PROGRAM GUIDE: Strategic Networking & Development (SND) Program

PROGRAM OVERVIEW

Background

Emerging Technologies offer the promise of new industries and transformational solutions to challenges across Alberta's key sectors. Bringing together groups of Alberta researchers, graduate students, industry and others is an important part of building on ideas and moving key research forward in Emerging Technologies.

The Strategic Networking and Development (SND) Program makes funding available to researchers at **Alberta post-secondary institutions** to support activities ('Projects') such as workshops, conferences, competitions and other events which advance Alberta's research and innovation focus in the Emerging Technology Priority Areas of *Information and Communications Technologies (ICT) and Advance Materials and Manufacturing Technologies (AMM)*.

This Program provides funding for Projects which have as a primary objective research collaboration, academic-industry/end-user collaboration, recruitment of highly-qualified and skilled people (HQP) to Alberta, the employment of HQP by industry in Alberta; and/or profiling of Alberta's research and innovation strengths in Emerging Technology Priority Areas.

Program Details

The program offers financial support of **up to $10,000** per Project to researchers at Alberta Post Secondary Institutions to support Projects such as workshops, conferences, competitions and other events which advance research and innovation focus in the **Emerging Technology Priority Areas listed below**. For detailed descriptions of the Priority Areas consult Appendix A of this guide.

Emerging Technology Priority Areas		
Area	**Intended Outcomes of Activity / Event**	**Research topics**
Information and Communication Technologies (ICT)	• research collaboration; • academic-industry/end-user collaboration; • recruitment of highly-qualified and skilled people (HQP) to Alberta; • employment of HQP by industry in Alberta, and/or; • profiling of Alberta's research and innovation strengths	• Communications Networks and Services • Internet of Things (IoT)/ Machine-to-machine systems • Advanced Data Management and Analytics • Cybersecurity • Human Interaction with Digital Media • Quantum Computing
Advance Materials and Manufacturing (AMM)		• Automation (including Robotics) • Lightweight Materials and Technologies • Additive Manufacturing • Nanotechnology • Quantum Materials

Alberta Innovates' Strategic Networking & Development Program supports Emerging Technology Priority Area-aligned workshops, conferences, recruitment events, competitions and other focused gatherings, held in Alberta, organized/attended by Alberta researchers and/or post-secondary students.

HOW THE PROGRAM WORKS

Eligibility

(a) Applicant Eligibility Criteria - To qualify, an Applicant:

- Must be a post-secondary institution that is one of Alberta's Publicly Funded Institutions
- Generally, the Applicant Representative on an Application must be entitled to hold a grant account at the institution (i.e. Faculty member). In the case of an Application from a student, a Faculty member willing to oversee the grant must be identified in the Application. Students considering applying should first consult the Program Lead before submitting an Application.

(b) Project Eligibility Criteria

To qualify for funding all Projects must:

- Align with one or more of the Emerging Technology Priority Areas listed in this Program Guide;
- Deliver an activity such as a workshop, conference, recruitment event, competitive event, or other focused gathering, the primary objective of which must be one or more of the following:
    - Identify/develop research or academic-industry/end-user collaborations;
    - recruit highly-qualified and skilled people (HQP) to Alberta;
    - encourage retention and employment of HQP by industry in Alberta and/or;
    - profile Alberta research and innovation strengths
- The objective of the activity cannot be primarily research dissemination;
- Deliver the activity within Alberta, except in exceptional circumstances involving travel to workshops or international competitions;
- be completed within the Term; and
- submit to other criteria that Alberta Innovates may develop from time to time.

Program Objectives and Performance Measurement

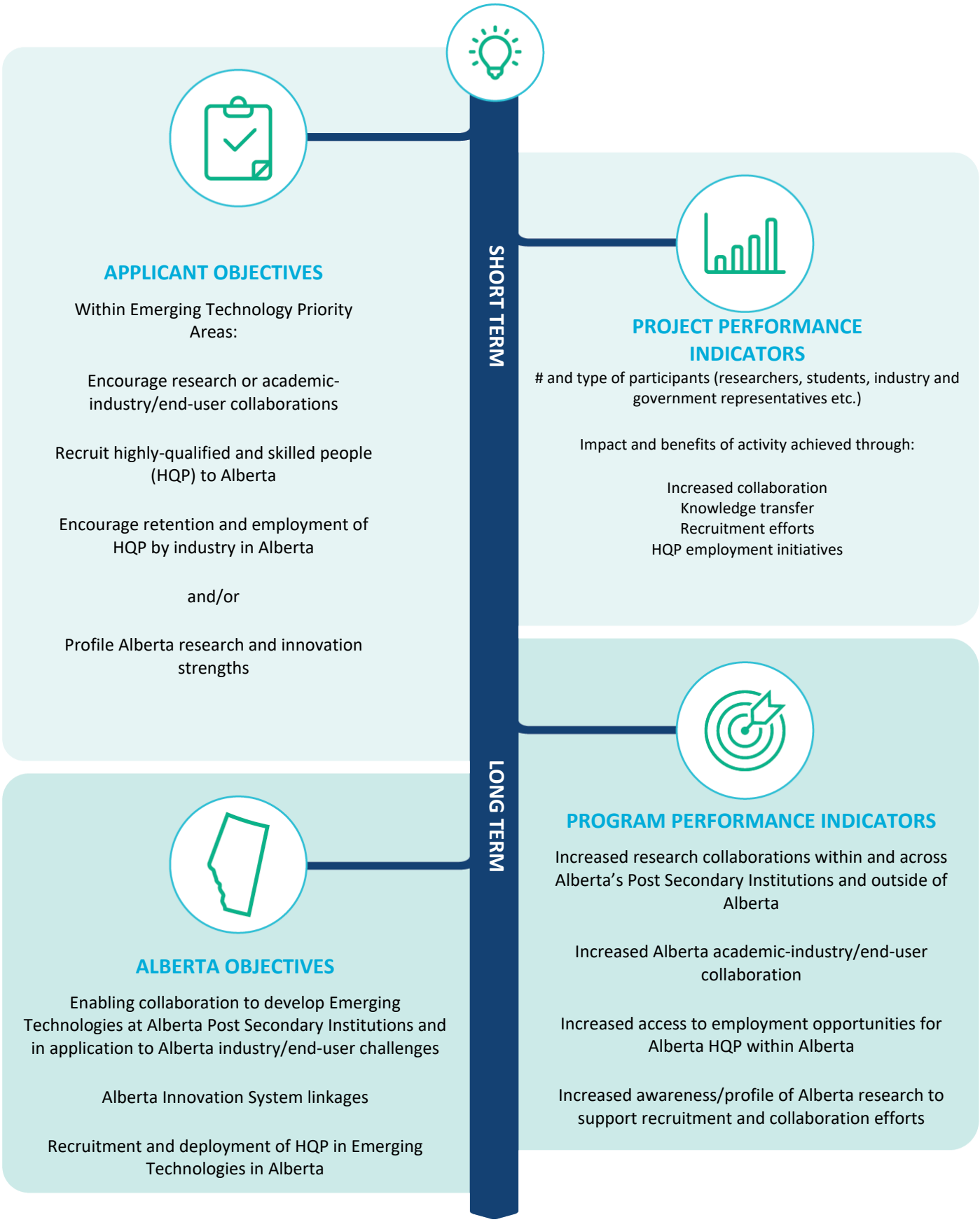
Over the life of a Project, Alberta Innovates employs an active project management philosophy, monitoring performance and supporting the Applicant to reach their objectives.

Once Projects are completed, Alberta Innovates continues to monitor performance for five (5) years to accurately evaluate the economic, social and environmental benefits realized for the province.

All Investment Agreements outline performance indicators tracked over the course of the Project and the responsibilities of the Applicant to report on outcomes subsequent to the completion of the Project.

Alberta Innovates has a common set of performance metrics it monitors, both at the individual Project level and for the aggregate Program. These are highlighted on the next page.

Objectives and Performance Metrics



How Funding Works

(a) Project Funding

The maximum Alberta Innovates investment for a single Project under the Strategic Networking & Development Program is $10,000.

There is no funding matching requirement under this program. However, Applicants are expected to demonstrate both the need for support, and when feasible (most cases), that they have secured or requested funding from other sources to cover a portion of the total Project cost. For example, typically the organizing researcher's department/faculty may contribute, industry may contribute, workshop fees offset some costs, and/or the Institution's facilities are made available for the event at no cost.

A typical Project Term for SND grant is approximately 2.5 months, beginning 45 days before an activity or event and ending one month after. This allows for grant expenditures for event costs leading up to and following an event. The maximum term for a SND grant is one year.

(b) Eligible and ineligible expenses

Alberta Innovates only funds reasonable costs incurred after the Effective Date on an Investment Agreement with you. Any costs incurred prior to the Effective Date in the Investment Agreement, or costs greater than market prices are deemed ineligible.

Costs must be incurred between arm's length entities. Please refer to our standard form Investment Agreement found on our website to get an in-depth understanding of eligible and ineligible costs.

HOW TO APPLY

PHASE 1
Engagement and Intake

1. **Contact** the Alberta Innovates Advance program manager to assess if the proposed project meets the minimum requirements of aligning with Government of Alberta and Alberta Innovates priorities and is aligned with the priority emerging technology target areas of this call.

2. **Register** on the Alberta Innovates SmartSimple Application Portal.

3. **Complete and submit** the Post Secondary Investments & Emerging Technologies (PSIET) Intake Form within the *Funding Opportunities* tab on the Portal dashboard. On the Intake Form, select "Strategic Research & Development (SND) Program" to complete.

3. **Intake Form Review** will be led by the Advance Program Manager to determine if the proposed project will be invited to submit a Detailed Proposal.

Applications are accepted year-round. Applications should be submitted a minimum of 8 weeks before the activity start date.

PHASE 2
Application and Evaluation

This Phase is by invitation only. The review process is competitive and only the highest-quality projects will be considered for funding.

Applications will be reviewed by Alberta Innovates.

Applications are reviewed regularly throughout the year.

PHASE 3
Project Management

Alberta Innovates will execute an Investment Agreement with the Applicant for approved Projects.

Applicants will complete and submit a Progress Report at the end of the Term.

An authorized financial statement of revenues and expenditures is required to be submitted along with the Progress report.

EVALUATION PROCESS

During the different phases of the program, Alberta Innovates leverages internal staff and external expert reviewers to evaluate the Applications submitted. Alberta Innovates evaluates Applications aligned with the Emerging Technology Priority Areas as shown in this Program Guide.

Alberta Innovates retains the sole right to determine the evaluation process and does not disclose the names of its external reviewers to ensure their objectivity and impartiality. All external parties are subject to both confidentiality and conflict of interest policies set by Alberta Innovates.

The assessment criteria and all investment decisions are at the sole discretion of Alberta Innovates.

TERMS AND CONDITIONS

This Program Guide is intended as a high-level overview of the Program. It provides interested Applicants with a roadmap of what to expect over the lifecycle of a Strategic Networking & Development Project, from the announcement of the program, through the Application stage, during the Project and post-completion. Should you have any questions about this guide or what is expected, please contact Alberta Innovates. Please be aware Alberta Innovates may modify this guide from time to time in keeping with any changes to the program.

Alberta Innovates will only correspond in writing and provide copies of the Application to the person named in the Application form as the one authorized to speak for the Applicant.

Once we have evaluated and approved an Application for funding, Alberta Innovates will require the Applicant to sign our standard form Investment Agreement. A copy of the Investment Agreement is available on the Alberta Innovates website. The Investment Agreement sets out in detail the roles, responsibilities and obligations of the various Parties to ensure a successful Project. Alberta Innovates will not provide any funding until the Investment Agreement has been signed by all Parties.

Alberta Innovates will only fund Applicants who have satisfied all eligibility criteria. Meeting the eligibility criteria does not guarantee access to funding, and all funding decisions will be made by Alberta Innovates at its sole discretion.

EQUITY, DIVERSITY AND INCLUSION (EDI)

Alberta Innovates believes the Research and Innovation ecosystem is stronger and more sustainable when it is broadly reflective of the overall diversity of our community and therefore embraces the principles of Equity, Diversity and Inclusivity.

CONTACT INFORMATION

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APPENDIX A –

STRATEGIC NETWORKING & DEVELOPMENT (SND) PROGRAM

PRIORITY EMERGING TECHNOLOGY TARGET AREAS

Proposed Projects must support the goals of the Strategic Networking and Development Program and fall within the targeted areas defined below.

- Information and communications technologies
- Advanced materials & manufacturing technologies

Information and communications technologies (ICT)

Context

The overall objective for proposals in the information and communications technologies (ICT) target area is to empower and protect individuals, organizations and society by leveraging ICT at scale. Indeed, many research challenges in the ICT area are focused on enabling humans to access the benefits latent in systems and data at scale while ensuring privacy and data security. Individuals can be empowered by utilizing data to improve their health, reduce environmental impact, increase personal productivity and enhance social interactions. Private and public organizations can use data analytics to enhance context awareness, leading to better decision-making. Innovative ICT helps societies to create successful economies while minimizing environmental impacts. Information is at the heart of these opportunities; however, information needs to be protected as well as responsibly and securely shared to gain the anticipated societal benefits.

Systems and data at scale require dealing with increasing data volume and velocity, data validity and veracity, and network and system diversity and complexity. Six research topics in ICT have been identified in support of this common thrust. Transformative research on communication networks and services is required to satisfy future bandwidth, energy and service needs. The Internet of Things (IoT) will allow unprecedented and fine-grained awareness of the surroundings, but will require overcoming communications and data-fusion challenges. Advanced data management, artificial intelligence and analysis techniques will allow humans and organizations to make better decisions on crucial social and/or economic issues. Cybersecurity is required to protect the confidentiality, privacy, integrity and availability of data and the systems over which it travels. Rethinking human interactions with digital media will improve the usability and usefulness of access to overwhelming amounts of information. Quantum computing is the next frontier of ICT, enabling improvements in sensor sensitivity and computational power by many orders of magnitude.

A strategic investment in ICT will allow Alberta's researchers to position at the forefront of innovation, leading to economic opportunities for Alberta companies as well as social benefits for Albertans. Research in this target area must specifically address one of the ICT research topics below.

1. Communications networks and services

Transformative research on software-defined networks: Future communication networks need to be scalable, flexible, agile, secure, and cost-effective to offer an array of end-to-end communication services and applications that meet the requirements of big data, cloud computing, mobility and IoT.

Software-defined networks will scale by control and adaptive management and will handle changing demand and resources to achieve energy and resource efficiency and sustainability. Orchestration of services built on cloud computing and virtualized resources will support a dynamic applications environment. Architectures and methods will scale by enabling end-to-end connectivity spanning heterogeneous networks, including wired and wireless segments. They will deliver quality of experience and real-time and bandwidth-intensive applications, and also tolerate transient disconnection. Wireless networks will scale by exploiting dynamic spectrum to provide higher bandwidth, with reliability and low power, leveraging future radiofrequency and millimetre wave. Heterogeneous radio networks will interoperate to support services in IoT and 5G networks and to replace existing wired access, as well as new satellite and airborne networks. Wireline networks will be transformed by software-defined network elements (switches, routers, appliances) and virtualized network functions that will leverage scalable photonic and electronic technologies.

2. Internet of Things (IoT)/Machine-to-machine systems

Scaling IoT infrastructure: The next-generation IoT has the potential to change the way people and systems live in a world of massive and disparate data sources, and to provide opportunities for connectivity at different scales. It needs to include advanced communications with a wide range of low-power, low-cost, software-enabled devices. It should accommodate stationary, autonomous and wearable elements, in robust self-reconfiguring arrangements.

Integration, analysis and consumption of sensor data: Next-generation IoT systems need to operate in real or near-real time in a context of extreme data diversity and volumes. Information architectures and standards are needed to enable the reliable fusion of sensor data of disparate types from the full spectrum of data sources. The resulting systems must support the efficient extraction and rendering of relevant information to allow timely decisions and actions by users and systems, while enforcing appropriate requirements for data authentication and verification.

3. Advanced data management and analytics

Management, analytics and information extraction of data at scale: The volume, velocity, variety and veracity of data demand new approaches to the management of that data. New analytical methods, including the ability to predict, optimize and anonymize at scale—in real or near-real time—are required to derive useful information from the data. Information needs to be extracted from a spectrum of data sources, such as numeric, textual, image, audio and video data, as well as social interactions and personal data.

Analytics for decision-making: Data at scale need to be analyzed to enable decision-making by people, applications, machines and systems. This includes interactive visualizations, query systems and other analytics that allow decision participants (human or software) to dialogue with the data and the analytics to arrive at a decision that is accurate and effective.

Artificial intelligence and machine learning: There is a need to develop artificial intelligence/machine learning capacity and develop opportunities to optimize artificial intelligence/machine learning use for application and digital transformation across one or multiple sectors.

4. Cybersecurity

Secure authentication and authorization at scale: New and improved methods to authenticate the identities of people, sensors, processes and systems, and to authorize access to services and information, will mitigate a fundamental weakness exploited by many cyber attacks. Useable, effective and scalable security interfaces and protocols are required. With increasing amounts of data, progress in this area will aid data security and privacy.

Quantitative approaches to cybersecurity: Quantitative approaches to cybersecurity will facilitate the application of data analytics and other metric-based approaches to protecting information and systems. The development of ontologies, behavioural and mathematical models, analytics, metrics, patterns, use cases and datasets will further the understanding, detection and prevention of both existing and new cyber threats—such as those being driven through the emergence of personal informatics, the IoT and quantum computing.

Advanced threat detection and defence systems: Advanced threats that are difficult to detect and defend against include moving and polymorphic targets that change over time, "low and slow" attacks and targeted attacks, which avoid detection by simple alert-based systems, in an ever-increasingly complex network of participants and targets. Advanced threat detection and defence systems will require coordination and correlation across different points in time and data sources and will leverage analytics and other approaches such as polymorphic defence.

5. Human interaction with digital media

Designing effortless interactions: Interactions must become invisible and engaging, as well as transparently indicate data quality. *Invisibility:* Sensors and intelligence that make the interface disappear can address challenges of wear ability, minimization of mental load and actionable feedback. *Engagement*: Gamification, for example, can sustain motivation for challenges such as health, sustainable practices and people-centric security. *Transparency of data quality:* In the face of noisy data, information display should convey data uncertainty at a cognitively acceptable level. Application examples include novel interaction techniques; interactions for special groups, places and contexts; collection and collation of personal data for personal use; living in information spaces; and augmented reality and virtual environments.

Effective tools for creating and populating physical and virtual objects and spaces: For designers ranging from professionals to hobbyists, software tools are needed to support maker and do-it-yourself cultures, to facilitate seamless transition between physical and virtual worlds and objects, and to leverage interactive modelling and animation. Design tools must support practices including sharing and collaboration, iterative prototyping, and stages of creative inception, refinement and deployment. Individuals and groups require tools for customization of interfaces to specific use cases, demographics, context and individual preferences, with as little training as possible. Individuals need tools to deploy their own approaches to information management. Designers of varying expertise need tools to create virtual and augmented environments, and to build social information spaces.

6. Quantum computing

Exploitation of quantum devices: The challenge involves exploiting quantum engineering for improved performance and efficiency of useful devices. In particular, it includes development of quantum devices and applications that use multiple qubits, entanglement and quantum algorithms for sensors, actuators and communication systems that outperform their classical counterparts. Examples include deploying and improving navigation tools; quantum sensors for chemistry, magnetic fields, electron transport and photon detection; quantum actuators for interconversion of information

(spin/charge/photon/phonon); and quantum communication for physics-based information security. The challenge is to develop devices and applications that can be deployed with near-term impact to areas such as medicine, environmental monitoring, materials and chemical characterization, security, improved nanofabrication and metrology.

Special-purpose quantum processors: A quantum computer is the ultimate quantum device and has broad applications, from breaking classical security protocols to machine learning. The challenge is to realize special-purpose quantum computers and in particular to deliver a well-working processor of 100 qubits. Examples include one optimized for running quantum simulations of materials and another for testing the robustness of quantum error correcting methods. These two building blocks are essential to the continued development of yet more complex and capable quantum processors. In addition to new hardware devices, the challenge includes new algorithms for quantum computing, particularly for small, noisy processors.

Advanced materials and manufacturing technologies (AMM)

Context

The overall objective for proposals in the Advanced materials & manufacturing technologies (AMM) target area is to lead to innovations and improvements in both the manufacturing process and the products produced. The overarching research thrust for all proposals must be to expand knowledge of the interactions between the material/part behaviour, machines and the final product performance. Proposals in this area must address these through a combination of science-based modelling and experimentation. This involves the integration of mathematical models of processes, materials, products and machines across manufacturing operations.

Research topics

1. Automation (including robotics)

The goal of research proposed under this topic is to design innovative machines and their efficient utilization to improve quality and productivity in manufacturing, transportation or farms through experimentally proven science-based digital models.

Design: Projects under this research topic should focus on design and digitally model intelligent, modular, reconfigurable and multi-functional machines that are easy to adapt to products. The following areas are specifically targeted: development and modelling of modular kinematic arrangements of the multi-axis machines, robots and material-handling devices; development and integration of novel smart sensors, actuators, robots and devices; multi-body dynamics and vibration modelling of machines; computer control modelling of multi-axis, multi-functional machines; digital modelling of physical interaction between machine structure, computer controller and processes.

Utilization of machines: Projects under this research topic should focus on developing methods and instruments to improve the productivity, accuracy, operation and safety of manufacturing, transportation or farms with the following target areas: integration of smart devices to machines, robots and assembly systems; human-machine/robot interaction; digital modelling of the manufacturing process physics for predictive process planning; on-line calibration and adaptive adjustment of digital models with sensory feedback; sensor-fused monitoring and adaptive control of processes; on-line and off-line part and machine metrology; energy-efficient and/or environmentally friendly manufacturing, transportation or farm processes; development of methods to improve safety in the manufacturing, transportation or farm environment.

2. Lightweight materials and technologies

Lightweight product design, assembly and use: Projects should focus on the development of innovative materials, material structures, designs and manufacturing methods, including fabrication technologies, that are needed to create lightweight multi-material products and assemblies of equivalent or superior performance in use and for maximum life-cycle energy efficiency. Projects that address component- level product development or system-level approaches will be considered. Specifically, projects are to address optimization for manufacturing (material and machine) built on a framework of integrated computational materials engineering (ICME), linking structure/process/property relationships to accelerate and enhance future product and process design. In the development of lightweight products and assemblies, care should be given to identify potential integration issues and formulate possible mitigation strategies.

3. Additive manufacturing

Projects in this area must integrate innovative solutions from more than one of the described research topics.

Process stability, monitoring and control: This research topic focuses on the development of the next generation of additive manufacturing technologies, integrating in-process monitoring, sensing and close-loop control strategies that allow for simultaneous improvement in manufacturing speed, repeatability and product consistency. Included in this challenge are hardware and algorithms adapted to process dynamics encountered during additive manufacturing processing and the response of the deposited material.

Development of tailored materials for additive manufacturing: This research topic focuses on the improvement and development of new additive manufacturing-specific categories of materials with adapted printability, allowing for new additive manufacturing opportunities, improved deposition quality/utilization (including recyclability and re-use) and response to post-processing operations. These will lead to superior process sustainability, part quality and performance.

Design for additive manufacturing: This Research Topic focuses on the development of integrated computation and design methodologies linking additive manufacturing process characteristics, part functionality, component and feature geometries, topology and internal structure optimization, and adaptive slicing strategies, to fully capture the novel disruptive potential of additive manufacturing.

4. Nanotechnology

Design and synthesis of nanomaterials: Projects should focus on the understanding of structural/functional properties and self-assembly characteristics that enable the synthesis of functional hierarchical 3D systems. Advantages of the material at the nanoscale and the impact of dimensionality on product properties of interest must be demonstrated. Emerging nanomaterials of interest include hybrid materials such as graphene, quantum dots, metal oxides, polymer-nanocomposites and their assemblies, based on Earth-abundant and Earth-friendly materials. A theoretical understanding, based on science-based modelling, of how these materials can be designed and integrated into manufactured products must be provided.

Scalability of synthesis and deposition/manufacturing processes: Projects in this research topic must focus on novel, efficient and sustainable manufacturing techniques for mass production of nanomaterials. Techniques to realize mass production on scales required for their integration into manufacturing processes or products, using either top-down or bottom-up processes, must be demonstrated. Clean manufacturing techniques, such as those using Earth-abundant and Earth-friendly materials, green solvents or solvent-free techniques, are encouraged. Reproducibility of the production

process and engineering scale-up is required to produce high-quality nanomaterials, addressing safety aspects in handling and use. Modelling of the process and key parameters are required to demonstrate scalability.

5. Quantum materials

Scalability and manufacturing of graphene or graphene-like materials: Projects in this area must address the mass production of graphene or graphene-like materials. Graphene, the two-dimensional atomic crystal, possesses superior physical properties that include extreme mechanical strength, exceptionally high electronic and thermal conductivities and impermeability to any gas. The laboratory process of mechanical exfoliation of graphene is simple and cheap for small graphene sheets; however, a major challenge is to mass-produce graphene sheets (both small and large) with the same outstanding performance as those created in laboratories. Manufacturing of several new two-dimensional materials that have many of the properties of graphene is also important for future applications. These include a single layer of silicon (silicene), germanium (germanene) and black phosphorus (phosphorene) or other similarly structured materials.

Integration of graphene or graphene-like materials into devices: Projects should address the possible applications of small and large graphene (or similar materials) sheets and projects in the area of integration into future devices. For example, the small sheets of these materials could be used in composites, functional coatings, batteries and supercapacitors. Large graphene films could be used in touch panels; low-cost photovoltaic devices; next-generation flexible, wearable electronics and optoelectronics; high-frequency transistors; photodetectors; optical modulators; energy generation and storage; sensors; and bioapplications. The films of silicene and germanene could be directly integrated into the current electronics industry, once the hurdles of manufacturing these materials on a large scale are resolved. A single layer of black phosphorus is promising for novel applications in nanoelectronics and nanophotonics.