2 Design Type and Regulative Framework

2.1 Design Type: Normal Versus Radical Design

Vincenti (1990; 1992) uses two dimensions to characterize design processes: design hierarchy and design type. Here we focus on design type because earlier research suggests that this is important for how engineers deal with ethical issues (Van de Poel and Van Gorp, 2006). Vincenti (1990) uses the terms "operational principle" and "normal configuration" to indicate what normal design as opposed to radical design is. "Operational principle" is a term introduced by Polanyi (1962). It refers to how a device works. For example, incandescent light bulbs and fluorescent lights have different operational principles. In a light bulb a tungsten wire conducts the electrical current. This heats up the wire: electrons are excited and emit light as they fall back. In fluorescent lights a large voltage passed between two electrodes travels through a gas creating a kind of plasma. Electrons from mercury atoms in the tube are excited and emit ultraviolet light. Phosphorus powder on the glass transfers the ultraviolet into visible light by electrons being excited and emitting light in the visible range when falling back. So although both types of lights give light they have different operational principles.

Normal configuration is described by Vincenti as: '… the general shape and arrangement that are commonly agreed to best embody the operational principle.' (1990, 209). We interpret the general shape and arrangement to include the kind of material that is used. Vincenti does not include the materials explicitly but the materials used in a design are very important for the shape of parts and the product. Moreover, using different materials, for example plastics instead of steel, often requires new types of knowledge to produce a product and new methods to test it. The use of such new knowledge and methods is typical for radical design compared to normal design.

According to Vincenti's definition, in normal design both the operational principle and normal configuration are kept the same as in previous designs. In radical design, the operational principle and/or normal configuration are unknown or a decision has been made not to use the conventional operational principle and/or normal configuration.

2.2 Regulative Framework

For most products, a system of regulations and formal rules exists that can be used to govern design decisions, including decisions on ethical issues like safety and sustainability. Van Gorp (2005) has introduced the term regulative framework for the system of norms and rules that applies to a class of technical

products with a specific function. A regulative framework consists of all relevant regulation, national and international legislation, technical standards and rules for controlling and certifying products.[2] A regulative framework is socially sanctioned, for example by a national or supra-national parliament such as the European parliament or by organizations that approve standards. Besides the technical standards and legislation, interpretations of legislation and technical standards also form part of the regulative framework. Interpretations of standards and legislation can be provided by the controlling and certifying organizations and by engineering societies for example, during the courses they organize for engineers on state of the art design practices. Informal rules and company-specific rules are not part of the regulative framework.

There are various EU directives for a broad range of products.[3] This includes for example the Directive Machinery 98/37/EC, which covers all machinery with moving parts. Another important directive is the Low Voltage Equipment Directive 73/23/EC, which covers all equipment with a voltage between 50 and 1000 DC and 75 and 1500 AC.

EU directives have to be implemented in national law within the EU. It is, therefore, to be expected that all EU countries will have national laws implementing the EU directives. All these directives refer to technical standards such as the EU codes.[4] If these standards, or national standards if the EU codes are not available yet, are followed in design processes, then compliance with the directive is assumed. The European Committee for Standardization (CEN) is responsible for formulating the standards. CEN has committees for formulating standards on subjects ranging from chemistry, to food, consumer products, construction, transport and packaging (www.cenorm.be).[5]

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[2] In Van de Poel and Van Gorp (2006) we use the concept 'normative framework' introduced by Grunwald (2000; 2001). The normative framework is different from the regulative framework because the normative framework has to meet certain normative criteria.

[3] The main goal of standardization in the EU is to ensure a free market and to remove technical barriers for trade within the EU (European Committee, 1999). Besides the goal of supporting a free market, standardization 'promotes safety, allows interoperability of products, systems and services, and promotes common technical understanding' (www.cenorm.be).

[4] In the US, the following terminological distinction is often made between codes and standards: codes are legal requirements that are enforced by a governmental body to protect safety, health and other relevant values; standards are not mandatory; they are usually regarded as recommendations (Hunter, 1997). EU codes are not legally enforced. If EU codes have been applied the design is assumed to comply with the relevant directive. In the mentioned US terminology, EU codes are therefore technical standards.

[5] A full description of the cases can be found in Van Gorp (2005).