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

Task 1 – Kick-off meeting webinar
December 11, 2018

Webinar

Time:
Tuesday, December 11, 2018 - 9h00-11h00 Eastern Standard Time (EST)
15h00-17h00 Central European Time (CET)
Agenda

9h10-9h20 (EST)  Welcome and Introduction to Annex XVIII  
Mouloud Amazouz, CanmetENERGY (CA)

9h20-9h35 (EST)  Introduction to Task 1 of Annex XVIII  
Paul Stuart, Polytechnique Montréal (CA)

9h35-10h35 (EST) Activities in member countries (10 minute presentations + 5 minute questions)  
René Hofmann, Technical University of Vienna (AU)  
Jean-Jacques Marchais, Schneider Electric (FR)  
Eemeli Hytönen, VTT Research Centre (FI)  
Pierre Filiatreault, BBA (CA)

10h35-10h55 (EST)  Around the Table Expressions of Interest and Discussions

10h55-11h00 (EST)  Conclusions and Next Steps
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Minutes of the kick-off meeting

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

Time:
Tuesday, December 11, 2018 - 9h00-11h00 Eastern Standard Time (EST)
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Participants: list available at the end of the booklet

1. Welcome and Introduction to Annex XVIII – Presentation by Annex manager - Mouloud Amazouz (MA)

MA starts with agenda of the day, then presents the main Objective of webinar, namely:

- Attract experts to join Annex XVIII on Digitalization, and to participate in the Tasks to come
- Overview of Annex XVIII and task 1 and presentation of general plan
- Target next steps of the Annex

MA indicates that the aim of the Annex is to encourage the adoption of digitalization, artificial intelligence and related technologies to improve energy efficiency and to mitigate GHG emission in the process industries. Large final industrial GHG emitters (Oil refining, forestry, mining, etc.) are the main targeted sectors. Nine countries are already official members of the Annex and three countries have expressed an interested to join.

In this context, Annex XVIII offers an opportunity to share the understanding of digitalization and AI in the process industries, be informed about opportunities and barriers in order to help support energy-intensive process sectors.

Main topics for the Annex might include digitalization as it relates to supply chain optimization, predictive maintenance and automated diagnosis, simulations and digital twinning and control, cyber security...

MA closed his presentation by citing potential long-term outcomes of the Annex: understanding of good practices in digitalization technologies in process industry will eventually be enhanced, safety will be improved, and linking ecosystems will lead to better decision-making.

2. Introduction to Task 1 of Annex XVIII – Presentation by Task 1 manager - Paul Stuart (PS)

During the first year of activity, focus will be on:

- Overview of state-of-art digitalization: technologies and application fields
- Assessment of Digitalization Technologies on process industry sectors and Identification of RD&D opportunities for the strategic development of Digitalization Technologies and their application in energy process sectors.
• Survey of Big Data, Digitalization and Data Analytics centres of excellence related to the energy-intensive process sectors, in participating and non-participating IETS countries.
• Narrow to common areas of interest by Task participants, and identification of future Tasks

Deliverables:
• Technical report will be prepared including:
  • Survey of Digitalization technologies
  • Trends in using Digitalization Technologies for energy efficiency and GHG emissions reduction in industry
  • A compendium of leading experts
• Proposal for Future Annex XVIII Task(s) including:
  • List of potential projects to be addressed in a 3-year Task
  • Grouping of projects into themes and identifying task leader

PS summarized confirmed Task 1 participants, introduced the next presentations.

3. Presentations by member countries

Presentation 1: By Jean-Jacques Marchais (JJM), Schneider Electric (FR)
Main points raised:
• IT is witnessing an exponential acceleration over last years.
  Industry- Digitalization –Energy –GHG: It is a wide topic. There is a need to define a more precise definition and to be clear on what we want to focus on.
  Digitization is expected to have a significant benefit to industries. This should be highlighted as the main driver.
  Energy efficiency and GHG emission reduction are one of many other benefits: this is not the main driver but rather “the cherry on the cake”.
• There are multiple benefits from digitalization projects that should be considered.
  IT industry and power supply chain are also significant energy consumers that should be considered.

Presentation 2: By René Hofmann, Technical University of Vienna (AU)
Main points raised:
1. Introduction to SIC: Smart Industrial Concept (SIC) a cooperation Doctoral School about Holistic Approach with Digitalization of Industrial Processes and Applications
There is a coupling between Annex 15 (industrial excess heat recovery) and Annex 18.
Digital transformation of the Industrial Energy Supply could be achieved by data handling and treatment, design optimization and planning, power Market and sector coupling & operational optimization.

**SIC in nutshell is:**

- Added value through specific use of data
- Development of methods for energy-optimized operation of industrial plants
- Optimum system design for future environment
- Consideration of mutual interaction industry ↔ energy networks

Work in unified and well balanced approach with implementers, operators and consultant markets

**SIC concept embeds EDCS (Energy Demand Control System) for industrial process control**

Aim of SIC is to develop methods for energy-optimized operation of industrial plants

An example of modelling thermal energy storage was presented

**SIC** is a consortium which is connected directly to the Annex objectives

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**Presentation 3: By Eemli Hytönen (EM) (for Antti Arasto), VTT Research Centre (FI)**

**Main points raised:**

- Overview of the background of VTT (Mission, Vision, Strategy, and business areas)
- VTT Digitalization approach: Try to bring Digitization into technology development (eg fast up-scaling of new technologies)
- VTT applies digitalization to energy efficiency in two ways:
  - Digitalization of process development
  - Development of process optimization tools, modularity and modelling of unit processes

- **Particular interests related to Digitalization in the Annex**
  - Actively develop digitalization in energy efficiency field with Key research players
  - New idea generation together
  - Global best practices
  - Global visibility for the topic

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**Presentation 4: Pierre Filatreault (PF), BBA (CA)**

**Main points raised:**

- Overview of BBA consulting
- Industry 4.0: The assortment of Industry 4.0 technologies promises to bring forth an era of hyper-automation and increased productivity.
- The value of Digitalization comes in three components:
  1. **Visibility (IOT):** Reduce variation with better information
2. **Clarity**: Obtain operational insight (clear visualisation of data) enabling clear decision making
3. **Agility**: Forward looking business intelligence and planning

2. **BBA 4.0 areas of focus**:
   - Artificial Intelligence
   - Big Data and Advance Analytics
   - Augmented Reality and Virtual Reality
   - Broadband Connectivity (IIoT, Connected Worker)
   - Drones

**Questions and Discussion**

**Question 1** raised by Fernando Cornejo (Vice-President, PTS Aura Minerals) addressed to Jean-Jacques Marchais (JJM) from Schneider Electric:

**Q1**: AI is currently being used in the mining industry to operate specific areas of processing plants, however, those algorithms are based on fuzzy mathematics, which are fairly basic and lack a self-learning capability - Is this effort going to cover exploring further improving of this the support workforce for Schneider?

**A1**:
- Overall situation: we have number of approaches, all based on basic mathematics but sometimes, fuzzy logic has been used. In Schneider Electric, a dedicated AVEVA with significant experience in energy intensive industries, developing the support of workflows (workflow management)
- There is a need of sharing knowledge on technology and on the process
- Collaboration between industry, client and suppliers is critical issue to be successful

**Question 2** raised by Fernando Cornejo (Vice-President, PTS Aura Minerals) addressed to all:

**Q2**: In Mining, I believe there is a lot of importance on defining properly a roadmap, having perhaps a heavier weight at this stage, as digitalization is new in our industry, and would like to hear from the panelists on their experience in the Mining sector?

**A2**:
- Priority is to define the area of interest with highest value, mitigating the risks and controlling the level of effort.
- Every operation and every site needs to be handled independently because each operation has different levels of technologies.
- When it comes to how sophisticated the IOT is, the roadmap is broad. It goes down to IOT level and data collection, all the way up to data acquisition and data quality where we are focusing.
We are building a digitalization framework and it is data driven operational excellence where we must start from data/information. Then, we pick the areas of interest within the operations.

Question 3 raised by Mouloud Amazouz (Canmet Energy) addressed to PF from BBA and all:

According to you, what are the reasons why Artificial Intelligence (AI) is not widely used in industry?

- There is a relative trust of basic process control systems versus lack of trust of unknown approaches/technologies.
- There is an important social acceptability issue to address (e.g., removing control from operators).
- As time goes on, more awareness and understanding of benefits and how it can be used will be established.
- There will be a growing understanding and trust: It is going to be increasingly common.
- There are already broad applications of machine learning in several fields (e.g., computational fluid dynamics area, remote sensing): Trust issue should not be there.
- Recent success stories are definitely helping broader adoption (autonomous cars and trains).
- We are in the beginning of the curve; communication of success stories can eventually grow understanding and adoption of these implementations.

4. Around the Table Expressions of Interest and Discussions

Four participants gave their thoughts on the Annex and on their interests in Digitalization.

1. Ivan Kantor from Ecole Polytechnique of Lausanne - Switzerland

Affiliation: Research institute in Lausanne /Industrial process and energy engineering group

Areas of interest:

- **Industry approach:**
  - Look at it as a multiscale perspective. Try to help support decision making toward more efficient energy and environment impact reduction, using modelling and optimization tools.
  - Look at it as how it is related to rest of system (i.e., Biomass Resource)

- **Digitalization approach:**
  - There is a need for digitalization to improve efficiency in industry
  - Sensors technology: Measurement sometimes are not available or not reliable, so digitalization can help with new sensors and more measurement
  - Allows to look at model predictive control and data reconciliation
  - One of relevant aspects of digitalization: Having generic model representing processes
  - Sharing data: providing interface for other industries to connect to
  - Use predictive control to investigate behavior/interaction (with electricity mix)
- Looking at energy efficiency and industry as part of system integration framework (representative models)

2. Mark Collins, EkhoSoft – USA
   - In Canada, EkhoSoft is working with a company there is no internal system to monitor energy consumption prediction.
   - Companies in the NA process industry are not motivated compared to European companies
   - About GHG emission in USA, as we talk industry, we should not forget to consider transportation and energy production (60% of GHG emission)

3. Adelaide Mendes, Galpenergia – Portugal
   - Using advanced control as a kind of machine leaning applied to process control. Also, predictive maintenance (sensors). Very good results have been obtained.
   - Areas of interest and expectations:
     - Industry 4.0 and IOT are an opportunity to go further
     - Big data help to improve energy efficiency and reduce GHG emissions drastically
     - Improve capacity to troubleshoot process unit and be proactive.

4. Massimo Celino, ENEA Unità Tecnica Tecnologie dei Materiali – Italy
   - Areas of interest and expectations:
     - It is not easy to jump the gap between technology and introduction of these technologies to industry.
     - It is important exchange ideas on this topic and involve industries in order to find a common background to start the discussion.
     - Not involved officially but very interested to join the Annex as a center of excellence to push further big data applications.
5. Conclusions and Next Steps

Next Steps Presented by Technical coordinator of the Annex - Zoé Périn-Levasseur

- Confirmation of countries interest in participating in Annex/Task 1
  - Follow-up email to be issued
- Task 1 Meetings (every 3-months during 2019)
  - March 2019: Technical Issues (4-hours, by webinar)
  - June 2019: Country Experts (4-hours, by webinar)
  - September 2019: (2-days, face-to-face)
    - Refine technical outcomes and messages
    - Identify Annex XVIII common interests/subsequent Tasks...
  - December 2019:
    - Presentation of Technical Report
    - Confirmation of subsequent Tasks

Concluding remarks of the Webinar by the Annex manager - Mouloud Amazouz
IETS Annex XVIII
Digitalization, Artificial Intelligence and Related Technologies for Energy Efficiency and GHG Emissions Reduction in Industry

Task 1 Kick-off meeting

Mouloud Amazouza, Zoé Périn-Levasseura, Paul Stuartb
aNatural Resources Canada, CanmetENERGY, Varennes (CA)
bPolytechnique Montréal, Montréal (CA)

December 11, 2018
Agenda

• Objectives of the webinar
• Overview of Annex XVIII
• Summary of Task 1 activities
• Presentations on activities and interests by country members
  – Questions and answers
• Roundtable discussions on activities and interests
• Actions and future meetings planning
Objectives of this Webinar

• To attract (more) experts in the field to join Annex XVIII on Digitalization, and to participate in the Tasks to come

• To overview Task 1 objectives and general plan

• To target what are the next steps
Overview of Annex XVIII
Overview of Annex XVIII

- **Objective**: stimulate the adoption of digitalization, AI and related technologies for energy efficiency improvement and GHG emissions reduction in the process industries through international collaboration.

- **Targeted sectors**: large final industrial GHG emitters such as oil refining, iron & steel, forestry, minerals & mining, oil & gas, etc.

- **Participating and interested countries**: Austria, Belgium, Canada, Finland, France, Germany, Italy, Netherlands, Norway, Portugal, Sweden, Switzerland.

- **Annex manager**: Mouloud Amazouz, CanmetENERGY/NRCAN/Canada

- **Task 1**: Assessment study
  - **Task 1 manager**: Paul Stuart, Polytechnique Montréal/Canada
General Drivers

• Digitalization, AI and related technologies have the potential to **enhance and extend the capabilities of humans, and help businesses achieve more, faster and more efficiently**

• Expansion in **open source AI algorithms and Big data storage platforms and frameworks** development

• **Increasing digitization** (Industry 4.0) implies more data (Big data)

“Lack of digital culture and training is the biggest challenge facing industrial manufacturing companies”
Big Data ⊜ Big Value using AI

- Achieve real-time decision making using actionable information/knowledge extracted from delivered in a timely manner
- Understand the roots of poor performance
- Become proactive as oppose to reactive, through real-time predictive analytics and optimisation
- Reach Intelligent Data-driven Manufacturing operations by connecting the entire value-chain – i.e.:
  - Raw materials → Transformation → Valuable products → Market
- Successfully achieve the holy grail of continuous improvement
Potential Topics of the Annex

Industrial plants will increasingly rely on automation, machine learning, computer vision, and other fields of AI to meet rising demands and transform the way they make, move, and market things. Topics in this area include, but are not limited to:

- Supply chain optimisation
- (Existing) Assets utilisation maximisation and downtime minimisation
- Predictive maintenance and automated fault diagnosis and correction
- Digital and advanced control
- Operations optimization
- Simulation and digital twinning
- Cyber security
- Others…

Reference: Siemens magazine, 2018
Outcomes of the Annex

- **Enhanced capability and understanding** of good practice in Digitalization technologies in the specific context of process industry energy efficiency and GHG emissions reduction.

- **Connected ecosystems: Driving better decisions**

- **Increased knowledge** about the implications of industrial Digitalization from improved productivity and energy and environment perspectives in the process industry.

- **Enabled individuals: Challenging and empowering both workers and customers**

- **Improved safety and security**

- Etc...
Overview of Task 1 Activities
Some Task 1 Activities

1. **State-of-the-art** in Digitalization Technologies and application fields. Overview of **trends through to Industrie 4.0**.

2. Assessment of the **potential impact of Big Data** on process industry sectors. Drivers and Barriers. Identification of **RD&D opportunities for the strategic development** of Digitalization Technologies. **Applications** in the energy-intensive process sectors.

3. Survey of Big Data, Digitalization and Data Analytics **centres of excellence** related to the energy-intensive process sectors. **Digitalization Technology projects** in participating and non-participating IETS countries – **identification of country experts**.

4. **Narrow to common area(s) of interest by Task participants, and identification of future Tasks...**
Two Deliverables

- Deliverable Number 1: Technical Report ("White Paper")

  - Survey of Digitalization and related areas
    - "Digitalization Technologies"
  - Trends in using Digitalization Technologies for energy efficiency and GHG emissions reduction in industry
    - Implementation strategies
  - Compendium of leading experts
Two Deliverables

• Deliverable Number 2: Proposal for Future Annex XVIII Task(s)
  – List of potential projects to be addressed in a 3-year Task
  – Grouping of projects into themes (Potential Tasks)
    • Task Leader identification
  – Assemble proposals from themes where there is interest...
## Task 1 Interested Participants

<table>
<thead>
<tr>
<th>Country</th>
<th>Contact</th>
<th>Affiliation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Austria</td>
<td>René Hofmann</td>
<td>Technical University Vienna Institute for Energy Systems and Thermodynamics</td>
</tr>
<tr>
<td>Canada</td>
<td>Paul Stuart, Michelle Levesque, Pierre Filiatreault</td>
<td>Polytechnique-Montréal CanmetMINING BBA</td>
</tr>
<tr>
<td>Finland</td>
<td>Eemeli Hytonen, Antti Arasto, Jani Lehto, Lauri Sikanen</td>
<td>VTT Technical Research Centre of Finland Luke - Natural Resources Institute Finland</td>
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<tr>
<td>France</td>
<td>Jean-Jacques Marchais</td>
<td>GIMELEC/Schneider Electric</td>
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<tr>
<td>Italy</td>
<td>Massimo Celino</td>
<td>ENEA Energy Technology Department</td>
</tr>
<tr>
<td>Portugal</td>
<td>Adelaide Mendes</td>
<td>Desenvolv.Tecnológico da Refinação - ARP/DPT</td>
</tr>
<tr>
<td>Sweden</td>
<td>Jenny Greberg</td>
<td>SIP STRM (Strategic innovation program for the Swedish mining and metal producing industry)</td>
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</tbody>
</table>

Participants from Belgium, Germany, Netherlands, Norway and Switzerland are still to be determined
Presentations on Activities and Interests by Country Members
Presentations

1. Jean-Jacques Marchais, Schneider Electric (FR)
2. René Hofmann, Technical University of Vienna (AU)
3. Eemeli Hytönen, VTT Research Centre (FI)
4. Pierre Filiatreault, BBA (CA)
Roundtable Discussions on Activities and Interests
Roundtable Discussion

• Your thoughts on the Annex
• Your interests in Digitalization
• Whether you would recommend other country experts
• Whether you are likely to join the Annex
• Anything else you might like to say...
Actions and Future Meetings Planning
Next Steps...

• Confirmation of your interest in participating in Annex/Task 1
  – Follow-up email

• Task 1 Meetings (every 3-months during 2019)
  – March 2019: Technical Issues (4-hours, by webinar)
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  – December 2019: Webinar
    • Presentation of Technical Report
    • Confirmation of subsequent Tasks
Thank you!

First webinar inputs

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

IETS Annex XVIII
Although not new in Industry – Exponential acceleration over the last years
Industry - Digitization – Energy – GHG: a wide topic!

Definitions? Where to focus?

Digitisation
- IOT – IIOT
- Big Data - AI
- Cybersecurity

Industry
- Process energy intensive
- Discrete manufacturing
- Fossil fuels
- Energy Efficiency - Electrification
- Renewable energy

Energy

GHG
- CO2
- Other GHG
A recent study of digital transformation in over 400 companies conducted by The Massachusetts Institute of Technology Center for Information Systems Research (MIT CISR) and management consulting firm AlixPartners found that 23% of those businesses could be considered "future-ready." That means they had digitally transformed their business operations and customer interface. As a result, their net margins were 16% higher than the industry average.

In a June, 2015 MGI report, “The Internet of Things: Mapping the Value Beyond the Hype,” found that value from the application of the Internet of Things in the factory setting would arise chiefly from productivity improvements, including a 10 to 25 percent improvement in labor efficiency and energy savings of 10 to 20 percent.

All sectors are impacted

Industry
- Oil & Gas
- Metal & Mines
- Chemicals
- Pulp and Paper
- Transportation
- …

IT Industry
- Data Centers
- Networks
- Edge & End use devices

Power Supply Chain
- Power Generation Efficiency
- Grid planning & Operation
- DER & Prosumers

And don’t forget consumption and Transport and Buildings are responsible of around 60% of fossil fuels CO2 emissions.
Several Promising technologies

Source WEF

http://www3.weforum.org/docs/WEF_Building-Blockchains.pdf
But it’s not just technology!

Benefits

Market Uptake
• R&D support
• Pilot financing
• LT Suppliers uptake

Use cases

Business models

Technology

Costs & Risks

Mitigation Plans
• Skills building
• Cybersecurity
• IP and data privacy
• Interoperability
• Environmental impact

Policies and regulations impacts?
To conclude

Framework ?

Focus ?

Deliverable ?
Life Is On

Schneider Electric
Presentation SIC! – Smart Industrial Concept Annex XVIII Kick-off

Univ. Prof. René Hofmann

Institute of Energy Systems and Thermodynamics, TU Wien

11/12/2018
Innovations for Energy Systems in Industry

Questions to be answered ...

Industry

Systemic

• Demand for renewable generation / Sectoral Coupling Gas, Electricity, Heat / Need for flexibility

Technology

• Storage tanks, heat pumps, etc. / New production processes / Network technologies (e.g. DC)

Market

• Which market design? / What is the object of markets? / Where are the boundaries of local energy communities? / New business models

Infrastructure

• Energy networks (gas, electricity, heat) / Industrial energy infrastructure / Production processes and plants

How to perform an inventory?

How to derive potentials for excess heat usage?

Impact of Policy-Instruments on Excess Heat and its usage?

Technologies for excess heat usage
Smart Industrial Concept!
an cooperation Doctoral School about Holistic Approach with Digitalization
of Industrial Processes and Applications for 2050 and beyond
SIC! in a Nutshell

- Added value through specific use of data
- Development of methods for energy-optimized operation of industrial plants
- Optimum system design for future environment
- Consideration of mutual interaction industry ↔ energy networks
SIC! [Smart Industrial Concept]

https://sic.tuwien.ac.at

Data handling and treatment
- PhD#1
- PhD#2

Design optimization and planning
- PhD#4
- PhD#8

Power market sector coupling
- PhD#6

Operational optimization
- PhD#3
- PhD#5
- PhD#7
- PhD#8
Competence Areas of PhDs

- **Data Driven Modeling**
  - PhD# 1,2-8

- **Mathematical Optimization**
  - PhD# 2-6,8

- **Sector Coupling, Power Grids, Markets**
  - PhD# 5-8

- **Control Development, MPC**
  - PhD# 1-3

- **Thermodynamic System Modeling**
  - PhD# 3,4,7

- **Prozess Analysis, Prozess Integration**
  - PhD# 4,5,7
SIC! united and well balanced approach

Experienced industrial partners...

...supported by scientific excellence
Embedding of the EDCS (Energy Demand Control System) in existing common industrial process control systems (goal is the fully automated application)
Knowledge Representation: Design/Runtime

Plant Design

Control Design

Model Design

Data Mining

SIC! Ontology

Model Tuning

Data Analysis

SIC! Runtime

Model Transformation

Annex XVIII
Modeling Thermal Energy Storage


1D Model

Model validation with real Lab measurement data
Physical vs. data driven
Analysis of model formulation (for exact description of storage behavior)
Neural network techniques
Full understanding of the highly dynamic operation
Institute for Energy Systems and Thermodynamics

Univ.Prof. Dr. René HOFMANN
Head of Research Area Industrial Energy Systems
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PhD Student in SIC!
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https://sic.tuwien.ac.at
Information session on Annex XVIII: Digitalization for Energy Efficiency and GHG Emissions Reduction in Industry

Antti Arasto (antti.arasto@vtt.fi)
Eemeli Hytönen (eemeli.hytonen@vtt.fi)
VTT – beyond the obvious

VTT is one of the leading research, development and innovation organizations in Europe. We help our customers and society to grow and renew through applied research. The business sector and the entire society get the best benefit from VTT when we solve challenges that require world-class know-how together and translate them into business opportunities.

Our vision
A brighter future is created through science-based innovations.

Our mission
Customers and society grow and renew through applied research.

Strategy
Impact through scientific and technological excellence.

Established in 1942
Owned by Ministry of Economic Affairs and Employment
Net turnover and other operating income (VTT Group 2017) 258 M€
Total of personnel (VTT Group 31.12.2017) 2,368
Doctorates and Licentiates (VTT Group 2017) 27%
from abroad (VTT Group 2017) 36%

11.12.2018
Opportunities in the world of huge challenges

- Growth with sustainable innovations
  - Climate action
    - Clean energy for the future
  - Resource sufficiency
    - Prosperity from resource wisdom
  - Industrial renewal
    - Innovations empowering industry
  - Safety and security
    - Resiliency in turbulent world
  - Good life
    - Improved quality of life and work
VTT’s business areas

- **KNOWLEDGE INTENSIVE PRODUCTS AND SERVICES**
  - Sensing and integration
  - Connectivity
  - Data-driven solutions
  - National Metrology Institute VTT MIKES
  - Micronova manufacturing services

- **SMART INDUSTRY AND ENERGY SYSTEMS**
  - Lifecycle solutions
  - Nuclear safety
  - Smart energy and transport solutions
  - Digital engineering
  - Business innovation foresight

- **SOLUTIONS FOR NATURAL RESOURCES AND ENVIRONMENT**
  - Industrial biotechnology and food solutions
  - Biomass processing and products
  - Sustainable energy and chemical technologies
Digitalisation meets energy efficiency in Finland

VTT primarily applies digitalization to energy efficiency in two ways

1. Totally new (energy) efficient unit processes → digitalization of process development
2. Optimization on process level → Development of process optimization tools, modularity and modelling of unit processes
Our particular interests related to Digitalization in the Digitalisation annex

- Actively develop digitalization in energy efficiency field with Key research players
  - New idea generation together
  - Global best practices & benchmarking
- Global visibility for the topic
Annex XVIII Express of Interest
About BBA

- Established in 1979
- Canadian consulting engineering firm
- Multidisciplinary engineering teams
- More than 750 employees
- Ten offices throughout Canada
- Niche expertise in the following sectors:
  - Power
  - Mining and Metals
  - Oil, Gas and Biofuels
  - Environmental Services
- Client- and technology-oriented approach
  - From preliminary studies to commissioning
  - Partnership approach to maximize success
Convergence of many disruptive technologies that will transform our world. From artificial intelligence to the Internet of Things to autonomous vehicles, the assortment of Industry 4.0 technologies promises to bring forth an era of hyper-automation and increased productivity.
Value of Digitalization

Visibility.

Clarity.

Agility.
Industry 4.0

- Autonomous Robots
- Simulation
- System Integration
- Internet of Things
- Cloud Computing
- Cybersecurity
- Additive Manufacturing
- Augmented Reality
- Big Data
BBA 4.0 Areas of Focus

- Artificial Intelligence
- Big Data and Advance Analytics
- Augmented Reality and Virtual Reality
- Broadband Connectivity (IIoT, Connected Worker)
- Drones
De la définition jusqu’à la mise en œuvre d’un projet, BBA offre depuis plus de 35 ans une vaste gamme de services de génie-conseil et de gestion de projet. Reconnue pour son savoir-faire dans les secteurs énergie, mines et métaux et pétrole, gaz et biocarburants, BBA compte sur une équipe d’experts de haut niveau pour transformer des problèmes complexes en solutions pratiques, avant-gardistes et durables.

BBA s’appuie sur un réseau de bureaux pancanadien pour desservir ses clients et réaliser des mandats à l’échelle locale, nationale et internationale.