A Hub for Education and Research: Linking New Zealand manufacturing and universities through systemic development for enhanced communication

Jane Goodyer
Massey University
J.Goodyer@massey.ac.nz

Don Houston
Flinders University
Donald.Houston@Flinders.edu.au

Thomas Neitzert
Auckland University of Technology
Thomas.Neitzert@aut.ac.nz

Abstract

The project discussed in this paper is intended to develop mechanisms to link New Zealand's universities' collective capability in providing manufacturing education and research and represent this capability as a harmonious system of university provision to stakeholders. The project is underpinned by Stafford Beer's conception of viable systems model (VSM) which has been incorporated to guide both the design of the intended outcomes of the project and the functioning of the project itself. In terms of the VSM the primary intended outcome from the project is to design and activate "system 4" - the development/intelligence/marketing function - for the universities' manufacturing education and research functions. Unlike most attempts to link universities with industry, the project is not focused on a single university's connection to its environment but rather is focusing on the universities collectively as the organization- or system-in-focus. The context, design and initial phases of the project as a work in progress are the major foci of the body of the paper. Its intended outcomes and their anticipated benefits for both the New Zealand manufacturing sector and universities also will be described briefly. The final section of the paper considers the potential transferability of the methodology and the intended product – the knowledge network and hub – to other contexts.

Keywords

Viable Systems Model, universities, manufacturing, New Zealand, design

INTRODUCTION

The project discussed in this paper is intended to develop mechanisms to link New Zealand's universities' collective capability in manufacturing education and research and represent this capability to stakeholders. The project is being undertaken by a project group representing Massey University, Auckland University of Technology, Flinders University and New Zealand Trade and Enterprise. The project proposal was developed as a response to a major initiative in government education policy and a key report outlining a vision for the New Zealand manufacturing sector. These key environmental influences are outlined below to set the stage for description of the conceptualization of the project and its intended outcomes, and initial stages of the project in action.

Increasingly individual Universities and the higher education sector are being expected to link more effectively with communities and industry to enhance their contribution to national social and economic wellbeing. New Zealand is no exception to this trend. In 2006 New Zealand's Ministry of Education published its strategy which outlined the government's expectations and priorities for New Zealand's tertiary education system over the next five years. The Tertiary Education Commission (TEC) is responsible for leading the government's relationship with the sector, and for policy development and implementation. In 2007 TEC launched its Encouraging and Supporting Innovation (ESI) fund, which specifically supports the Tertiary Education Strategy 2007-12 through the objective "Building Relevant Skills and Competencies for Productivity and Innovation" to encourage the tertiary sector to contribute to innovation and productivity. TEC has challenged the tertiary education system to provide high quality comprehensive qualifications and to support employers to continuously upskill the workforce by providing informed study choices.

This challenge is also mirrored in the report "Manufacturing+: A Vision for World Leading New Zealand Manufacturers" published by New Zealand Trade and Enterprise (NZTE) in 2006. The report develops a clear vision and strategy for the economic development of the manufacturing sector. Its Vision Group, comprising representatives from NZ Council of Trade Unions, Business NZ, Ministry of Economic Development and Foundation for Research Science & Technology, in consultation with 500 manufacturers identified a set of recommendations for manufacturers, government policy, trade associations and unions, and education and research providers intended to ensure New Zealand (NZ) manufacturing sector's capability is enhanced to improve productivity and innovation.

The report highlighted specific issues and recommendations intended for education and research providers to action. In particular, these are:

- **Providing the right skills and training** – Manufacturers recognise the work being done within specific education programmes and institutes, however they consistently report a disconnect between tertiary institutes and manufacturers. They seek that tertiary education organisations (i.e. universities, polytechnics, etc) create qualifications that are relevant to the industry.
- **The need for continuing education in the workforce** - Manufacturers are well aware of their own knowledge gaps or weaknesses but find it difficult to locate relevant and accessible educational offerings.
- **Connecting with research organisations** – Manufacturers wish to work more closely with the research capabilities of universities and Crown Research Institutes as a means of leveraging and extending the knowledge within their business. There were many calls for help to close the perceived gap between the industry and research organisations.

It was the linked aspirations of the Tertiary Education Strategy and the Manufacturing+ report that prompted the proposal for our project. The project, which is funded through the ESI fund, is intended to develop a Manufacturing Knowledge Hub for Education and Research [HERE] to support New Zealand's (NZ's) manufacturing sector. Knowledge HERE will unite NZ's universities capability in providing manufacturing education and research and represent this capability as a harmonious collective of university provision to stakeholders. The Manufacturing Knowledge HERE will be used to facilitate communication and collaboration among universities to support the transformation of the manufacturing sector.

The next section describes the project conceptualization and design which drew on Beer's Viable Systems Model (VSM) to prescribe the functional aspects of the project and connections between them. Our intended product and outcomes and their anticipated benefits for both the New Zealand manufacturing sector and universities also will be described briefly. Subsequently the discussion turns to the implementation process for the project. The last part of the paper considers the potential transferability of the methodology and the intended product – the knowledge network and hub – to other contexts.

THE ORIGIN OF THE 'KNOWLEDGE HERE' IDEA.

The idea to try to do something to bring NZ's universities collectively and the manufacturing sector together more effectively came from Jane Goodyer's exploration of industry linkages as a relatively newly arrived staff member at Massey University and associated conversations between Jane and Don Houston, who at the time was also a member of staff at Massey. (Don has since relocated to Flinders University, South Australia but remains a contributor to the project.) We collectively have spent many years working in manufacturing engineering and manufacturing management in universities (and industry to a lesser extent). We recognised problems of cooperation between universities and associated problems of getting out there to industry and industry getting in to us captured in the "Manufacturing+" report. Each of us was aware of efforts by individual universities in the UK and NZ to establish links with manufacturing industry. We knew of the existence of isolated islands of excellence supporting the manufacturing sector in NZ. However, we also were aware that limited cooperation occurs between universities and there is no common access point for industry to link with courses or identify consultancy or research expertise. As manufacturers had indicated through "Manufacturing +", they find it difficult and time consuming to 'drill-down' through the plethora of information each University provides.

Jane and Don both had previous experience of the benefits of VSM as a design/diagnostic frame in industry (Goodyer et al., 1995) and education (Houston, 2008) respectively. The model seemed to fit the problem of communication, sharing information and connecting with the manufacturing sector environment facing the universities, so we decided to try it as a design model for an intervention.

THE KNOWLEDGE HERE PROJECT AS A VIABLE SYSTEM

Stafford Beer's (1981, 1984) Viable Systems Model (VSM) provides a mechanism for modelling of an organization as an intelligent information processing system. The VSM as an approach to organizational design, focuses on the relationships between functions, structure, information and organizational learning. As Beckford (1998, 289) notes "an organization is considered to be viable when it is capable of survival in a given environment and capable of learning and adaptation to changes in that environment". Learning is fundamentally about communication and using information effectively towards viable continuation and growth.

Within the model, the effective use of information connects five interrelated functional systems:

- System 1: Implementation - the parts of the organization that do what the organization exists to do - uses information to guide the doing and produces information on what is being done and has been done. This system, sometimes referred to as the primary activity, is usually autonomous, has its own management and is embedded in its own environment. These activities can be seen as viable systems in themselves;
- System 2: Coordination - uses information to make short term balancing decisions on resource allocations to ensure that what is being done in the near future is consistent with overall policy direction and priorities. It allows the primary activities to respond to local demand by themselves and coordinates responses to the control function;
- System 3: Control - which distributes, monitors and audits resources between and across the functional systems towards organizational goals, uses information of various types (policy, financial, productivity, etc.) to audit/monitor the implementation system. This encompasses all the traditional and newer audit functions - financial, quality systems, environmental, etc.
- System 4: Intelligence - in the military sense - or planning gathers information about the environment (broadly defined including stakeholders) and about the functioning of the organization itself, represents the organization to its environment and also influences the environment. This function links the other functions to policy and the organization to the outside world. This function may encompass research and development, and also marketing;
- System 5: Policy/identity - which establishes the organization's preferred future and develops the policy frameworks to focus efforts towards the achievement/pursuit of that preferred future, uses information to set overall direction for the organization and disseminates information about overall direction and essential characteristics of the organization (strategic policy).

If any one or more of these functions is underdeveloped or missing, or the information flows between them are poor or blocked, then the organization is not making the best possible use of information that is essential to its survival, development and growth. It also faces the danger of optimising parts while sub-optimising the viability of the whole.

Each of these functions and clear responsibility for them was built into the project design, which was intended to avoid common threats to viability (Jackson, 2000).

The bidding process for funding through the ESI Fund helped to ensure that the project design was robust, with assessment criteria requiring clear statements regarding strengthening outcomes for stakeholders, alignment with university sector priorities and giving clear preference to collaborative projects. Project partners were sought out, with AUT and NZTE brought onboard to the bid. Massey University is leading the project and is responsible for project management through to successful completion. Auckland University of Technology, through Thomas Neitzert's involvement, is collaborating in activities to complete the project outlined below. At the same time several other universities indicted support for the project. In essence, the project's 'essential characteristics' were established and represented to key stakeholders in this initial design phase. It effectively created the first representation of System 5 for the project based on our initial intelligence/marketing/development (System 4) work.

The project group – Jane, Don, Thomas and Craig Armstrong, representing NZTE - designed all five functional systems. The group has ongoing responsibility for shaping the project's essential characteristics (system 5) through consultation with key stakeholders (systems 4). The group also has responsibility for coordination and control of the day-to-day implementation of project activities (systems 2, 3). Members of the project group also have direct responsibility for parts of project implementation (system1). The project implementation process is outlined later in this paper.

Formalised linkages to key stakeholders have been built into the project design to attempt to ensure that system 4 effectively engages with interests around the manufacturing sector. The linkages are also intended to ensure that the policy function (system 5) is responsive to stakeholder interests. A steering group comprising mainly

manufacturers has been established. The members were selected to cover multiple dimensions of the sector, i.e. value chains such as electronics, food and beverage, marine/transport; organizational size – SMEs, large and multinational enterprises; and geographic spread across New Zealand. The steering group plays an important role to ensure that the project meets the needs of all stakeholders and is essentially a peer review process. NZTE is critical in ensuring our Knowledge HERE represents the needs of manufacturers and in facilitating the collaboration between the manufacturing sector and universities. NZTE is is represented on the steering group by Craig. Thomas, as Chairperson of the New Zealand Council of Engineering Deans (NZCED), is also a key player in the steering group. NZCED is a consultative body consisting of a representative from each tertiary provider offering one or more accredited professional engineering degrees. Each university's Head of School/Faculty will have a direct link to represent their views. The Steering Group will meet with the project group every six months.

The project group is supported at an operational level by a project coordinator, Terra Kuwano, and a project administrator (both employed by Massey University). The project coordinator plays a central role in identifying key stakeholder expectations and requirements by doing the data collection, environmental scanning and analysis. Terra will also be the direct link between the project group and the web designer who will be a sub-contracted specialist web design firm. The chosen firm will do the detailed design and build of web page portal which is a key aspect of the second work package in the project.

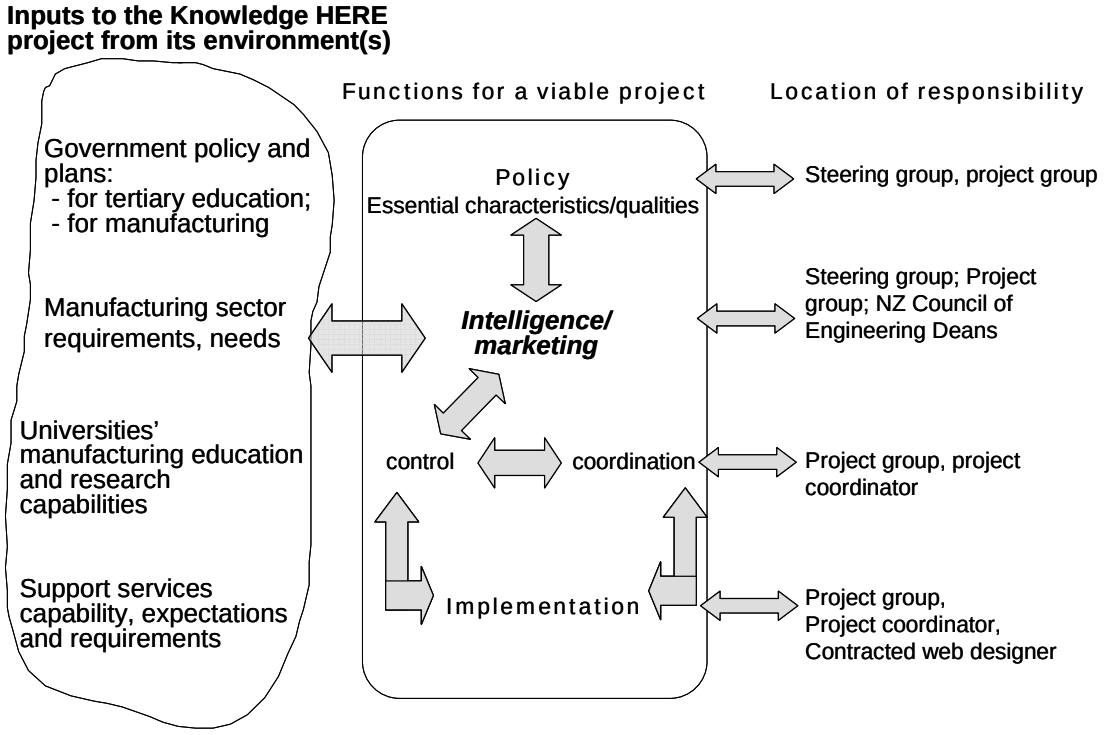

Figure 1: The Knowledge HERE project as a viable system

The responsibilities for the various functions are shown in Figure 1. The project group, and in particular Jane as project leader, are responsible for communication and information flows between them.

PROJECT PRODUCTS AND OUTCOMES: ENACTING SYSTEM 4 FOR NZ UNIVERSITIES' MANUFACTURING PROVISION

In terms of the VSM, the primary intended outcome from the project is to design and activate "system 4" - the development/intelligence/marketing function - for the universities' manufacturing education and research functions (Figure 2). Unlike most attempts to link higher education with industry, the project is not focused on a single university's connection to its environment but rather is focusing on the universities collectively as the organization or system-in-focus. A key output of the project is the creation of a website to host the Manufacturing Knowledge HERE.

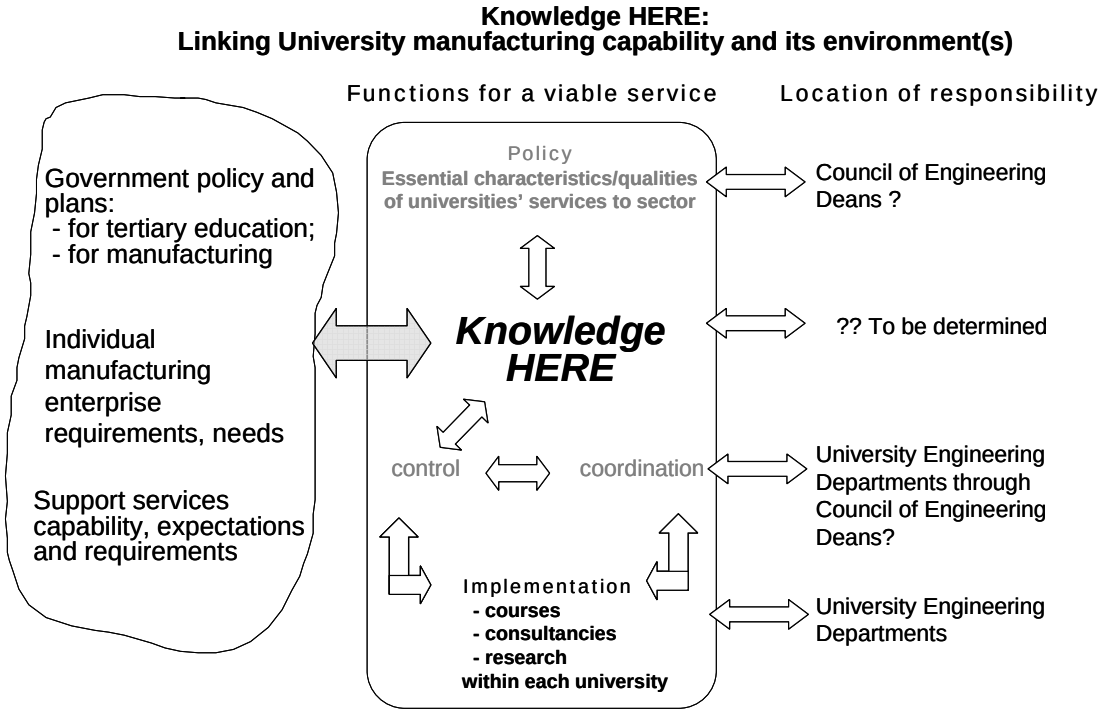

Figure 2: Knowledge HERE as an integral part of a viable system of universities support for manufacturing

University collaboration will provide a united and easily accessible gateway, through the Manufacturing Knowledge HERE, for the manufacturing sector. We predict that engagement between manufacturers and universities will be strengthened. This enhanced inter-relationship will provide knowledge of stakeholder needs that can be used to:

further understand and enhance our current contribution that university teaching and research make to economic growth;

significantly improve research connections and linkages to create economic opportunities;

increase our understanding of each other's provision so that each university can enhance its differentiation and complementarities.

It is envisaged that the project will positively contribute to the following government priorities for the university sector:

- **Initiatives to contribute to regional and national economic growth**

  By eight universities providing a united and easily accessible platform that the manufacturing sector can easily tap in to, we anticipate that NZ manufacturers will improve their productivity and international competitiveness.

- **Initiatives to improve effectiveness and quality of provision**

  Currently there is little information on the extent and nature of provision for the sector let alone its effectiveness and quality. The Knowledge HERE is intended to provide a platform to illustrate university capability and through it we can monitor and capture the needs of the manufacturers. This important 'real-time' information can guide and inform universities on how to improve their capability and to encourage collaborative activities to optimise design and deployment of services.

- **Collaboration with other universities**

  The focus of the project is to establish a collaborative hub of capability including all universities providing education, consultancy and research support to the manufacturing sector.

- **Innovative stakeholder engagement processes**

  The Manufacturing Knowledge HERE will act as a user-friendly, 'one stop shop' for manufacturing education and research, which in itself is innovative. Currently the mechanism for knowledge

dissemination to manufacturers (about manufacturing education and research) is managed locally at each university through individual web sites and published materials.

- **Increased links with other tertiary education sub-sectors**

Although this project focuses on the capabilities of universities, it is envisaged that it is a pilot to demonstrate the effectiveness of the Knowledge Hub concept for a specific sub-sectors (i.e. universities) to engage with their stakeholders. In the future it is envisaged that this concept will expand to include other sub-sectors' capabilities (e.g. Institutes of Technology and Polytechnics, Industry Training Organisations, etc.) to form a totally inclusive education sector range of manufacturing capabilities.

TOWARDS KNOWLEDGE HERE: PROJECT IMPLEMENTATION

The project implementation process comprises three substantive 'work packages' each with key activities and milestones. The first is to review University manufacturing capability, manufacturers' requirements and manufacturing support services requirements. This package will generate a comprehensive description of current provision and a three way 'gap analysis' of provision against needs. The analysis will set the stage for Work Package 2 which comprises scoping, design and launch of a website to host Manufacturing Knowledge HERE and development of a marketing plan. Work Package 3 is evaluation of the website and wider dissemination of information about it. We intend spending 2 months evaluating the effectiveness of the portal, by involving all stakeholders in a review of its effectiveness.

The tasks within work package 1 are outlined below.

1: Form Project Group and Steering Group

The project group exists and is progressing the project. The Steering Group is being formed and a first meeting planned.

2: Design & scope the review criteria required identifying each University's manufacturing support capability.

Establish the subjects, expertise, functions, etc to be included in the hub. A focus group comprising of academics with different expertise to support manufacturers (e.g. Product Development, technology, systems design, supply chain, etc.) will help define the scope of capability inclusion in the Knowledge HERE.

3: Preliminary review NZ University capabilities

Assess the publicly available information (i.e. websites, brochures, etc.) with respect to each university providing manufacturing support.

4: Identify units & individuals

Here potential relevant functional units and individuals to be included in the Manufacturing Knowledge HERE are identified.

5: Generate engagement strategy for each University

This activity focuses on the mechanism for accurate data collection. What information do we need to collect? Where do we find it? Who is going to support data collection in each university? How do universities provide information for the Knowledge HERE to use?

6: Confirmation of University capabilities

Visits and interviews of relevant functional units and individuals will be undertaken to identify the accuracy and 'up-to-dateness' of information. This will involve a 3 day visit per university to meet relevant staff/facilities. The information (i.e. interview data, websites, etc) will be collated and analysed

7: Identify manufacturers' expectations and requirements of Knowledge HERE

This activity seeks manufacturers' current knowledge of the university sector, their expectations, how they find knowledge, etc. What do they expect of the hub? The information (provided by focus groups, telephone interview data, survey, etc.) will be collated and analysed.

8: Identify support agencies' expectations and requirements of Knowledge HERE

This activity seeks support agency (e.g. NZTE, BizNZ, IPENZ, etc) current knowledge of the university sector, their expectations, how they find knowledge, etc. What do they expect of the hub? The information (provided by focus group outputs, telephone interview data, survey, etc.) will be collated and analysed.

9: Three-way gap analysis

A comparison of university capability and stakeholder (i.e. manufacturers and support agency) needs.

Our intention is that a report on university support for manufacturing – both current capability and indications of preferred future will be produced at the end of twelve months. While ambitious, we believe that this phase of the project is a vital precursor to the specific design of the portal and to building the networks to be linked through Manufacturing Knowledge HERE.

ISSUES FOR FURTHER CONSIDERATION

The project proposal suggested that the project may act as a pilot that may be expanded to include other tertiary education sub-sector manufacturing capabilities (e.g. Institutes of Technology and Polytechnics, Industry Training Organisations, etc.) or even duplicated to different business or public sectors; e.g. the Health Knowledge HERE would represent NZ's university capability in providing education and research to the health sector. That possibility remains in the future.

However, reflecting on Figure 2 above, which positions Knowledge HERE in relation to the Universities schools of engineering, has raised several issues for the project group and schools of engineering to consider if the project is to realize its full potential. Not the least, it raised the question of who is going to be responsible for the management and maintenance of Knowledge HERE in the long term. Developing the mechanisms and measures to encourage each participating university to keep the information updated and relevant to the manufacturing sector is crucial. Additionally our reflection has suggested that the coordination and control functions across and between the schools are under-developed (hence represented in grey typeface in the current version of the diagram) and where such functions should lie is unclear (and hence question marked in relation to the New Zealand Council of Engineering Deans). These issues need to be resolved for Manufacturing Knowledge HERE to realise its potential as System 4 for the universities' manufacturing engineering support capability.

More broadly, the project currently is focused on the engineering capability of the NZ universities but the manufacturing sector also engages with and has requirements in relationship to other parts of the universities in particular the various schools and faculties of business. Their involvement in the project, if any, has yet to be resolved.

CONCLUSION:

Using the Viable Systems Model as a design template helped us to ensure that the project was seen as well structured and potentially worthwhile for stakeholders and, we believe, contributed to the success of our bid for funding. Revisiting the VSM has helped us to focus on the intended design of the project's intended output. It has raised some significant issues about coordination between the engineering schools that otherwise may have been overlooked and potentially compromised the outcomes of the project in the longer term. While resolving those issues is beyond the scope of our project, the creation of Manufacturing Knowledge HERE will hopefully prompt the schools to consider other mechanisms needed to contribute to the viability of the schools collectively and their ability to interact to more effectively meet the needs of the manufacturing sector.

ACKNOWLEDGEMENT

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