2016 National Research Infrastructure Roadmap Capability Issues Paper

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Thank you for the opportunity to respond to the 2016 National Research Infrastructure Roadmap Capability Issues Paper. For the sake of brevity, I have answered only the questions I consider relevant to Weir Minerals' activities, below.

Advanced Physics, Chemistry, Mathematics and Materials

Question 21: Are the identified emerging directions and research infrastructure capabilities for Advanced Physics, Chemistry, Mathematics and Materials right? Are there any missing or additional needed?

As Advanced Manufacturing is one of the National Science and Research Priorities, I was surprised to find no mention of additive manufacturing within the 2016 National Research Infrastructure Roadmap Capability Issues Paper. Additive manufacturing is the major disruptive technology within the manufacturing industry leading the way into what The Economist in 2012 called the 3rd industrial revolution.

In the past 20 years of development, additive manufacturing of binderless metallic parts has moved from novel proof of concept to FAA certified parts and we at Weir Minerals believe that there is an incredibly valuable future in this technology for both our company and any country that decides to get in on the ground floor of this burgeoning field of technological development.

According to The World Bank, manufacturing provided less than 6.7% of Australia's GDP in 2015 compared with close to 30% in the 1950's. We as a nation jumped into the 2nd industrial revolution with a flourishing manufacturing industry during the war years and following decade or so of peace time but with our high wages, remote location and the rapid adoption of advanced manufacturing techniques of our south-east Asian neighbours, manufacturing output began to fall.

Australia now has the opportunity to reverse this downward trend by investing in advanced manufacturing and it is my belief that additive manufacturing is the technology that will enable this reversal as it overcomes the previous hurdles manufacturing in Australia faced.

There is a significant weakness in Australia's current approach to research infrastructure in general, that being a lack of co-located scale of activity. In the case of advanced manufacturing technologies for example, there are multiple institutions within the Australian National Fabrication Facility (ANFF) with small numbers of low to medium value additive manufacturing machines focussing on the same medical and aerospace applications. While there is some benefit to be derived from the multitude of research groups working independently in a field, the innovative potential is significantly reduced due to the duplication of resource and effort. Australia does not have the luxury to indulge this lack of scale if technological excellence is the goal. A clear contrast to this dispersed model is the UK Catapult model, which focusses on single locations with great depth in capability and equipment to drive leading research and most critically, technology transfer of

research outcomes into innovative solutions. Within the Australian environment this role is supposedly filled by the CRCs and NCRIS facilities. However these are invariably multi-institute organisations, resulting in fragmentation of capability across institutes.

High value facilities such as ANSTO, the Australian Synchrotron and square kilometre array are examples of significant clusters of research infrastructure, and this model should be applied to the critical research priorities. For example, replication of the Manufacturing Technology Centre in Coventry, UK, to create a single point of contact for research and research translation of advanced manufacturing technologies.

As a second point, I would also like to state that microscopy and microanalysis is essential to the work we do at Weir Minerals. We produce excellent wear resistant engineering products that are used for mining and minerals processing. Improved wear resistance results in longer product service lives, lowering the significant losses that occur due to the downtime required for the replacement and repair of equipment parts, and therefore increasing the profits of our customers in the Australian resources industry.

Our product development work requires the use of the latest microscopy tools, but these instruments are very expensive. The AMMRF has an open-access model that provides us with a simple and transparent means of accessing these instruments. The nodes advertise commercial rates at which we can access the facilities, with the comfort of knowing that the policy around IP is that it will be fully retained by us. We are able to send one of our staff members to be trained as independent users, or we can pay a premium for a staff member to undertake the work on a fee-for-service basis.

We are collaborating with researchers at the University of Sydney to develop new products that can last longer in abrasive environments, and can resist impact and corrosion, which we hope will help to open up new markets for us. An essential part of this alloy design work is understanding how our manufacturing methods impact the microstructure of the alloys, and how the microstructure influences the final properties of the finished components. For this work we use the AMMRF scanning electron microscopes, transmission electron microscopes, energy dispersive spectroscopy, electron backscatter diffraction and nanoCT.

I would like to advocate for the continued support of such microscopy facilities through a national open-access model in the 2016 NCRIS roadmap.