METRICS FOR BENCHMARKING INTERNATIONAL DESIGN INFRASTRUCTURE

Dr. Terence Love

Faculty of BEAD, Curtin University
Western Australia
tlove@love.com.au

Abstract: This paper reports research aimed at identifying parameters for benchmarking national design infrastructures that compare nations that are similar in terms of key national indicators. In this paper, design infrastructure is taken to mean all that expertise and resources necessary to convert information and new knowledge into designs for real world products, services, systems and organisations. Building effective and efficient design infrastructure is central to improving economic and social outcomes at national, institutional, business and community levels. Different design infrastructures are appropriate to different nations because of their economic and historical profiles. The importance of this design infrastructure research lies in providing information for business and government resource managers to make informed choices about committing resources into design infrastructure. The paper describes a benchmarking to identifying which areas of design infrastructure investment are likely to be more effective in a specific national situation.

Keywords: Design

1. INTRODUCTION

Design infrastructure is a key determinant of the success of innovative, knowledge-based strategies that are central to many national plans for economic and social development (see, for example, Boardman, 2001; Commonwealth of Australia, 2001; Dept of Industry Science and Resources, 1999, p. 3; Innovation Summit Implementation Group, 2000; Rothschild, undated; Technopolis Innovation Policy Research Associates, 2002; Technopolis Innovation Policy Research Associates CENTRIM & SPRU, 2002, p. ii; The British Council, 2001). Having a sound design infrastructure is implicated in the successful commercial exploitation of ideas; successful business processes and strategies; and gaining economic and social benefits from investments in research (see, for example, Commonwealth of Australia, 2001; Dept of Industry Science and Resources, 1999; Innovation Summit Implementation Group, 2000; Owen, 1990; The British Council, 2001).

This paper reports research aimed at identifying parameters for benchmarking national design infrastructures by comparing nations that are similar in terms of a range of national indicators. Kearns from Xerox Corporation provides a reference definition of benchmarking (Camp, 1989, p. 10) stated in terms of the products, services and practices of industry leaders. Reshaping Kearn's definition in line with the 'working definition' of benchmarking proposed by Camp (1989, p. 12), and the national context of design infrastructure, leads to the definition used in this paper. I.e. 'Benchmarking design infrastructure is the search for best practice in developing design infrastructure that leads to superior performance across nations with similar key national indicators and development histories'. Different countries have different design infrastructure needs. Benchmarking across countries with a similar national indicators, and similar developmental path offers the basis for guiding design infrastructure investment.

The definition of design used in this project is that of Simon (1981, p. 129) who defined as '[devising] courses of action to change existing situations into preferred ones'. His definition applies anyone involved in making plans to change the future and is especially appropriate to investigating issues relating to design infrastructure because of its suitability for building coherent theory across design domains (Friedman, 2000). Key aspects of Simon's definition are: that designing is an intrinsically human internal non-routine activity whose outcome is a *plan*; that designing may be a part of any activities aimed at creating a change; that designing is not solely an activity of professional designers; and that designing can occur at micro and macro levels in many different types of human activity across individuals' work, private and public lives.

The planning of design infrastructure has been relatively neglected in the design research literature. In most countries, the funding and planning of specific elements of design infrastructure such as design education courses, design centres, design research centres, design associations, have been developed in an ad-hoc manner. This is problematic for business and government resource managers wishing to improve economic and social outcomes by investing in design infrastructure. For successful investment in design infrastructure it is necessary to have some means of identifying which areas of design infrastructure investment are likely to be more effective.

This paper describes the identification of preliminary classes of metric to investigate the relative state of national design infrastructures of nations clustered according to a range of national indicators. The development of these design infrastructure metrics draws on the international technology research literature relating to innovation and national economic and social development.

Design-focused countries such as the UK and Korea have started the development of design-focused performance metrics for key design sectors (see, for example, Chung & Whitefield, 1999; Kim, D., 2002; Summers, 2001). These metrics are country specific, however, and are not yet coherently integrated internationally with other indicators relating to national economic and social characteristics.

2. IDEA OF DESIGN INFRASTRUCTURE

Design infrastructure, as it relates to national innovation processes and national economic and social development outcomes, lies between the other two main aspects of profitable innovation: research and entrepreneurship. The model below in Figures 1 and 2 represents this relationship in a graph chosen for simplicity and brevity. This aligns with the model and analyses of Kodama (1995, pp. 142-188). In conceptual terms, the graph visually locates the human activity of designing and design infrastructure that supports it between 'knowledge and information generation created by research activity and investment in research infrastructure', and 'the entrepreneurial activities that distribute the actualised outcomes of design activity via some exchange of value - such as a profitable financial agreement'.

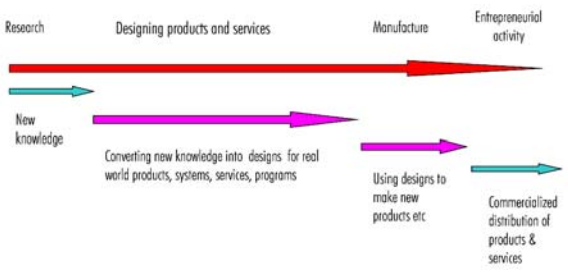

Figure 1: Design, Research and Entrepreneurial Processes

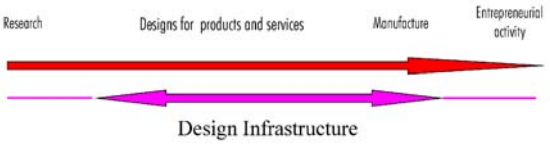

Figure 2: Relationship between Design Infrastructure, Research and Entrepreneurship

Two boundary issues are noted. First is whether dissemination of data, new information and knowledge from research is best classified as within design infrastructure or research infrastructure. A determining facture is that the value of any new knowledge lies only as an input to design activity, i.e. as a contribution to design infrastructure. Second are the funding and control pathways that flow backwards from entrepreneurial motivations that contribute to shaping design outputs and the relative balance of different elements of national design infrastructure. These feedback processes occur only in commercial activity that relates to designing and hence are more specifically linked to design processes and infrastructure than to entrepreneurial functioning. At this stage they seem better classified as belonging in design infrastructure.

3. ELEMENTS OF DESIGN INFRASTRUCTURE

Design infrastructures have a range of components (see below). It would be expected that most of these design infrastructure components would be found in any developed country that had a strategic approach to developing the contribution of design activity to national economic and social outcomes

Typical elements of design infrastructure include:

- Full range of companies offering design skills across all disciplines
- Design education programs in primary, secondary tertiary, postgraduate levels, life long learning programs, continued professional development programs.
- Design associations. These are a measure of whether a critical mass of design businesses and design practitioners are established in particular discipline areas.
- Government body(ies) dedicated to developing, supporting and managing national design infrastructure and initiating the development of additional design infrastructure elements as appropriate.
- Active design-focused research being undertaken across a broad range of disciplines
- Design research organisations
- Funding for design research from national research funding organisations
- Funding for in-house design research from industry and commercial organisations
- Significant proportions of commercial investment in design activity compared to research and development activity
- The establishment of well-funded national and regional design centres for different discipline areas
- Clear evidence in government policies of the understanding of design activity and the place of design activity and design research in national economic and social development
- Availability of commercial and educational sources for design-associated technologies such as CAD, rapid prototyping, mathematical analysis, data-collection resources, useability laboratories
- Design competitions
- A clear coordinated path of how designing is utilised to shape national economic and social development
- Institutional arrangements that strategically cross-feed learning to and from design infrastructure, research infrastructure and entrepreneurial infrastructures.
- Institutional infrastructures to integrate the accumulated knowledge-based expertise of practitioners, researchers and managers in design activity as a high-value, exportable, knowledge-economy service.

The exact mix and balance of these design infrastructure elements is different in different nations. Possible reasons for differences include: relative weaknesses in national design infrastructure; incomplete development of design infrastructure; and differences in the history of national economic ands social development in each country.

For example, countries whose economic and social histories have been dominated by resource exploitation are likely to have different design infrastructure form countries that have specialised in invisible earnings or manufacturing. This is a situation that reflects colonial relationships.

Typically, the development of design infrastructure, like the development of national economic characteristics is slow. Government policy can, however, strongly impact design infrastructure development and the timescale in which it occurs. Korea, for example, is undergoing radical transformation from an agricultural/cheap labour manufacturing economy to being a design-focused knowledge-based economy. This is a government-driven transformation to move the Korean economy up the industrial value chain (Kim, L., 1997). The Korean government's strategies have been to change Korea from being a 'low value manufacturer of goods designed by others' to being a 'high value designer of

high quality products manufactured either in Korea, or elsewhere, in low labour cost nations (Kim, D., 2002). Outcomes include a new generation of international-scale industrial organisations, *chaebols*, such as LG and Daewoo, and increased innovation through its small and medium enterprises. The Korean design infrastructure strategy focuses on the establishment of world-class design centres as a core element in their design-based development strategies (Korea Institute of Design Promotion, 2000).

4. BENCHMARKING

Camp (1989, pp. 16-18) suggested a four stage , benchmarking process with a total of ten sub-processes. The four stages are: planning, analysis, integration, and action. Translating the terminology of Camp's benchmarking process to suit benchmarking national infrastructures gives:

Planning:
- Identify what is to be benchmarked
- Identify comparative countries
- Determine data collection

Analysis:
- Determine performance 'gaps'
- Project future performance levels

Integration:
- Communicate benchmark findings and gain acceptance
- Establish functional goals

Action:
- Develop action plans
- Implement actions and monitor progress
- Recalibrate benchmarks

This paper is concerned only with three sub-processes of the planning stage:

- Identify what is to be benchmarked
- Identify which organisations are to be compared
- Identify data gathering methods

The remainder of this paper focuses on these three sub-processes.

5. IDENTIFYING BENCHMARKING INDICATORS OF DESIGN INFRASTRUCTURE

Identifying what needs to be benchmarked, benchmarking indicators, requires first an understanding of the scope of design infrastructure. A preliminary review suggested four high-level categories of design infrastructure:

- The provision of design services
- Generation of knowledge to improve design activity
- Dissemination of knowledge to improve design activity
- Resources that support design activity

The definitions of the above categories were chosen to align with the four main institutional arrangements (design businesses, design research, design education, and design support and management) and extend those concepts across the full breadth of design infrastructure. These four high level categories each contain several sub-subcategories:

Provision of Design Services includes: design businesses, in-house design teams and individuals, government organisations undertaking designing and the designers working in them, ditto for design-focused units in educational, research and not-for-profit organisations.

Generation of knowledge to improve design activity is mainly undertaken through formal research aimed at improving the efficiency and effectiveness of design activities, design education and the management of designing. It also includes less formal reflective practice. Institutionally, this is mainly undertaken in university, government and industry funded research centres plus clinical research undertaken locally in design teams or by individuals designers that is usually project specific. There is a need here to differentiate between: knowledge specific to improving the activity of designing, and knowledge that designers use in the course of their designing. For example, the first might focus on (say) improving team interactions in design processes, and the second might focus on (say) the quality of the material specification for a type of lightweight concrete.

Dissemination of knowledge to improve design activity is formally undertaken by conventional means in academia such as design education programs, in service training, life-long learning, conference presentations, journal papers. Its more public face includes promotion of design activity, which may involve public design centres, websites, design competitions, export promotion, education program promotion, public government support disseminated via newspapers, television and other media.

Resources that support design activity covers the wide variety of issues relating to the activities, institutions, and physical and virtual resources and foundations used in undertaking design activity. Perhaps the most significant resource, because designing is a human activity, are design professionals, including the managers and design support personnel. Important resource issues with regard to personnel are the relative availability and skill of designers, design researchers and design managers across the wide variety of design

disciplines. Practical resources used by designers include: CAD software, rapid prototyping equipment, information resources, and communication systems. Organisational resources include design associations, institutions, professional organisations and design centres that provide services and a means of continuity over time. Hegemonic resources include: awareness of the roles of design activity by government, senior management of businesses, media organisations. Financial resources are also needed to undertaken design activity, generate new knowledge about designing through research and to disseminate design knowledge – to those creating designs, those converting designs into real world outcomes, and to customers and users of designed outcomes. Much of this financial support comes from customers and users: major stakeholders in design activity

An alternative, and at first glance, more obvious approach, is to classify elements of design infrastructure in terms of design disciplines' This, however, proved to be inappropriate. Prior research (Love, 2003, 1998) indicates the number of disciples in which designers work is much higher, and changes at a faster rate, than commonly appreciated. Current investigations by K Friedman and T. Love suggest there are at least 400 and perhaps as many as 1000 different disciplines in which designing is a core activity. Superficial observation also suggests that around a dozen new design disciplines currently emerge each year. Using disciplines as the central basis for benchmarking design infrastructure, therefore, is precluded by dynamic and complex nature of the situation. It is also problematic because design activity is not discipline specific: designers are expected to be able to function in a trans-disciplinary manner. A substantial proportion of their expertise lies in activities specific to designing e.g. brief creation, criteria assessment, stakeholder needs elicitation, information management, design project management, design-focused analyses of marketing data, usability testing etc

6. IDENTIFYING RELEVANT KEY NATIONAL INDICATORS

Benchmarking design infrastructure across different nations requires a means of identifying country clusters with similar characteristics. A straightforward means of achieving this is through the standard national economic indicators relating to the relative balance of primary, secondary and tertiary economic activity. I.e.:

- Resource and agriculture activity
- Manufacturing activity
- Service industry activity (including knowledge and information services such as design activity)

The UK design council has also drawn attention to data relating to the contribution of design activity to GDP via export (Summers, 2001). This suggests that national import and export characteristics should be included as a country indicator criterion.

Preliminary inspection of Australia's design infrastructure (ref Lovein press) points to the importance of historical development. There are hegemonically based differences in design infrastructure between nations who have been colonizers compared to those that have been colonies. To some extent this would be expected to be reflected in their relative position on the resources – manufacturing – service industry continuum. More extreme in evolutionary terms, are those countries whose governments have made radical economic changes to shift their economies to be design focused in order to move them quickly up economic value chains. Korea is the most obvious example (see, for example, Kim, D., 2002; Kim, L., 1997) and similar changes have happened in Finland (Korvenmaa, 2000), the UK (see, for example, CBI 3M and Design Council, 2002; The British Council, 2001; Whitney, n.d.) and, recently, Estonia (Mollerup Designlab, 2003).

Internal consumption is a significant driver of design activity. This suggests that relative standard of living statistics would be expected to be a relevant differentiator of country types as regards the development of design infrastructure.

The characteristics of a nations' investment finance profile are another obvious factor that shapes development of design infrastructure. Relevant detailed criteria are availability of finance, levels of investment, and distribution of investment across primary, secondary and tertiary sectors.

Finally, as recent research in Estonia showed (ref), education provision is an important national differentiator with strong effects on design infrastructure development.

7. DATA GATHERING METHODS

The data relevant to standard economic indicators including import-export, education and standard of living, are typically available from national statistical services and from the country intelligence files of national government export support organisations In most cases, information about the features of countries' recent history relevant to benchmarking design infrastructure is readily available. A significant difficulty, however, is consolidating data for comparative purposes because data available from national statistical sources are frequently collected and presented in different ways.

Data gathering relating to design infrastructure metrics can range from straightforward to extremely difficult depending on the information required. Trade journals, in country design organisations, education databases, and national economic data

sources and web-based searches are potential sources of design infrastructure data. Detailed data of the sort collected by the Design Council in the UK (see, for example, Summers, 2001) of businesses in specific design sectors is not available for most countries and is difficult and expensive to collect. In the limit, data gathering possibilities significantly bound the choice of design infrastructure metrics.

8. CONCLUSIONS

The paper has presented an overview of the main issues relating to benchmarking national design infrastructure developments. It outlines a generic model of design infrastructure in relation to research and entrepreneurial infrastructures, and lists key elements of design infrastructure and related metrics. The paper also proposes criteria for defining national characteristics to cluster similar nations for benchmarking design infrastructure. The paper points to problems of data gathering that restrict the choice of design infrastructure metrics.

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