The Patent-Classification Technology/Function Matrix - A Systematic Method for Design Around

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The technology/function matrix is a type of patent map. A technology/function matrix can reveal through the implemented functions whether a particular technology faces a high level or low level of risk and the extent of patenting in different technologies. By analysing the technology/function matrix, one can identify substitute technologies to implement the main functions in avoiding patent infringement. However, a technology/function matrix is very difficult to create, because the patents need to be read, analysed and structured into the elements of technology/function matrix numbering over hundreds or thousands. In this research, the authors propose a method to create a technology/function matrix needed to execute a patent search without reading or analysing patents. Through the proposed method anyone can create a technology/function matrix in a short time without the help of an expert irrespective of the number of patents involved. The technology/function matrix can then be used to design around a particular technology easily, quickly and effectively.

Keywords: Design around, technology/function matrix, patent map, patent search, patent classification

Patenting designs and products has been the foremost mechanism among companies to prevent competitors from copying them.¹ Through patent rights, a company can claim a large amount of compensation or royalty from its competitors when such designs or products are copied or used. However, the downside is that patents with wide scopes get comprehensively protected and as a result the possibility of such patents being infringed becomes very high. Thus, even where competitors do not mean to copy another company’s design or product, they might end up infringing them. To avoid infringing patent rights, designing around competitors’ patents becomes a matter of concern to other companies that develop and sell similar products.²

The traditional methods of designing around are analogy and brainstorming, and the more recent are some systematic methods like Value Engineering (VE), TRIZ and patent map, especially the technology/function matrix. These methods are often used for patent design around solutions.

Value Engineering is a function oriented and systematic method for solving problems or reducing costs while improving performance and quality.³ The word ‘value’ is the ratio of function to cost, so VE is improving design, construction, and cost-effectiveness of product or service for increasing performance, reliability, quality, safety, durability, effectiveness, or other important features.⁴ Value Engineering through function analysis is a structured problem solving process to enhance product or service value for increasing customer satisfaction.⁵

TRIZ is a systematic innovation and problem solving method, which is based on analysis of millions of patents.⁶ TRIZ uses several powerful tools such as contradiction matrix, function analysis, and trimming to solve creative problems.⁷ The basic TRIZ problem solving process consists of four steps. First, the problem is identified; second, the specific problem is converted to a generic problem; third, a TRIZ tool like the contradiction matrix is used to find the generic solution; and finally, the generic solution converted to a specific solution for the specific problem.⁸

The contradiction matrix is a two dimension matrix built by putting 39 technical parameters in its columns and rows. Every matrix element is an engineering problem occurring due to the contradiction between one technical parameter in a column and another parameter in a row. Most of these matrix elements have at least one standard solution of

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40 inventive principles. Using the inventive principles one can solve any engineering problem.

Function analysis is through analysing all components and the interactions of a system to know the negative, ineffective and excessive interactions, in turn expressed as subject-action-object. Through function analysis the problem of a product or system can be identified and solved.

Trimming is a method which cuts down the components of a system or product but provides functions not less or more than before. In this method prior to trimming, all components of a product system and their interactions are drafted like in the case of function analysis. Then the harmful components including those that provide no useful function are cut off. The remaining components are used to provide the functions which were provided by the components that were cut down.

The technology/function matrix is a type of patent map. A patent map which is a graphical model of patent visualization, is built by collecting patent information from patent specification for a specific purpose or use; assembled, analysed and represented in a visual form such as a chart, graph, table or matrix. Patent maps help in selecting subjects for research and development, picking out new ideas for innovation, and gaining information of competitors’ technology development in order to devise a suitable strategy. Two major types of patent maps are the technology and management maps. The management map comprises statistics relating to assignee, country, application date, publication date, IPC (international patent classification), USPC (US patent classification), citation or other bibliographies of a patent.

Usually, the technology map is a matrix like assignee/IPC matrix, assignee/USPC matrix, technology/function matrix, etc. These technology maps help managers, R&D personnel and engineers to estimate the development of target technology or product. For example, a technology/function matrix shows the development phase of the technology implementing a function, and whether the technologies implementing those functions have opportunities or risks. Managers, R&D people and engineers can make decisions for development of technology or product base on the technology/function matrix.

The Fig. 1 depicts the ‘autologous cell renewal therapy technology’ technology/function matrix.
represented as a bubble graph. The ‘problems to be solved by the invention’ as the X axis is equivalent to ‘function’ and ‘means for solving the problems’ as the Y axis is equivalent to ‘technology’. The matrix shows that technological development is focus of functions like ‘improvement of capacity for regeneration’, ‘therapy improvement’, ‘improvement of differentiation, induction and control’ and ‘improvement of cell collection’, because the greater part of the patents can be attributed to the four functions (the bubble size directly corresponds to the quantity of patents).

The Table 1 is an example of technology/function matrix of nano-composite materials. Here, the technology (polymer) used to implement the function (mechanical dimensional stability) is in a more mature stage of development because there are more patents in this matrix element than others. It is very difficult to create a technology/function matrix. The first step in the traditional method of creating a technology/function matrix is deciding the search terms which are the technology or function terms of the subject. For example, if the subject is ‘nano-composite material’, the search terms could be ’nano’ and ‘composite’ appearing in the title or abstract. The second step is creating the technological category and functional category. For example, for nano-composite materials, the technological categories include polymer, clay, ceramic and metal, and the functional categories include: mechanical and dimensional stability, permeability, thermal stability, flame retardancy, chemical resistance, surface appearance, etc. But the second step usually needs the help of an expert. The last step is reading, analysing and categorizing the patents obtained by the search into the technology/function matrix using manpower. In this step, the patents are categorized into elements of the technology/function matrix; a step that always requires the help of an expert.

The limitation of VE or TRIZ is that they can only be used to design around for avoiding infringing a specific patent right, because both VE or TRIZ focus on a specific product, system or technology topic, and on solving a specific problems related to them. Hence even after designing around a patent using VE or TRIZ, it is still possible that one may infringe other patents. This happens because a product or design is protected by patent families with the specifications using hypernyms or hyponyms which make the patent scope or components different from the specific patent right that has been designed around.

The technology/function matrix contains an overview of technologies and functions, and its use will avoid infringing family patents and patents written using hypernym or hyponym. But the traditional method of creating a technology/function matrix has a big problem – it is an enormous task to read, analyse and categorize patents into the technology/function matrix, especially when the patents are number more than thousands. This happens to be one of the main reasons why a technology/function matrix is difficult to create. Another problem of traditional method is that it is difficult to build the technological category and functional category without expert help, needless to say reading, analysing and categorizing more than thousands of patents into a technology/function matrix.

As the Table 2 shows, TRIZ is more advantageous in terms of creating and analysis compared to VE. The technology/function matrix, on the other hand is at a disadvantage in creating, but has two very important advantages; one is avoiding more than one patent infringement risk and the other is the design around technology is precise and clear. Inspite of its advantages, the technology/function matrix is rarely used due to its difficulty of creation. A method of creating a technology/function matrix that is much easier than the traditional methods is very much required.

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<tr>
<th>Table 1 — The technology/function matrix of ‘nano-composite material’</th>
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<tr>
<td><strong>Function</strong></td>
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<td>Thermal stability</td>
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<tr>
<td>Flame retardancy</td>
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<td>Chemical resistance</td>
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<tr>
<td>Surface appearance</td>
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<tr>
<td>Electric conductivity</td>
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<tr>
<td>Optical and light emitting property</td>
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<td>Cement/adhesiveness</td>
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<tr>
<td>Magnetic property</td>
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<tr>
<td>Other</td>
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<td><strong>Total</strong></td>
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Proposed Method

In this research, the authors propose a new method to create a technology/function matrix without help of an expert or a person having ordinary skill in the art. It means that everyone can create the technology and function categories, and categorize patents into the technology/function matrix without an expert’s help. One just needs to execute a patent search in order to collect appropriate patents, gather statistics relating to the patents’ IPC and USPC, and then fill in elements of the technology/function matrix with the result of second patent search.

Prior to creation of the technology/function matrix by the proposed method, the topic or subject needs to be identified. The first step of the proposed method is patent search. The purpose of the patent search is to distinguish the patents related to the subject, and gather statistics of these patents to build the technological and functional categories. Therefore, in this step, keywords related to the topic or subject, are established and a patent search strategy set up. The second step is to collect the IPC and USPC data from the patents isolated in first step. The purpose of the IPC and USPC statistics is to know the technologies and functions often used in the subject area. The third step is to build the technology and function categories. In this step, the technologies and functions which are related to the subject are selected using IPC and USPC data. The last step is to create the technology/function matrix of the subject area using the selected IPC and USPC as the X axis and Y axis of the technology/function matrix, and then organizing the located patents into the technology/function matrix. The detailed steps of the proposed method and the process flow are depicted in Fig. 2.

IPC is a kind of patent classification formulated by World Intellectual Property Organization (WIPO) and is based on the different areas of technology under which the inventions in the patents fall. IPC divides technology into eight sections with more than 70,000 subdivisions. IPC consists of section, class, subclass, main group and subgroup, where the sections are the highest level of hierarchy and the subgroups provide a detailed description of technology of IPC.

USPC is another patent classification formulated by the United States Patent and Trademark Office (USPTO). It is based on the function, effect, end-product, structure or use of a patent. There are about 450 classes of patent and about 150,000 subclasses of patent in the USPC. Classes and subclasses have titles which provide a short description of the class or subclass and definitions which provide a more detailed explanation.

Step 1: Patent Search

A different patent search strategy needs to be worked out for different purposes. For the purpose of study, research, industrial analysis or design around, a loose patent search strategy is used so as to collect a large number of patents. To design around patents, the following things need to be known: firstly, what are the technologies often used in the subject area; secondly, are there any technologies that have the same or similar function as the technologies to be designed.
around and thirdly, what are the functions that match the requirement and can be used instead of the original function. For example, in the case of nano-composite material, the patent search strategy consisted of just the keywords ‘nano’ and ‘composite’ appearing in the title or abstract, and resulted in 824 patent matches. In another instance, ‘touch panel’, the patent search strategy included the terms ‘touch panel’ or ‘touch screen’ in title, abstract or claim of issued and published patents. A total of 19,780 patents were obtained (the search date was 31 May 2012 and the search engine used was ‘Free Patents Online’). This example of touch panel shall be used further to describe the proposed method.

Step 2: IPC and USPC Statistics

There are at least one IPC code and USPC code allotted to every US patent. This also means that there may be many more number of codes than the number of located patents themselves.

The Table 3 shows the USPC codes that account for 90 per cent of the codes that appear in patents for ‘touch panel.’ The UPC code 345/173 is the most commonly used code (26.77 per cent), and thus qualifies as the main and important function of the subject ‘touch panel’.

From the Table 4, it is evident that the IPC code G06F3/041 is the most commonly occurring code in patents related to the subject area ‘touch panel’.

Step 3: Building Technological and Functional Categories

The next step is to build the technological and functional categories. While the traditional method requires the help of experts to create the technology and function categories, the proposed method can be used without help of experts, R&D people or persons.

### Table 3 — The major USPC codes for ‘touch panel’

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skilled in the art. The proposed method uses USPC and IPC as the function and technology categories. This is based on the definitions of IPC and USPC, wherefrom it is evident that the classification of IPC is based on technology categories of the patents, while the USPC is based on functions characteristics of inventions. For ‘touch panel’, the main or important technologies and functions are selected from Table 3 and Table 4.

As the Tables 5 and 6 show, the top 20 IPC and USPC codes are selected in the technological and functional categories and sorted. Since mere codes cannot be understood generally, descriptions need to be provided to the codes. Descriptions to codes exist, although they may be lengthy since these codes are hierarchical. These are appropriately condensed or recombined to come up with the right descriptions.

**Step 4: Creating Technology/Function Matrix**

As can be seen from the Table 7, an N x N matrix was generated by placing the technological category (IPC) in the first column and functional catagories in the first row. The matrix indicates the interaction between the two categories, with higher values indicating a stronger interaction.

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<tr>
<td>11</td>
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<td>1.77</td>
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<td>12</td>
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<td>473</td>
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<td>45</td>
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<td>143</td>
<td>0.53</td>
</tr>
<tr>
<td>13</td>
<td>G06F19/00</td>
<td>440</td>
<td>1.64</td>
<td>46</td>
<td>G06F7/00</td>
<td>137</td>
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</tr>
<tr>
<td>14</td>
<td>G07F17/32</td>
<td>425</td>
<td>1.59</td>
<td>47</td>
<td>G09F9/00</td>
<td>134</td>
<td>0.50</td>
</tr>
<tr>
<td>15</td>
<td>H04M1/00</td>
<td>425</td>
<td>1.59</td>
<td>48</td>
<td>G06F15/00</td>
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<td>0.49</td>
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<td>G06F17/30</td>
<td>368</td>
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<td>H04N5/44</td>
<td>132</td>
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<td>G06F3/02</td>
<td>365</td>
<td>1.31</td>
<td>50</td>
<td>G03G15/00</td>
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<td>18</td>
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<td>1.30</td>
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<td>G06K15/00</td>
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<td>0.46</td>
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<tr>
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<td>1.29</td>
<td>52</td>
<td>G06K7/10</td>
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<td>G06F3/044</td>
<td>339</td>
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<td>G06F15/16</td>
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<tr>
<td>22</td>
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<td>H04N5/222</td>
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<td>23</td>
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<tr>
<td>25</td>
<td>G06Q20/00</td>
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<td>G06F3/14</td>
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<td>115</td>
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<tr>
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<td>0.74</td>
<td>62</td>
<td>G09G5/08</td>
<td>101</td>
<td>0.38</td>
</tr>
<tr>
<td>30</td>
<td>G02F1/1333</td>
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<td>0.73</td>
<td>63</td>
<td>H04W8/02</td>
<td>101</td>
<td>0.38</td>
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<tr>
<td>31</td>
<td>H04M1/725</td>
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<td>0.73</td>
<td>64</td>
<td>G06F3/038</td>
<td>100</td>
<td>0.37</td>
</tr>
<tr>
<td>32</td>
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<td>195</td>
<td>0.73</td>
<td>65</td>
<td>G07G1/00</td>
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<td>0.36</td>
</tr>
<tr>
<td>33</td>
<td>H04N7/18</td>
<td>185</td>
<td>0.69</td>
<td>Total</td>
<td>24841</td>
<td>90.16</td>
<td></td>
</tr>
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</table>

**Table 5 — Selected functional categories**

<table>
<thead>
<tr>
<th>USPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>345/173</td>
<td>Touch panel</td>
</tr>
<tr>
<td>345/174</td>
<td>Touch panel including impedance detection</td>
</tr>
<tr>
<td>345/175</td>
<td>Touch panel including optical detection</td>
</tr>
<tr>
<td>345/177</td>
<td>Touch panel including surface acoustic detection</td>
</tr>
</tbody>
</table>

**Table 6 — Selected technological categories**

<table>
<thead>
<tr>
<th>IPC</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>G06F17/00</td>
<td>Digital computing or data processing equipment or methods, specially adapted for specific functions</td>
</tr>
<tr>
<td>G06F17/30</td>
<td>Information retrieval, database structures</td>
</tr>
<tr>
<td>G06F3/00</td>
<td>Input arrangements for transferring data to be processed into a form capable of being handled by the computer; output arrangements for transferring data from processing unit to output unit</td>
</tr>
<tr>
<td>G06F3/01</td>
<td>Input arrangements or combined input and output arrangements for interaction between user and computer</td>
</tr>
<tr>
<td>G06F3/02</td>
<td>Input arrangements using manually operated switches</td>
</tr>
<tr>
<td>G06F3/033</td>
<td>Pointing devices displaced or positioned by the user</td>
</tr>
<tr>
<td>G06F3/041</td>
<td>Digitizers</td>
</tr>
<tr>
<td>G06F3/042</td>
<td>By opto-electronic means</td>
</tr>
<tr>
<td>G06F3/044</td>
<td>By capacitive means</td>
</tr>
<tr>
<td>G06F3/045</td>
<td>Using resistive elements</td>
</tr>
<tr>
<td>G06F3/048</td>
<td>Interaction techniques for graphical user interfaces</td>
</tr>
</tbody>
</table>
category (USPC) in the first row. The matrix elements of second column such as IPC1N, IPC2N,… up to IPCnN are the number of patents relating to technology IPC1, IPC2,…, IPCn, and the matrix elements of second row like USPC1N, USPC2N, … up to USPCnN are the number of patents relating to function USPC1, USPC2,…, USPCn. The matrix elements such as [IPC1 & USPC1], [IPC1 & USPC2], …, [IPCn & USPCn] are the number of patents relating to both technology IPCn and function USPCn.

In the proposed method, the values of IPCnN, USPCnN and IPCn & USPCn can be obtained by patent search. The patent search strategies for ‘IPCnN’, ‘USPCnN’ and ‘IPCn & USPCnN’ matrix elements for the subject area ‘touch panel’ are described in below:

**The Patent Search Strategy for IPCnN Matrix Elements**

As can be seen from Fig. 3, IPC1, IPC2,… and IPCn are the subsets of the patent pool with all of the patents belonging to the patent pool having the technology IPCn code.

The patents in this patent pool of ‘touch panel’) are searched using the terms ‘touch panel’ or ‘touch screen’ in the title or abstract or claim of patents. The strategy used for the search of IPCnN matrix elements is as follows:

\[
\text{TTL}/(\text{"touch panel" or "touch screen"}) \text{ or ABST}/(\text{"touch panel" or "touch screen"}) \text{ or ACLM}/(\text{"touch panel" or "touch screen"}) \text{ and } \text{ICL/IPCn}
\]

(wherein TTL-title, ABST-abstract, ACLM-claim(s) and ICL-international classification)

For example, the search strategy could be “(TTL/(“touch panel” or “touch screen”) or ABST/(“touch panel” or “touch screen”) or ACLM/(“touch panel” or “touch screen”)) and ICL/G06F17/00”.

**The Patent Search Strategy for USPCnN Matrix Elements**

Similar to the technology patent pool, USPC1, USPC2… and USPCn are the subsets of the patent pool with all of the patents belonging to the patent pool having the function USPCn code (Fig. 4).

So also, the patent search strategy using the function USPC code follows a strategy similar to the technology IPC code as above. Thus, the patent search strategy of USPCnN matrix elements is:

\[
\text{TTL}/(\text{"touch panel" or "touch screen"}) \text{ or ABST/} (\text{"touch panel" or "touch screen"}) \text{ or ACLM/("touch panel" or "touch screen"}) \text{ and } \text{CCL/USPCn}
\]

For instance, it could be “(TTL/(“touch panel” or “touch screen”) or ABST/(“touch panel” or “touch screen”) or ACLM/(“touch panel” or “touch screen”)) and CCL/345/173”.

<table>
<thead>
<tr>
<th>Technology</th>
<th>Function</th>
<th>USPC1</th>
<th>USPC2</th>
<th>…</th>
<th>USPCn</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPC1</td>
<td>IPC1N</td>
<td>IPC1 &amp; USPC1</td>
<td>IPC1 &amp; USPC2</td>
<td>…</td>
<td>IPC1 &amp; USPCn</td>
</tr>
<tr>
<td>IPC2</td>
<td>IPC2N</td>
<td>IPC2 &amp; USPC1</td>
<td>IPC2 &amp; USPC2</td>
<td>…</td>
<td>IPC2 &amp; USPCn</td>
</tr>
<tr>
<td>…</td>
<td>…</td>
<td>IPC3 &amp; USPC1</td>
<td>IPC3 &amp; USPC2</td>
<td>…</td>
<td>IPC3 &amp; USPCn</td>
</tr>
<tr>
<td>IPCn</td>
<td>IPCnN</td>
<td>IPCn &amp; USPC1</td>
<td>IPCn &amp; USPC2</td>
<td>…</td>
<td>IPCn &amp; USPCn</td>
</tr>
</tbody>
</table>

**Table 7 — The technology/function matrix**

**Fig. 3 — The technology IPCn subsets in the patent pool**

**Fig. 4 — The function USPCn subsets in the patent pool**
The Patent Search Strategy for IPCn & USPCn Matrix Elements

The patent pool has technology subsets of IPC1, IPC2... and IPCn and function subsets of USPC1, USPC2... and USPCn as depicted in Fig. 5. The black blocks are the patents belonging to the IPCn and USPCn subsets of the patent pool when the patent in the patent pool has both the technology IPCn and function USPCn codes.

It is understood that the IPCn & USPCn matrix elements result from the interaction between IPCn and USPCn in the patent pool, the patent search strategy for the IPCn & USPCn matrix element would thus be:

\[
\text{TTL/('touch panel' or 'touch screen') or ABST/('touch panel' or 'touch screen') or ACLM/('touch panel' or 'touch screen')) and ICL/IPCn and CCL/USPCn}
\]

The patent search strategy of ‘IPC1 & USPC1’ matrix elements resulted in 44 patents, meaning thereby that there are 44 patents that contain the technology ‘digital computing or data processing equipment or methods, specially adapted for specific functions’ (G06F17/00) along with the function ‘touch panel’ (345/173).

Design Around Analysis

The existence of ‘IPCn & USPCn’ matrix elements means that there are N patents comprising both the IPCn technology (IPC code) and the USPCn function (USPC code). In other words, the ‘IPCn & USPCn’ matrix elements imply that there are N patents which use the IPCn technology to implement the USPCn function. Thus, it can be reasonably deduced that the IPCn technology is related to the USPCn function, irrespective of whether the relation is direct or indirect. For example, according to the Table 8, it is seen that there are 3,579 patents which possibly use the ‘digitizer’ (IPC code G06F3/041) technology to implement the ‘touch panel’ (USPC code 345/173) function.

However, the existence of zero IPCn & USPCn matrix elements can have several meanings; like for instance, ‘G06F17/00 & 345/175’ and ‘G06F17/30 & 345/174’ matrix elements as seen in Table 8. One is that it is impossible to use the IPCn technology for implementing the USPCn function. Secondly, no one probably thought of using the IPCn technology to implement the USPCn function before inspite of it being possible. Thirdly, it is very difficult to use the IPCn technology to implement the USPCn function, so no patent has attempted it. Therefore, there is a need to analyse further the reasons for the non-existence of certain ‘IPCn & USPCn’ matrix elements.

From Table 8, it can also be seen that the G06F3/041 and G06F3/033 technologies are the two main technologies used for implementing the main functions, namely, USPC codes- 345/173, 345/174, 345/175 and 345/177 for ‘touch panel’. This also means that using G06F3/041 and G06F3/033 technologies to implement the 345/173, 345/174, 345/175 and 345/177 functions involves a higher risk of infringement. One can therefore infer that the G06F3/041 and G06F3/033 technologies are the technology targets that need to be designed around.

What technologies are good choices to be used for the designing around main technologies in a subject? The answer to this are the ‘IPCn & USPCn’ matrix elements which have a low value meaning that there

Table 8 — The technology/function matrix of for ‘touch panel’

<table>
<thead>
<tr>
<th>Touch Panel</th>
<th>Function 345/173</th>
<th>345/174</th>
<th>345/175</th>
<th>345/177</th>
</tr>
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<tbody>
<tr>
<td>G06F17/00</td>
<td>662</td>
<td>44</td>
<td>2</td>
<td>0</td>
</tr>
<tr>
<td>G06F17/30</td>
<td>368</td>
<td>33</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>G06F3/00</td>
<td>541</td>
<td>96</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>G06F3/01</td>
<td>349</td>
<td>107</td>
<td>8</td>
<td>4</td>
</tr>
<tr>
<td>G06F3/02</td>
<td>365</td>
<td>111</td>
<td>15</td>
<td>5</td>
</tr>
<tr>
<td>G06F3/033</td>
<td>2019</td>
<td>976</td>
<td>152</td>
<td>106</td>
</tr>
<tr>
<td>G06F3/041</td>
<td>4407</td>
<td>3579</td>
<td>382</td>
<td>188</td>
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<tr>
<td>G06F3/042</td>
<td>507</td>
<td>126</td>
<td>19</td>
<td>348</td>
</tr>
<tr>
<td>G06F3/044</td>
<td>339</td>
<td>123</td>
<td>225</td>
<td>9</td>
</tr>
<tr>
<td>G06F3/045</td>
<td>995</td>
<td>347</td>
<td>662</td>
<td>15</td>
</tr>
<tr>
<td>G06F3/048</td>
<td>1915</td>
<td>687</td>
<td>46</td>
<td>28</td>
</tr>
</tbody>
</table>
are less number of patents using that particular technology to implement the particular function. The reason of choosing the IPCn technologies of the ‘IPCn & USPCn’ matrix elements which have less number of patents is the lower patent infringement risk than the matrix elements that have large number of patents. But the IPCn technologies of the ‘IPCn & USPCn’ matrix elements containing no patents are not good choices unless it is certain that the IPCn technology can be used to implement the USPCn functions.


**Design Around via the Proposed Method**

How the proposed method can be used to design around a patent is explained through an illustration. Consider a critical patent in the ‘touch panel’ subject like the US Pat No 7479949 (‘949 patent’) that is to be designed around. The ‘949 patent uses two technologies, namely, G09G5/00 and G06F3/048, for the functions 345/173, 345/169, 715/786, 715/784, 345/156, 345/157, 345/173-181. The main function of the ‘949 patent is touch panel (345/173), and the main technologies used are ‘control arrangements or circuits for visual indicators common to cathode-ray tube indicators and other visual indicators’ and ‘interaction techniques for graphical user interfaces’. According to Table 8, the number of patents utilizing the G06F3/00, G06F3/01, G06F3/02, G06F3/042, G06F3/044 and G06F3/045 technologies to implement the function 345/173 are less and also these technologies are similar to the main technology G06F3/048 of the ‘949 patent. Further, it is observed that the technology G06F3/00 has been used in less number of patents than others. However, an IPC description check shows that technology G06F3/00 is the upper layer technology of G06F3/048 (in terms of hierarchy), whereas the technology G06F3/02 is a same level technology compared to G06F3/048. Therefore, the technology ‘input arrangements using manually operated switches’ (G06F3/02) can be used in place of ‘interaction techniques for graphical user interfaces’ (G06F3/048) to implement the function ‘touch panel’ (345/173).

On the other hand, when the purpose is technological research and development, it is necessary to understand which are the technologies to implement the functions; those with less number of patents to avoid the risk of patent infringement. Take ‘touch panel’ for example. According to the Table 8, the touch panel (345/173) implemented by ‘arrangements for converting the position or the displacement of a member into a coded form by digitisers’ (G06F3/041) has the highest risk. Therefore, other technologies like G06F3/01, G06F3/02, G06F3/042 or G06F3/044 should be used to design around the technology G06F3/041, because these technologies are similar to G06F3/041. For the same reason, one can use the technologies G06F3/01, G06F3/02, G06F3/033, G06F3/042, G06F3/044 and G06F3/048 to design around the technology G06F3/045. If one considers the functions 345/173, 345/174, 345/175 and 345/177, for instance, it is good to use the technologies G06F3/01, G06F3/02 or G06F3/044 to design around the technology G06F3/041.

**Conclusion**

The technology/function matrix is a powerful and useful tool for design around patents. But most people or companies do not want to create it, because creating a technology/function matrix using the traditional method is time-consuming, labour-intensive, expensive and requires the help of an expert.

There are several advantages in the proposed method including easy constitution of a patent search strategy for every technology and function field along with creation of the technology/function matrix by the patent search. Accordingly, the first advantage of the proposed method is that one can organize patents into the technology/function matrix by patent search without the help of experts or person with ordinary skill in the art to analyse patents. The second advantage of the proposed method is that it is labour-saving, because this can be done by a few people. The most important advantages of the proposed method are low time consumption and low cost. The traditional method needs much more manpower and experts to analyse patents, and more the number of patent, the longer the traditional method takes. It may actually take several months. But the proposed method just needs very little time to create the technology/function matrix even if the patent pool has thousands of patents.
While the proposed method has several advantages, it still has two main limitations. One is that, it is based on the patent classification USPC, a classification that only US patents have. It can therefore be used only for creating the technology/function matrix for US patents. The patents or applications in the WIPO (World Intellectual Property Organization), EPO (European Patent Office), China, Japan or Korea which have abundant patents worthy of analysis to design around, cannot be investigated by this method.

The other main limitation is that although the IPC or USPC codes are categorized in great details, they have official definition with detailed descriptions, which may not match the actual requirement.

To obtain and examine information from different patent databases and build the technological and functional categories to match the actual requirement for design around, future research can develop methods which can create technology/function matrix irrespective of the patent database used.

References
2 Gaff Brian M, Murphy Brian P, and Cuomo Peter J, Defending against patent infringement, http://www.edwardswildman.com/files/News/e967ba05-b48e-4d03-9f7b-