quality and performance of a design solution. In fact, studies undertaken in the field of machine systems design and in particular power transmission have shown that standard components can provide between 50 and 80 per cent of the components in an assembly [3]. As global competition continues to rise, the utilization of standard components in machine systems is likely to increase, because of the many advantages previously discussed. The development of methods that deal with the incorporation of standard components during systems design is therefore an important area, which is overlooked by many researchers. The majority of current research deals with the selection of individual components in isolation [4-6], rather than considering the system and each of its elements as a whole. The incorporation of selection issues into a systems approach is necessary because of the highly coupled nature of mechanical components, which must be considered together with qualitative selection issues, in order to develop an optimum solution [7, 8].

1.1 Standard components and embodiment design

During the transformation of a concept to an embodied solution the designer must take decisions regarding the type and combination of mechanical elements that are necessary in order to perform the desired function of the system. The relative selection of these components and their corresponding sizes will determine the overall performance capabilities and physical characteristics of the system. These physical characteristics include measures such as spatial occupancy, reliability, working range capabilities, transmission stiffness and importantly cost, all of which determine the commercial success of the machine. As a consequence, the designer must consider all these aspects while embodying a solution and must select various component types, sizes and configurations to best achieve all the desired characteristics.

Pressures for reduced time to market do not leave room for time-consuming trial-and-error approaches. Today, experimentally validated computer modelling has become the preferred choice for rapidly carrying out the assessment of performance and the evaluation of design alternatives. The application of these modelling techniques are essential where standard components are to be considered. This is because of the large number of manufacturers and suppliers, each providing many different types of component which are available over a large number of discrete sizes. This makes for an exponential number of possible configurations for component types, sizes and combinations, which must be investigated by the designer in order to determine the best-performing solution.

For the purpose of this work a component type represents a specific range of mechanical elements from a particular manufacturer, while component sizes relate to the range of discrete element sizes available for a particular component type. In order to embody fully a conceptual schema the designer must iteratively select component types and/or sizes in order to fulfill the requirements for the design. In addition to fulfilling performance and physical requirements, the designer must also consider other aspects of the design such as preferred suppliers, recommended practices, reliability, component standardization, scalability and rationalization of designs within the company. These aspects are not meant to be exhaustive but merely to illustrate some of the other qualitative considerations that a designer must evaluate. The common approach of the designer, when embodying a concept, is to select a configuration of components and then to effect changes in individual component types and sizes, evaluating the system performance after each change. This is performed iteratively in order to achieve an optimum solution not just in terms of performance capabilities but also against aspects of the design previously described. Because of the inherently time-consuming nature of these tasks and the desire to reduce development time a designer may elect to disregard changing component type in preference of the pursuit of a single design solution. As a consequence an optimized solution may only be optimum for the specific configuration. In addition to this, the designer team may also attempt to reduce time and effort by undertaking this activity in cooperation with a particular supplier with whom they have a relationship, although understandable this may further reduce the likelihood of developing an optimum solution.

1.2 Computer-based support for selecting systems of standard components

A computer-based support tool to aid the embodiment of systems, however defined, needs to address a number of issues. In particular the ability to consider many alternatives within shortened activity times as well as the ability to evaluate achievable component configurations. To address these issues, provision for the identification of incompatible component types and the suggestion of alternative component types must be incorporated. In addition to this, the recognition of acceptable or unacceptable component combinations or chains is demanded, in order to reduce search space and search time. For example a novice designer may attempt to connect incompatible components together, while a more experienced designer may utilize chains of components that are compatible but not practised for reasons such as reliability, stiffness or cost. Therefore, designers need to know whether elements are compatible and whether the combination of elements that they have chosen are best-practised or acceptable alternatives. For the purpose of this work, the term ‘best practised’ may relate to either internal or corporate practices as well as