

The challenge of the codification of tacit knowledge in designing and making: a case study of CAD systems in the Hong Kong jewellery industry

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Abstract

Using the separation of designing and making activities in quantity-production systems of the Hong Kong jewellery industry as a case, this paper will show that codifying the tacit knowledge into the CAD systems is becoming deliberately feasible when the tacit knowledge are converted into accessible and applicable formats without losing its distinctive properties. The contextual analysis of the conventional jewellery production systems indicates that the separation of knowledge leads the consequence and the problems of partial representation. In order to study how the tacit-format attributes, which were separately contributed by the jewellery designers and goldsmith, can be extracted, recaptured, recorded, integrated and finally coded into CAD database, a project of scanning a hand-crafted 3D object was initiated and implemented. The successful result of the tested project not only demonstrates the feasibility of codification of tacit knowledge in design representation, but also gives a strong theoretical foundation of the extendibility of both tacit and coded knowledge in a design perspective. © 2001 Elsevier Science B.V. All rights reserved.

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1. Introduction: craft-based product quantity-production, computer technology and the problems of design representation

In order to deal with the rapid growth of mass demand in the global markets, the Hong Kong jewellery manufacturing industry has shifted since the

1970s from craft-based small batch-making to quantity-production. This transition has brought about the development of a localized conventional jewellery factory production system. Based on intensive exploitation of low-cost technology and the separation of designing and production processes within the technical division of labor, the industry has effected a translation of a craft-process into a mechanized industrial process.

This system, whilst relatively successful in the past, now comes under increasing pressure from Hong Kong's competitors, since they are undermining Hong Kong's competitiveness on both the cost

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and technology sides.¹ Computer technology, particularly CAD/CAM and RP tools, now provide more efficient means, in the sense of time-compression, in product design, development and production. However, for the craft-based products like jewellery which are embodied with rich intrinsic socio-cultural value of craft, such new technology, although providing clear benefits in production and development, also gives rise to serious philosophical and practical challenges, particularly in terms of the translation or encoding of handcrafted sensibilities, skills and embodied features into computer-based design representations.

2. The problems of design representation

As we are aware, design representation is central to the industrial design and development processes and therefore, central to the success or failure of the design brought to realization in this system. Ideally, the designer will present the design object, for manufacture, so explicitly that the representation will be error-free in terms of the translation of the designer's intent into the realized product. This would be a condition of maximum reliability of the representation, as both encoding satisfactorily the designer's intent and the information required to effect a translation to a determinate product.² Indeed, "good"

design representations, from this point of view, will be those where the designer can avoid in-complete or in-accurate messages in the representation and where the information presented (depending on context) is as complete as needs to be to achieve error-free translation and production. However, reality tells us that it is inevitable that errors are going to be made in design representation since design representations are translations and are so twice over: first, of the designers' mental intent and second, because the orientation to production itself demands a second degree of translation or transformation in which both original intent (sketch) and the design-representational translation (design image) are orientated to production (production-drawings).

There are two, inter-linked levels of problem in this process. First, as translations all design representations are subject to the same laws of "impossibility": that is, no translation is a perfect reproduction and in the translation some things are inevitably lost. Second, there is the question of the representable. Certain aspects or attributes of things are more easily represented than others. Those others, particularly those surrounding tacit experience and which pertain to the "worked" quality of the thing are extremely difficult, if not all but impossible, to be represented. This means that all design representation is both inadequate translation and, to a degree, both incomplete and "impossible." It is important that designers recognize and are prepared to deal with this situation since failure to fully accept this endemic problem leads to false optimism that indeed "everything can be representable or represented." The practical failures, at critical moments, of many CAD/CAM systems show that this is not the case. There are real problems therefore of the adequacy of design representations both to the requirements of production and in terms of the ability of design representations to represent what cannot be represented.

Inadequate design representation, in Petroski's [1,2] view,³ is mainly rooted in the failure to con-

¹ The competitors include such as those technology-based jewellery companies in Germany, Italy and Switzerland, which are focusing on the replacement of the workmen's involvement by computer production technologies as an effective business strategy, and also those cost-based jewellery firms from Thailand and India which have rich gem resources and relatively cheaper land and labor costs. The problem is compounded for Hong Kong jewellery firms in that whereas western competitors, with greater capitalization, can utilize high technology to overcome problems of jewellery production and newly industrializing competitors still have flexibility of cheaper materials, labor and other costs, the Hong Kong jewellery industry is squeezed between both poles. Increasing pressure on the production processes for cost effectiveness inevitably leads to a lowering of product quality and therefore, in the long run, to the competitiveness of the Hong Kong jewellery firms and the industry as a whole.

² The success of the design representation has to be couched in these terms since in modern production contexts of the de-skilling of labor, the "success" of the potentially ambiguous (if sometimes evocative or impressionistic) representation cannot depend on the few people who have sufficient interpretative ability to interpret even ambiguous renderings.

³ Henry Petroski has made detailed description of the change of many historical artifacts to demonstrate and support his view in a series of publication since 1980s.

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