

Digitalization, Artificial Intelligence and Related Technologies for Energy Efficiency and GHG Emissions Reduction in Industry

IETS Annex XVIII

Proposal for Task 1: Assessment Studies

Proposed by:

**CanmetENERGY
Natural Resources Canada**

And

Polytechnique Montréal (Canada)

August 1st, 2018

About the IEA

The International Energy Agency (IEA) is an intergovernmental organization that acts as energy policy advisor to 29 member countries in their effort to assist in developing reliable, affordable and clean energy solutions for member countries.

Founded during the oil crisis of 1973-74, the IEA's initial role was to co-ordinate measures in times of oil supply emergencies. As energy markets have changed, so has the IEA. Its mandate has broadened to incorporate the "Three E's" of balanced energy policy making: energy security, economic development and environmental protection. Current work emphasizes climate change policies, market reform, energy technology collaboration and outreach to the rest of the world, especially major consumers and producers of energy such as China, India, Russia and the OPEC countries.

The IEA conducts a broad program of energy research, data compilation, publications and public dissemination of the latest energy policy analysis and makes recommendations regarding good practices.

About the IETS

The Industrial Energy-related Technologies and Systems (IETS) is one of IEA's over 40 Technology Collaboration Programs (TCP). The IETS program focuses on energy use in a broad range of industry sectors, uniting IEA activities in this area. The program was established in 2005 as a result of a merger, revamping and extension of activities formerly carried out by separate individual programs. The former programs for Pulp & Paper and for Process Integration are now parts of the IETS. The new program is still under development, with several new activities starting up. The specific objective of IETS is to allow OECD Member countries and OECD non-Member countries to work together to foster international co-operation for accelerated research and technology development of industrial energy-related technologies and systems, with a main focus on end-use technologies, taking into account other relevant IEA activities. Through its activities, the program will increase awareness of technology and energy efficiency in industry, contribute to synergy between different systems and technologies, and enhance international cooperation related to sustainable development. The Participants will implement a wide range of co-operative activities in the fields of:

- Scientific research;
- Technology and systems research, development, demonstration and deployment;
- Technology and systems;
- Technology and systems assessment of policies and consequences;
- Information dissemination.

The IETS presently has 11 active member countries: Austria, Belgium, Canada, Denmark, France, Germany, Netherlands, Norway, Portugal, Sweden, and the United States. Other countries may join the IETS to take part in the TCP.

1. Digitalization, artificial intelligence and related technologies

1.1 Definitions

Digitalization, artificial intelligence (AI) and related technologies (Big Data, Data Analytics, Internet of Things (IoT), Automation, Control, etc.) are conceptual terms that are closely associated and often used interchangeably in a broad range of literature. Table 1 below gives the most common definitions of the terms used in the field of digitalization.

Table 1. Glossary of digitalization-related terms

Term	Technical definition
Digitization	Automation of existing manual and paper-based processes, from an analog to a digital format.
Digitalization	Process of employing digital technologies and information to optimize business operations, create new revenue and optimize costs
Process digitalization	Digitalizing processes means that some digital technologies are being used in the processes and managing data digitally (digitized data and digitally native data), in order to convert processes (not simply digitization) into processes more efficient, more productive, more profitable and with greater customer satisfaction in their digital and physical experience with the company.
Big data	Data sets are becoming bigger and more complex that traditional data-processing application software are inadequate to deal with them. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data source.
Artificial intelligence (AI)	Simulation of human intelligence processes by machines, especially computer systems.
Data analytics	Process of examining data sets in order to draw conclusions about the information they contain, increasingly with the aid of specialized systems and software.
Internet of Things (IoT)	The Internet of Things (IoT) is the network of physical devices, vehicles, home appliances, and other items embedded with electronics, software, sensors, actuators, and connectivity that enables these things to connect and exchange data.
Industry 4.0	Industry 4.0, also known as the Fourth Industrial Revolution, integrates Internet of Things (IoT), data integration, cloud computing, and other technological advances into the heart of the production and

	manufacturing systems.
Automation	Creation of technology and its application in order to control and monitor the production and delivery of various goods and services. It performs tasks that were previously performed by humans.

1.2 Background

Digitalization, artificial intelligence and related technologies represent disruptive technologies that could have an important ability to render processes to be much more productive in the future – and with this, result in significant reductions in GHG emissions. For example, according to a [McKinsey analysis](#) (Chui et al., 2018), a big data/advanced analytics approach in manufacturing processes can result in a 20 to 25 percent increase in production volume and up to a 45 percent reduction in downtime.

Experts agree that the analysis of large data sets will be key for competitiveness, productivity growth, and innovation, and that its potential is only beginning to be exposed. However, the application of digitalization, artificial intelligence and related technologies in the energy-intensive process sectors is relatively embryonic compared to applications in other sectors such as banking, healthcare, manufacturing, insurance, web-based retail, etc.

In the manufacturing industry – such as the forestry, mining and smelting, oil and gas, energy production, and chemical and fertilizer sectors, to name a few – most of the data collected today are not used, and the data that are used, not fully exploited. This is due to barriers like Big Data accessibility, integrity and ownership, financial constraints, lack of business cases, and a talent gap. Although large manufacturers have been using statistical process control and statistical data analysis to optimize process operations over the last years, harnessing and analyzing the wide variety of data that exists in different sources will allow them to improve quality, increase manufacturing throughput, increase insight into the root causes of manufacturing issues, and reduce machine failure and downtime. With these new business values and technology capabilities, manufacturers will be able to change business model designs for greater adaptability and manufacturability – thereby improving supply chain management, process performance, and energy management – and ultimately, use the insights of analytics at all stages of the whole industry value chain¹.

Energy-intensive processes today can incorporate sophisticated data management systems, which capture process data across the supply chain for business decisions, as well as at the process level for quality, control and automation purposes. This dataset is possibly the foundation of an opportunity to identify new strategies for achieving radical GHG mitigation as global warming increasingly takes hold – related to increased efficiency and improved

¹ Industry value chain includes the resources management of the supply chain, the transformation processes and the distribution of products.

competitiveness. This application of Big Data and Digitization to achieve GHG emissions reduction will be further driven by new policy instruments and carbon pricing, new types of primary energy, managing energy cost volatility, etc.

1.3 Big Data: The Base for Digitalization

Big Data is about “lots of data”, but far beyond this - including different kinds of data to make better decisions. There is an important need to identify first, and then develop applications of Big Data and Digitalization – incorporating the breadth of data types and Big Data techniques to create disruptive competitive advantage and at the same time result in radical GHG emissions reduction.

The Figure 1 below (taken from the IBM Big Data and Analytics Hub) refers to the 4 V’s of Big Data: Volume, Velocity, Variety and Veracity. Big data challenges include capturing data, data storage, data analysis, search, sharing, transfer, visualization, querying, updating, information privacy and data sources.

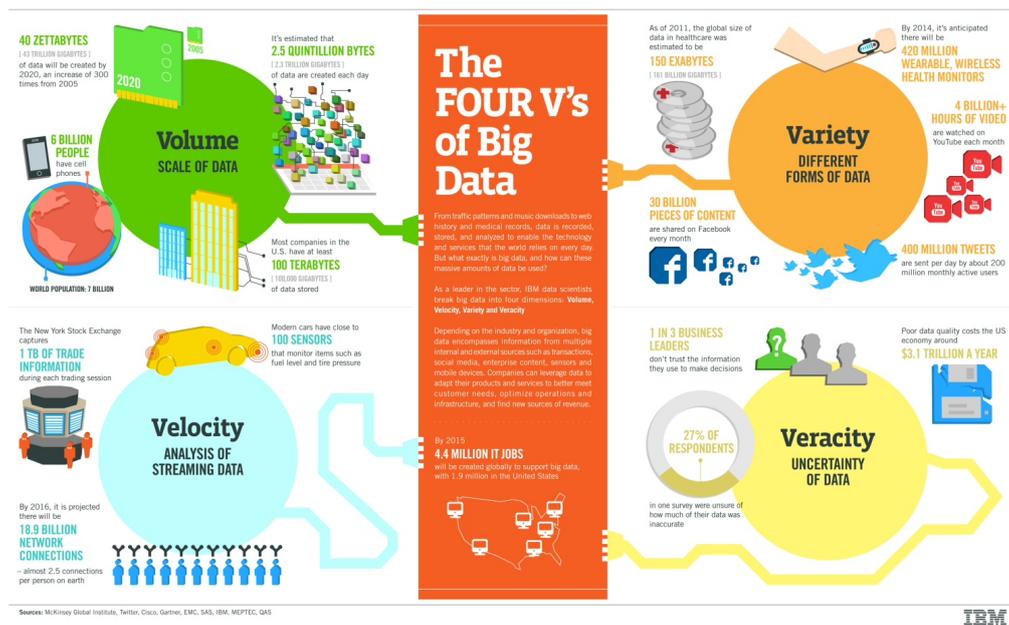


Figure 1. The Four V’s of Big Data (IBM, 2018)

Digitalization has been identified as having the potential to change the ways industry do business, direct applications in energy-intensive industries. There is a significant opportunity for developing Big Data applications for energy use reduction and sustainability purposes. Novel approaches for exploiting the pre-existing amounts of existing structured and unstructured data, and development of new methods and tools considering energy and sustainability are therefore important areas as well as data security and safety. Another aspect to consider is the distribution of roles between industry, technology providers and academia in this development, until now.

2. Technical/Scientific Sector

The targeted technical sector for this Annex includes large final industrial emitters – such as the forestry, the mining and smelting, oil and gas, energy production, and chemical and fertilizer sectors, to name a few - that are responsible for much of industrial GHG emissions in the IETS member countries.

With globalization, large companies are increasingly seeking to unify manufacturing platforms, process data from across the enterprise, and operate processes to help manage global sourcing and complex supply chains. These three strategies will be greatly impacted by digitalization, and can result in significant GHG emissions reduction.

At the plant level (see Figure 2), there are a range of strategies for using digitalization, artificial intelligence and related technologies that can result in radical GHG emissions reduction, building on:

- Value and assets maximization
- Predictive maintenance and automated fault diagnosis and correction
- Distributed decision-making and optimization (multi-agent)
- Automation and advanced control
- [Digital twinning](#)

At the supply chain level, especially with complex portfolios of added value, differentiated products, there are important trends that digitalization, artificial intelligence and related technologies will be essential for. SAP SE company lists the following trends, which represent an important opportunity for the effective use of digitalization (SAP SE, 2016):

- **Innovative products at better margins:** Customers demand constant innovation
- **Small lot sizes and individualization:** Quick order completion and delivery of tailor-made solutions create additional value for customers.
- **Customer collaboration:** Critical customer relationships must be strengthened to sustain high levels of customer satisfaction and retention rates.
- **Value-added services:** The digitization and interconnectedness of products and services creates additional value. An example is to advise on the best usage of a complex product, which can drive new revenue opportunities.
- **Disintermediation:** Companies will increasingly look up, down, and across their value chains to expand into additional markets.

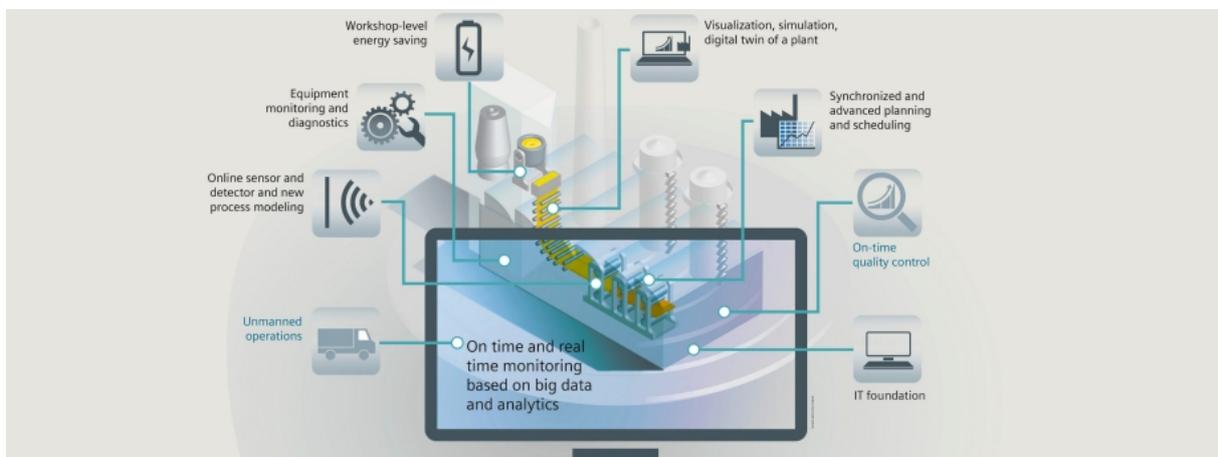


Figure 2. Big data, digitalization and related technologies for smart process industry (Siemens magazine, 2018)

SAP SE also identified the following priorities for companies that can result in disruption of the enterprise through digitalization:

- **Sensing of demand:** Real-world demand data increases planning accuracy and improves decision support.
- **Operational efficiency:** More accurate predictions and faster decisions can be made.
- **Energy efficiency:** Less energy is used to achieve the targeted quality level.
- **Manage talent and recruiting:** Simplification occurs across all of talent acquisition and training.

One of the targeted applications of digitalization is the forest value chain optimization. Big Data and AI applications are in their infancy in the forest products sector, and at the same time their implementation is inevitable over the coming years especially in connection with transformation to the bioeconomy. In a recent survey of 73 forest company executives by PriceWaterhouseCoopers, 72% said that they were “setting themselves ambitious targets for a high level of digitalization and integration” in the next 5 years. The executives felt that “digitalization, integration and automation opportunities will enable their companies to collaborate both internally and across their value chains in ways that will provide a step change in productivity”. To remain competitive, it is urgent that companies based on energy-intensive processes embark, exploring practical ways to implement their Big Data and AI strategies.

Value-adding processes in the forest-based bio-energy and bio-products industry currently rely on humans and simplified models to make decisions aimed at optimizing the value chain. The diversity of biomass and the products extracted from it make this task very complex.

Forest biomass comes from various sources and is very diverse (different species, moisture content, impurities, distances from collection to use, etc.). Optimizing the supply and blend of biomass in bioenergy/biorefinery operations is an important challenge. Because detailed data is not available for all forest regions, wood species, biomass suppliers and individual biomass trucks, and because online instrumentation is not available to measure required parameters, big data and AI techniques are essential to maximize biomass value and produce high-value bioenergy, biochemicals and bioproducts. This application would lead to GHG emissions reduction.

3. Objectives and Scope of the Annex

This proposal seeks to advance knowledge and development of digitalization, artificial intelligence and related technologies to improve the economic and environmental performance of targeted energy and GHG-intensive industries. The initiative would seek to assemble a network of academic, research labs, IT providers and process industry stakeholders to cooperate on the availability, quality and use of data (quality, quantity, location, operational, energy, etc.); to align capacity; and inform decision-making relevant to the targeted sectors;

The objective of this Annex is therefore *to stimulate the adoption and digitalization technologies for energy efficiency improvement and GHG emissions reduction in the process industries*. To achieve this objective, the Annex sub-goals are:

- *To create an international network and information infrastructure for stakeholders to exchange knowledge in the area of digitalization technologies*
- *To facilitate joint development of new knowledge and expertise on Digitalization*
- *To support and accelerate the deployment of digitalization practises in the energy-intensive process industries.*

This will be achieved through collaboration between IETS members who will identify pertinent centers of expertise and projects in their countries, and eventually share the results from a range of digitalization, artificial intelligence and related technologies application projects in their countries. It will be recognized that Annex participants will have distinct expertise in the concerned technology areas, and the culture of the Annex will be inclusive in order to facilitate international cooperation and networking within this field.

4. Means and Target audience

This Annex seeks to identify applications in the process industries that are achievable in the relatively near-term, and at the same time, capture a vision for the full power of digitalization, artificial intelligence and related technologies over the longer term. The applications that have the biggest potential for energy efficiency and radical GHG emissions reduction are to be underlined.

For Task 1 especially, the targeted audience is broad:

- Recognizing the embryonic nature of Big Data and Digitalization in the energy-intensive process industries, researchers in private sector and government institutions involved or interested in the fields are targeted. It will be recognized that there will be a wide range of expertise levels amongst the Task 1 participants.
- Companies that would like to be aware of trends in Big Data and Digitalization in order to better define their corporate strategies in this area.
- Companies that are developing systems for improved supply chain management or advanced process control applications of Big Data.
- Government policy makers are encouraged to attend, to understand and influence the direction of future tasks in the IETS Big Data Annex.
- University groups that are increasingly focused on Big Data and Digitalization.

The objectives of the Annex shall be achieved by performing a series of Tasks. The Task structure forms a common path for the Annex participants. Each task will build on national projects to form a collaborative body of knowledge, which forms the Annex scope.

The Annex Manager, through the national bodies participating in the Annex, will organize the creation of Tasks in the Annex, and seek to evolve these with the domain and interests of participating IETS countries.

The Annex manager is responsible for the overall status and planning, schedule, compilation of reports and dissemination of the Annex.

The Annex Manager shall:

- Be responsible for the overall management of the Annex, including overall co-ordination, liaisons between the subtasks and communication with the Executive Committee,
 - Collect and distribute the results of the Annex,
 - Provide annual reports to the Executive Committee on the progress and the results of the work,
 - Provide to the Executive Committee, within six months after completion of all work under the Annex, a final report for its approval,
 - In co-ordination with the Participants, use its best efforts to avoid duplication with activities of other related programs and projects implemented by or under the auspices of the Agency or by other competent bodies, and
 - Provide the Participants with the necessary guidelines for the work they carry out with minimum duplication.
-

The Annex Manager will carry his own costs for leading the Annex.

This Annex shall enter into force on October 1st, 2018, and shall remain in force until it comes to a logical completion.

Participation in Annex XVIII is free for all IETS countries. However, to participate in tasks will mean a need for a contribution (normally mainly task-shared).

5. Task 1 structure and Benefits

The first step is the organization of a kick-off meeting, in which the final version of the Task 1 proposal will be adopted. The broad related areas are discussed and narrowed down, and the methodology, with an emphasis on the first task, defined in details. Groups having activities in this area and interest to join international collaboration should have been previously identified and should be attending this meeting.

Task 1 (one year duration): This “needs and interests assessment” task will include the following work plan:

- a. **Summary of the state-of-the-art:** Digitalization, artificial intelligence and related technologies vocabulary, types of data, methods for their analysis, potential applications, an assessment of the growth drivers, barriers and needs (technology and knowledge) to adoption of digitalization, artificial intelligence and related technologies
- b. Overview of **broad trends** in industry Big Data and Data Analytics
- c. Survey of Big Data, Digitalization and Data Analytics **centres of excellence** and energy-intensive process sectors **Big Data projects** in participating IETS countries
 - i. Case study reviews: Existing case studies on the use of Big Data in manufacturing plants
- d. Assessment of **potential impact of Big Data** on different process industry sectors, such as the forestry, the mining and smelting, oil and gas, energy production, and chemical and fertilizer sectors
- e. Identification of **RD&D opportunities for strategic development** of Big Data tools, methods and applications in the energy-intensive process sectors.
- f. Conduct a critical analysis collaboratively, and narrow to «**common target area(s)**» of interest by Task participants

Outcome: Establish the scope of the next Tasks based on these discussions. Future Tasks related to more defined areas of Big Data and Digitalization will be defined.

The objective of Task 1 is ambitious in the context of the very embryonic nature of digitalization, artificial intelligence and related technologies in the large emitter industrial sectors. Most researchers working in the targeted domain of the Annex are not typically affiliated with the GHG emissions reduction and/or energy analytics community. The onus will be on Task 1 members in participating countries to be effective at identifying and

attracting these researchers. **It is critical to succeed in Task 1 to have long-term success in the new Annex.**

The main value proposal from participating in Task 1 includes:

- Familiarizing with the field of Big Data and Data Analytics broadly
- Understanding the actors and the opportunity for industry
- Becoming aware of the needs and the actions envisioned to help support energy-intensive process sectors
- Influencing the direction of future tasks in the Annex.

Participating countries in Task 1 will also have access to:

1. Major conclusions on major barriers towards energy efficiency in the process industry (delivered via scientific publication on barriers and drivers)
2. Summary and major findings of the Task 1 results to be freely disseminated, including recommendation for future research and developments.
3. Proceedings/summaries of workshops.
4. Executive project summaries presented to the IEA IETS Executive Committee.
5. Newsletters presented at the IEA IETS homepage.

6. Organization of work and meetings

The Task Manager will organize Task meetings which will be arranged in alternating countries. Workshops will be arranged, if possible but not necessarily in connection with international conferences or other events. Participating IETS member countries are expected to take active part in these workshops.

Each participating country will carry their own costs for travel and national reports.

The Task Manager will carry his own costs for leading the Task .

7. Schedule

Task 1 of Annex XVIII shall enter into force on October 1st, 2018, and will end after one year.

Within the limits of the terms of the agreements, this Task may be extended by more Participants, acting in the Executive Committee and taking into account recommendation of

the Agency's Committee on Energy Research and Technology concerning the terms of this Annex. Extensions shall thereafter apply only to those Participants.

The following Table 1 is a tentative work schedule for the Task 1. The initial Task will comprise a “needs and interests assessment”.

Table 1. Proposed work schedule for Task 1

Start Date	End Date	Activity
November 2018	November 2019	<p>Task 1: Assessment studies</p> <p>Meeting 1: webinar, November 2018</p> <ul style="list-style-type: none"> • Adoption of the Annex proposal • Presentation of Task 1 activities: <ul style="list-style-type: none"> ○ Table of content proposal for task 1 ○ Discussion and adoption • Roundtable discussion of pertinent research in each participating countries • Presentations of the state of the art • Discussion on future actions. <p>Meeting 2: webinar, February 2019</p> <ul style="list-style-type: none"> • Progress meeting #1 on Task 1 • Progress report (short presentations) by participating countries on: <ul style="list-style-type: none"> ○ Preliminary findings of Task 1 ○ Barriers of performing Task 1 if any ○ Next steps until face-to-face meeting in fall 2019 • Initial discussion on area(s) of common interest for following tasks <p>Meeting 3: face-to-face, November 2019 (1 or 2 full days)</p> <ul style="list-style-type: none"> • Presentation of outcomes of Task 1 by participating countries • Definition of following tasks (description and work schedule)
November 2019	To be determined	Define and launch additional tasks

8. Deliverables

The deliverables for Task 1 will be the following:

- **White Paper:**
 - Basic definitions and context of the digitalization, artificial intelligence and related technologies field pertinent to the energy-intensive process sectors
 - Types of data, methods for their analysis, potential applications, an assessment of the growth drivers, barriers and needs (technology and knowledge) to adoption of digitalization, artificial intelligence and related technologies

- List of the Centres of excellence in the domain for participating countries
 - Identification of case studies where digitalization, artificial intelligence and related technologies are deployed
 - Trends in digitalization, artificial intelligence and related technologies
 - Definition of gaps and priority areas in the domain for energy-intensive processes
 - Identification of potential impacts of digitalization, artificial intelligence and related technologies on targeted industrial sectors
 - Identification of RD&D opportunities for strategic development of tools, methods and applications in the energy-intensive process sectors.
 - Critical analysis collaboratively, and identification of «**common target area(s)**» of interest by Annex participants
- **Proposals for future tasks:**
 - The outcomes of Task 1 will highlight the needs, actions and opportunities of applying digitalization, artificial intelligence and related technologies to support energy-intensive process sectors. The white paper will help to establish the objectives, the scope and direction of future tasks in the Annex.

9. Funding

1. Each participant will bear the costs of its own participation in the Task, including necessary travel costs. The cost of organizing working meetings will be borne by the host country. The working meetings shall be hosted in turn by the Task participants.
2. Each Participant shall bear all the costs incurring in carrying out the Task activities, including reporting and travel expenses. The Participants agree on the following funding commitment:
 - (1) Each Participant (country) will contribute to this Task a minimum of 0.3 person years
 - (2) The Task Manager will contribute with a minimum of 0.3 person years to the Task management

10. Obligations and Responsibilities of the Participants

Paul Stuart, Montréal Polytechnique, is designated Task Manager by the IETS Executive Committee. Changes in the subtask leaders may be agreed by the Executive Committee, acting by consensus of the participants.

The Task Manager shall be responsible for:

- Coordinating the work performed under the Task/subtask

- Assisting the Annex Manager in preparing the detailed work plan
- Assisting in the co-ordination of the Annex and advising the Annex Manager on the performance of the Annex
- Provide semi-annual status reports to the Annex Manager and to the other participants
- Assist the Annex Manager in organizing workshops and necessary intermediate meetings
- Assist the Annex Manager in editing the workshops proceedings and the final Summary and major findings of the Annex

Each Task participant must make a significant contribution to the Tasks/subtasks. The obligations of the Participants are also:

- Active participation in the workshops
- Preparation of necessary presentations and working documents for the completion of the Task including country specific reports
- Review of the documents and draft of the final report
- Each Task participant (country) shall contribute to this Task with a minimum effort of 0.3 person years,
- Where multiple organizations from the same country are involved, they must agree on whether the contribution is a coordinated contribution (min 0,3 person years), or separated contributions (min 0,3 person years each).

11. Information and Intellectual property

- Executive Committee's Powers. The Executive Committee, acting by unanimity, in conformity with this Task, shall determine the publication, distribution, handling, protection and ownership of information and intellectual property arising from this Task.
- Right to Publish. The Participants shall have the right to publish information provided to or arising from their Task, except for proprietary information.
- Proprietary Information. For the purposes of this Task, proprietary information shall mean information of a confidential nature such as trade secrets and know-how (for example, computer programs, design procedures and techniques, chemical compositions of materials, or manufacturing methods, processes or treatments) which is appropriately marked provided that such information:
 - (1) Is not generally known or publicly available from other sources
 - (2) Has not previously been made available by its owner(s) to others without obligation concerning its confidentiality; and

(3) Is not already in the possession of the recipient Participant(s) without obligation concerning its confidentiality.

- It shall be the responsibility of each Participant supplying proprietary information, and of the Task Manager, to identify such information as proprietary and to ensure that it is appropriately marked.
- The Participants and the Task Manager shall take all necessary measures in accordance with this paragraph, the laws of their respective countries and international law to protect the proprietary information provided to or arising from this Task.
- Production of Relevant Information by Governments. The Task Manager should encourage the governments of all Agency Participating Countries to make available or identify to the Task Manager all published or otherwise freely available information known to them that is relevant to the Task.
- Production of Relevant Information by Participants. Each participant agrees to provide to the Task Manager all previously existing information, and information developed independently of the Task, which can assist or is needed by the Task Manager to carry out its functions in this Task, which is freely at the disposal of the Participants, and the transmission of which is not subject to any contractual and/or legal limitations, under the following conditions:
 - (1) The Participant will make such information available, at its own costs, provided that such costs are not substantial
 - (2) If substantial costs are necessary for the Participant to make such information available, the Task Manager and all Participants will determine the charge of the costs for each participant, upon approval of the Executive Committee.
- Use of Confidential Information. If a Participant has access to confidential information which would be useful to the Task Manager in carrying out the studies, assessments, analysis or evaluations described in this Task, such information may be communicated to the Task Manager but shall not become part of any report or other form of documentation issued as part of this Task, nor shall it be communicated to the other Participants, except as may be agreed between the Task Manager and the Participant who supplies such information. This information has to be marked clearly as “confidential”.
- Acquisition of Information for the Task. Each Participant shall inform the Task Manager of the existence of information that can be of value to the Task, but which is not freely available, and each Participant shall endeavour to make such information available to the Task under reasonable conditions, in which event the Executive Committee may, acting unanimity, decide to acquire each information.
- Reports on Work Performed under the Task. The Task Manager shall prepare reports on all work performed under the Task and the result thereof, including studies,

assessments, analysis, evaluations and other documentation, but excluding proprietary information.

- Copyright. The Task Manager, or each Participant for its own results, may take appropriate measures necessary to protect copyrightable material generated under this Task. Copyright obtained shall be the property of the Task Manager, for the benefit of the Participants provided, however, that Participants may reproduce and distribute such material, but shall not publish it with a view to profit, except as otherwise provided by the Executive Committee.
- The Contracting Parties understand and agree that the name, acronym and emblem of the IEA has been notified to the World Intellectual Property Organisation (WIPO) Secretariat according to Article 6 of the Paris Convention for the Protection of Industrial Property, as amended on 28 September 1979. The Contracting Parties further understand and agree that the OECD/IEA shall retain the copyright to all IEA deliverables, materials or publications published or to be published by the IEA or jointly by the IEA and a third party to this Annex. Should the Contracting Parties use any such deliverables, materials or publications they shall give full acknowledgement to the OECD/IEA as being the source of the material with a copyright notice in the following form: © OECD/IEA, (year of publication).
- Authors. Each Participant shall, without prejudice to any rights of authors under its national laws, take necessary steps to provide the co-operation from its authors required to carry out the provisions in this paragraph. Each Participant shall assume the responsibility to pay awards or compensation required to be paid to its employees according to the laws of its country.

12. Annex and Task Management

The Task will be managed and co-managed by respectively:

Annex Manager	Task 1 Manager
Mouloud Amazouz	Paul Stuart
Phone: Office: 1-450- 652-6809 Mobile: 1-514- 262-6536	Phone: Office: 1-514-340-4711 Ext. 4384 Mobile: 1-514-891-3506
Email: mouloud.amazouz@canada.ca	Email: paul.stuart@polymtl.ca

13. Participants by Country

Canada

Canada will be managing the Annex for the duration of the Annex, and will take part and contribute in several tasks. Mouloud Amazouz, is the person responsible from Canada.

Sweden

Please list here your planned area of contributions, i.e. Tasks you are intending to participate in, and if you are interested in hosting a workshop at your affiliation.

Germany

Please list here your planned area of contributions, i.e. Tasks you are intending to participate in, and if you are interested in hosting a workshop at your affiliation.

Netherlands

Please list here your planned area of contributions, i.e. Tasks you are intending to participate in, and if you are interested in hosting a workshop at your affiliation.

Austria

Please list here your planned area of contributions, i.e. Tasks you are intending to participate in, and if you are interested in hosting a workshop at your affiliation.

Norway

Please list here your planned area of contributions, i.e. Tasks you are intending to participate in, and if you are interested in hosting a workshop at your affiliation.

14. Participants in this Annex

Participants are defined as active contributors to the program of work. They are either identical with the Contracting parties; or organizations, institutions and companies, nominated by the contracting parties. (not yet confirmed).

15. New Participants

During the course of the Task, new Participants are allowed to join only by unanimous decision by the Participants, and the approval of the IETS Executive Committee.

16. References

Chui et al., Notes from the AI Frontier: Insights from Hundred of Use Cases, Discussion Paper, McKinsey Global Institute (April 2018), Retrieved from URL: <https://www.mckinsey.com/featured-insights/artificial-intelligence/notes-from-the-ai-frontier-applications-and-value-of-deep-learning>

IBM Big Data & Analytics Hub (2018, July 18) The Four V's of Big Data *Retrieved from*
URL: <http://www.ibmdatahub.com/infographic/four-vs-big-data>

SAP SE (2016, August 2018) Value Creation in the Digital Paper and Packaging Business:
Inspire and Shape a Digital World that Reinvents Quality and Productivity *Retrieved from*
URL: https://technology.risiinfo.com/sites/technology.risiinfo.com/files/Digital_Whitepaper_Paper_and_Packaging.pdf