A taxonomy of design representations to support communication and understanding during new product development
ID Cards provide a **name**, **example** and **description** for the key design representations used by industrial/product designers during new product development (NPD). They are grouped into four categories: **sketches**, **drawings**, **models** and **prototypes**. Yellow tabs indicate the stage of NPD when the design representations are most commonly used (**concept design**, **design development**, **embodiment design** or **detail design**). Red and blue tabs show if the design representation is used mainly to communicate **design information** (red), **technical information** (blue) or both, with the specific type of information being indicated on the tab itself. All of the names and descriptions can be applied to design representations that have been produced using methods that are digital, non-digital or a combination of both.

**Credits**

Dr Mark Evans: PhD supervisor, ID Cards concept, graphic design
Dr Eujin Pei: PhD researcher, ID Cards concept, artwork
Dr Ian Campbell: PhD supervisor

**Card Layout**

- **Name of design representation**
- **Tabs for design information** (red) and **technical information** (blue)
- **Icon for design information**
- **Type of design information**
- **Icon for technical information**
- **Type of technical information**
- **Image of design representation**
- **Description of design representation**
- **Inactive tab in grey**
- **Active design stage in extended yellow tab**
- **Name of design stage**
- **Concept**
- **Development**
- **Embodiment**
- **Detail**
Background

ID Cards are one of the outcomes from a Loughborough Design School PhD undertaken by Dr Eujin Pei and supervised by Dr Mark Evans and Dr Ian Campbell. The aim of the research was to improve collaboration between industrial/product designers and engineering designers during NPD.


Research Methods

Literature review, action research, surveys and observations were used to collect data during the development of the ID Cards. A central feature of the research methodology was a high degree of global engagement with educators and practitioners, with support being received from leading universities, consultancies and manufacturers.

Results

Research findings indicated a need to facilitate greater understanding of the language and methods used by industrial/product designers and engineering designers. The key design representations employed during NPD were identified and surveys undertaken to establish when they were used and for what types of information. This generated large amounts of data that was converted into a playing card based tool for use by designers. ID Cards have translated and modified key elements of the 114 double-side cards into a more portable and accessible format to support the education and practice of designers at all levels.

Further details on the PhD can be accessed at http://hdl.handle.net/2134/5432

Loughborough Design School would like to thank its industrial/product design students for contributing the 32 images used on the ID Cards and the IDSA for its on-going support.

Concept Design

The most visually creative stage, employing techniques that facilitate speed and spontaneity.

Design Development

Involves a process of selection and refinement to ensure that proposals are capable of meeting the product specification.

Embodiment Design

Creates a fixed layout by selecting the most suitable configuration and evaluating this against technical and commercial criteria.

Detail Design

Defines the production item through the specification of details such as materials, dimensions and assembly. Supports final testing before manufacture.

Sketches

Preliminary, loose visual representations of design ideas that lack the detail of a more refined proposal.

Drawings

Formal representations to define design intent without ambiguity. More structured and controlled than sketches.

Models

Explore and define function, performance and appearance. Used to progress design development.

Prototypes

Communicate and verify the final design, facilitate customer evaluation and finalise performance/visual issues.
Areas of Concern
Features of the design that require investigation to help understand potential problem areas, particularly in terms of safety, use and manufacture.

Form
The exploration or specification of product appearance in terms of overall form, surfaces, proportion and scale.

Design Intent
How the components and features of a product combine to perform the required function.

Scenario of Use
Identifies how a product would be used in a projected sequence of events. May include relationships between the user, environment and other products.

Usability & Operation
How the product is used, including functional effectiveness, convenience and safety.

Visual Character
Supporting the generation of ideas with features that have reference to existing objects, products or living creatures.

Assembly
The systematic sequence of events required to bring components together to create the final product.

Components
Descriptions of the individual parts that combine to form the final product.

Dimensions
Specification through the use of a given unit of measurement, including angles and tolerances.

Materials
A specification for the metals, plastics, woods, textiles and other materials from which a product can be manufactured.

Construction
The detailed method for attaching individual components, including the use of adhesives, fasteners and fits.

Performance
Assembly of static or moving parts, including electro/mechanical systems, that demonstrate capacity to perform a function.
<table>
<thead>
<tr>
<th>Card</th>
<th>Description</th>
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</thead>
<tbody>
<tr>
<td>9</td>
<td><strong>Scenario &amp; Storyboard</strong>&lt;br&gt;Describes interaction between user and product, sometimes in an appropriate context.</td>
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<tr>
<td>10</td>
<td><strong>Layout Rendering</strong>&lt;br&gt;Defines the product proposal as a third angle orthographic projection with precise line and colour.</td>
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<tr>
<td>11</td>
<td><strong>Presentation Rendering</strong>&lt;br&gt;Contains a high level of realism to fully define product appearance as a perspective view. Particularly useful for decision making by non-designers.</td>
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<td>12</td>
<td><strong>Diagram</strong>&lt;br&gt;Schematic representation of the operating principle or relationship between components. Also known as a Schematic or Diagrammatic Drawing.</td>
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<tr>
<td>13</td>
<td><strong>Perspective Drawing</strong>&lt;br&gt;Descriptive three-quarter view produced using a perspective drawing technique. Created using line only without the application of colour or tone.</td>
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<tr>
<td>14</td>
<td><strong>General Arrangement Drawing</strong>&lt;br&gt;Exterior view of all components using line only and with sufficient detail to produce an Appearance Model if required. Usually drawn in third angle projection.</td>
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<tr>
<td>15</td>
<td><strong>Detail Drawing</strong>&lt;br&gt;Contains detail of components for the manufactured product. Also known as a Technical, Production or Construction Drawing.</td>
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<tr>
<td>16</td>
<td><strong>Technical Illustration</strong>&lt;br&gt;Communicates technical detail with a high degree of realism that is sometimes supported with symbols. Includes exploded views.</td>
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Models

17 Sketch Model
Informal, relatively low definition 3D model that captures the key characteristics of form. Also known as a Foam Model or 3D Sketch.

18 Design Development Model
Simple mock-up used to explore and visualise the relationships between components, cavities, interfaces and structures. Usually produced using card.

19 Functional Model
Captures the key functional features and underlying operating principles. Has limited or no association with the product’s final appearance.

20 Operational Model
Communicates how the product is used with the potential for ergonomic evaluation.

21 Appearance Model
Accurate physical representation of product appearance. Also known as a Block Model as it tends not to contain any working parts.

22 Assembly Model
Enables the evaluation and development of the methods and tools required to assemble product components.

23 Production Model
Used to evaluate and develop the location and fit of individual components and sub-assemblies.

24 Service Model
Supports the development and demonstration of how a product is serviced and maintained.