: European Study Group for Mathematics in Industry, at [insert location], [insert date]

Dear ,

The [insert name of group] in the [insert name of University] are currently sourcing industry problems for our annual European Study Group (problem-solving workshop) with Industry, to take place in [location] between [insert dates]. During this workshop we will bring together 60-80 leading mathematicians from a wide range of backgrounds to work intensively on real-world problems from industry.

We wondered if you might be interested in discussing any problems which may be suitable for this kind of workshop? We are very happy to visit you, or alternatively you, and any of your colleagues, are very welcome to visit us to meet the whole team.

[If available: Attached are some case studies from previous projects].

Please do not hesitate to contact me [or lead organiser details] to discuss possible projects.

Best wishes,

[include all contact details]

---



## How Can Study Groups Help?

Industrial and scientific partners have found that study groups provide:

- A clear formulation of an existing problem
- Fresh perspectives and new ideas
- State-of-the-art solutions
- Lasting and productive collaborations with active researchers
- Identification of research issues of long-term significance
- An opportunity to exploit the expertise of leading applied mathematicians

40 years of Innovation

To mark the 40<sup>th</sup> Anniversary of the University of Limerick, forty lime trees were planted in a golden spiral, each tree representing the students who graduated in that year.

## Interested in Attending?

Please register on our website: [www.macsi.ul.ie/esgi93](http://www.macsi.ul.ie/esgi93). We look forward to seeing you in June!

### Submit a Problem

If you are interested in submitting a problem to the study group we would be delighted to hear from you. To discuss this further please contact the MACSI Manager, Dr. Joanna Mason.

[macsi@ul.ie](mailto:macsi@ul.ie)  
+353 (0)61 21 3013

MACSI  
Department of Mathematics  
and Statistics  
University of Limerick  
Limerick  
Ireland



register  
now!

## ESGI 93 PROBLEM SOLVING WITH INDUSTRY 2013

MACSI | UNIVERSITY OF LIMERICK | 23 - 28 JUNE



## What is an ESGI?

European Study Groups with Industry are week-long problem solving workshops that are held several times a year and attract leading mathematicians and scientists to work on industrial problems. Study groups typically follow the same structure.

Day 1: Industrial representatives present their technical problems.

Days 2 - 4: Intensive brainstorming, modelling and problem solving, guided by the requirements of the company.

Day 5: Presentations of progress and recommended routes forward.

This is followed up by a written report. The company can opt to have a mathematician visit their site to discuss the solution.

## Typical Problems

In principle, there are no limits to the problems that can be tackled by mathematical modelling! In the past, problems ranged from incubating penguin eggs to shimmy in aircraft landing gear. A full list of past problems can be found at

[www.maths-in-industry.org](http://www.maths-in-industry.org).

## Special Areas of Interest

Study group problems can come from a wide range of industrial areas. These include:

Engineering  
Pharmaceuticals  
Electronics  
Transport  
Agriculture  
Energy  
Banking  
Medicine  
Food Processing

## Case Study

RUSAL Aughinish Alumina (RAA) produces alumina. Prior to shipping, the alumina is stored in large silos. Particle segregation in the silos effects the ability to predict alumina shipping quality.

RAA required ESGI87 to understand the physical mechanisms responsible for alumina segregation and to predict the particle size distribution and other parameters.



During ESGI87 a combined experiment and theoretical approach was applied. A two-dimensional mixing algorithm demonstrated excellent agreement with the corresponding Aughinish data. For more information see [www.macsi.ul.ie/esgi87](http://www.macsi.ul.ie/esgi87).



# APPENDIX 3

## Budget

Title:
Date:
Location:

PLEASE READ NOTES BELOW BEFORE POPULATING THE SPREADSHEET

Income	Price	No. Expected	Total
Registration (regular)			
<i>forecast</i>			0
<i>actual</i>			0
Sponsorship/Grant Funding			
<i>forecast</i>			0
<i>actual</i>			0
<b>Sub-Total</b>			
<i>forecast</i>	0	0	0
<i>actual</i>	0	0	0

Expenses	Price	No. Expected	Total
Catering			
<i>forecast</i>			0
<i>actual</i>			0
Travel			
<i>forecast</i>			0
<i>actual</i>			0
Accommodation			
<i>forecast</i>			0
<i>actual</i>			0
Printing, stationery, banners			
<i>forecast</i>			0
<i>actual</i>			0
Admin Costs			
<i>forecast</i>			0
<i>actual</i>			0
Room Booking			
<i>forecast</i>			0
<i>actual</i>			0
AV, photography			
<i>forecast</i>			0
<i>actual</i>			0
Other			
<i>forecast</i>			0
<i>actual</i>			0
<b>Sub-Total (Expenses)</b>			
<i>forecast</i>	0	0	0
<i>actual</i>	0	0	0

GRAND TOTAL (Income - expenditure)			
<i>forecast</i>			0
<i>actual</i>			0

Note:

1. This spreadsheet will allow you to keep track of your budge as things develop. It will also be helpful to see how accurate forecasts were to influence future budget plans.
2. 'Price' is unit price
3. GRAND TOTAL cells are on a traffic light system coded as 'red' for when expenditure exceeds income, amber when budget is breaking even and green when making a profit.

### **Initial email to academic participants**

Dear Colleagues, (apologies for cross-posting)

The [include number] European Study Group with Industry (ESGI) will be hosted by [University, dates].

ESGI are week-long problem-solving workshops which provide a unique opportunity for interaction between mathematicians, scientists, and industry. Originating in Oxford in 1968, ESGI have since been held several times a year across Europe. They bring together leading mathematicians from a wide range of backgrounds to work intensively on real-world problems. We expect to be able to accommodate 4-8 industry problems, which will be tackled by 50-100 academics ranging from PhD students to professors.

The format of the workshop is as follows:

Day 1: Industry representatives present their problems to the academics and students

Days 1.5 - 4: Academics and students work with industry representatives to solve their problems

Day 5: Academics present their final results

Follow-up: A few weeks after the study group, a report describing in detail the work of each group is written and given to the corresponding industrial partner.

Company representatives, academics, and students interested in participating or receiving further information are invited to visit our ESGI [insert number] web page: [link] to register.

Looking forward to meeting you in [city],

The ESGI [insert number] Organising Committee

Web page:

E-mail:

### **Specific Information close to the kick-off date**

To include:

- Double check of number of meals/nights of accommodation required
- Accommodation details
- Summary of problem (or link to) descriptions
- Registration details and outline programme (or link)
- Local/campus maps, travel details, workshop room details, car parking

## APPENDIX 5

### 5.1 Event organization checklist

Title:				
Date:				
Location:				
Action	Person	Deadline for action	Completed	NOTES
<b>Delegates</b>				
follow up e-mail, thank you for coming, presentations and reports, links to photos and webpage				
send feedback form on an e-mail format				
<b>Final budget calculations</b>				
check invoices have been paid				
final budget (post event) - reconciliation, reimbursements and payments				
<b>Company Liaisons</b>				
thank you (post event)				
send feedback form on an e-mail format				
follow up from any feedback and potential new work				
<b>Photography</b>				
post photos on website				
<b>Marketing</b>				
update webpages				
email all attendees				
email invitees not able to attend with summary of event (eg programme/pack)				
<b>Reports</b>				
remind reporters that reports are due by agreed deadline				
rrange follow up meetigs with the company to discuss reports				
offer to present results on the company's site to ensure that a wider audience is reached				
make information public once reports have been approved by the company				
<b>Other</b>				
lessons learnt, draft, circulate and file				
note revised forecasts on budget spreadsheet				
revise to do lists where necessary				

### 5.2 Delegate pack content list

#### DELEGATE PACK CONTENT LIST

STATUS @ [date]

##### DELEGATE BOOK

Document number	Title	Mono or Colour	No of pages	Status
1	Front cover with relevant logos	Colour	1	
	ESGI welcome note from organising committee, with photo	Colour	1	
	Sponsor acknowledgements: Logos and company profiles		1	
	Programme		?	
	Delegate List (name, e-mail and affiliation)			
	Back cover with logos	Colour	1	

##### ADDITIONAL DELEGATE PACK MATERIALS

Notepad	
Pen	
maps	
Campus maps (if applicable)	
Room details (maps)	

TEMPLATE ATTENDANCE LIST

[Title of Meeting]

[city], [country]

Dates from – to (weekday, date, month, year)

	Name	Country	Signature Day 1 [date]	Signature Day 2 [date]	Signature Day 3 [date]	Signature Day 4 [date]	Signature Day 5 [date]
1							
2							
3							
4							
5							
6							
7							
8							
9							
10							
11							
12							

Meeting Secretary  
(Chair or local organiser)  
Name + signature:

APPENDIX 6

6.1 Sample academic feedback form

FEEDBACK FORM- TEMPLATE
Please comment below:
1- Variety of problems
2- Organisation
3- Accommodation
4- Meals
5- IT Facilities:  ·Printing  ·Wi-fi  ·Internet access
6- How could we make the study group better next year?
Where do you see scope for future collaborative projects with you, eg. on European projects
Additional comments:
Name (optional):

6.2 Sample industrial feedback form

FEEDBACK FORM- TEMPLATE
Please comment below:
1- Which problem did you sponsor?
2- What did you find most helpful about the workshop?
Are you willing for us to share this response publicly?
3- What did you find least helpful about the workshop?
4- What could we change to make the workshop more helpful to you?
5- How could we help you better prepare for a similar type of workshop?
6- Would you like a member of the local organising committee to present the results from the workshop on your site?
7- Would you participate a similar event in the future?
8- Would you be interested in a training course in mathematical modelling techniques used during this workshop?
Any other comments

# Success story title

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## **EXECUTIVE SUMMARY**

Briefly summarise the success story in one paragraph.

## **CHALLENGE OVERVIEW**

How the contact was taken? Describe how the challenge became part of a European Study Group with Industry (ESGI) set of problems and, if available in your country, mention the complete list of previous ESGI problems (e.g. ESGI compilations web address).

What were the main objectives and strategies of the initiative, how were they established and by whom (name of company involved)? What was the motivation behind the initiative?

If necessary, briefly describe the situation before the initiative including major issues, trends and conditions in the area.

## **IMPLEMENTATION OF THE INITIATIVE**

How was the initiative carried out? Duration of the contract. How were financial, technical and human resources mobilised and where did they come from (permanent staff of the group; ad-hoc hired personnel)?

What role did the partners play in the implementation process? What problems or constraints were experienced in the implementation? How were they overcome?

## **THE PROBLEM**

Brief description of the mathematical model and of the mathematics used in the research. What were the major challenges of the research (modelling, new mathematical methods, experimental determination of parameters...)?

USE YOUR IMAGE PLEASE

---

### **CAPTION**

---

## **RESULTS AND ACHIEVEMENTS**

What were the results and achievements of the initiative for the company and Academia? Were the objectives realised as per the criteria? What criteria/indicators were used to measure the success of the initiative and how were these measured, qualitatively and quantitatively? What was the impact of the initiative? Did this contract have a follow-up?

## **LESSONS LEARNED AND REPLICABILITY**

OPTIONAL What are the most important lessons learned from this initiative? Has the initiative been replicated/adapted elsewhere? What is the potential of replicating all or parts of the initiative? Which parameters determine replicability (technological, socio-cultural, economic, political, etc)?

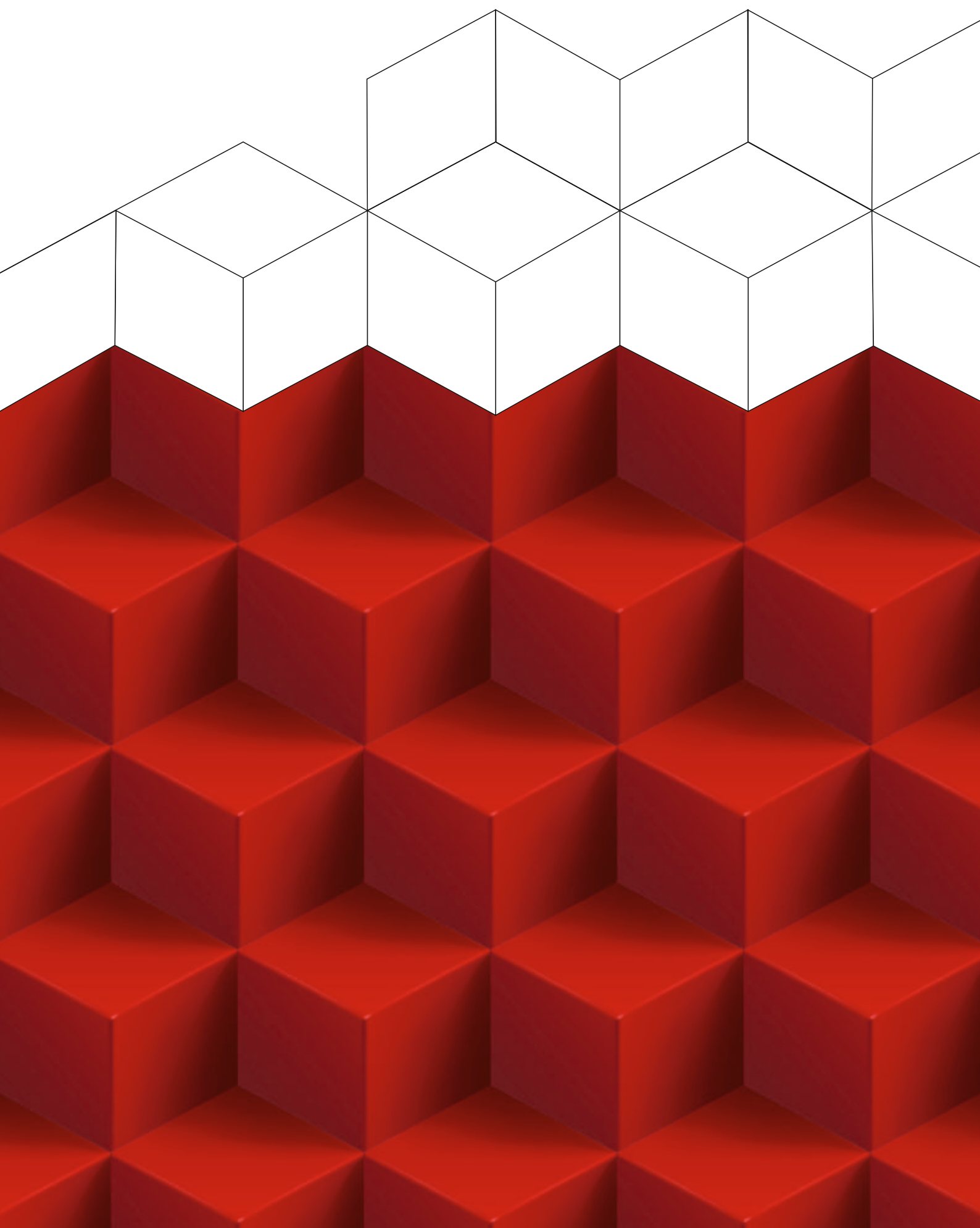
## **RESEARCH TEAM**

OPTIONAL Logo of the company involved in the story (Contact point in the company)

Name/logo of the Laboratory/Group (including address, webpage, e-mail of the contact person)

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Mathematics for industry network (MI-NET)  
COST ACTION Td1409  
December, 2017

