

Patent Search Tools for Competitive Intelligence for Product Design and Development of CBRN Decon Device

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ABSTRACT

Product design and development needs a lot of relevant and background information at the initial stage itself and literature review is one of the initial and important process in the new product design (NPD) process. In NPD, patent analysis is an important part of literature review, since the patent documents represent a huge reservoir of most systematic and updated information about any particular technology and product. A systematic search on a trusted global patent database with proper analytical tools could be used as powerful R&D tool to not only identify the state-of-art but also to extract leads to solution for critical R&D problems. Therefore, a focused search on professional patent database was performed to extract most relevant patent documents for R&D work related to the chemical, biological, radiological and nuclear (CBRN) decontamination device. Semantic keyword search and IPC based search followed by a thorough screening and analysis of the searched documents resulted in useful patent documents. These patent documents disclosed various aspects related to CBRN decontamination device which helped in the design & development of a novel CBRN Decon device.

Keywords: Product design, patent patent map, visualisation, decontamination, CBRN

1. INTRODUCTION

Product design and development: Product development process is described as 'the sequence of steps or activities that an enterprise employs to conceive, design, and commercialises a product'.¹ The design process helps to make sure not to overlook any of important aspects, set the unbiased solutions and enhance the team creativity. A product development process is viewed as a transformation or a translation of a market opportunity into a physical artifact available for sale.²

In the new product development (NPD), the designer has to study the existing related data which can be gathered through various means. One of the means is prior art, i.e., related existing patents. This prior art study can give a lot of information pertaining to the products like commercial potential, technical difficulties, type of novelty, i.e., radical or incremental innovation and its national or international status. It also helps in taking a well-informed decision to whether to design and develop the product/technology or not. This paper discusses in detail the use of patent search tools, techniques and methods in the process of new product design and development.

Published patent documents represent a huge reservoir of most systematic and updated information about any particular product or technology. Patent documents have lot of information in a very systematic manner. A systematic search on a trusted global patent database with proper

analytical tools could be used as a powerful R&D tool to not only identify the state-of-art but also to extract business critical insights.³ The first page of each patent document provides information about its inventors, assignees, examiners, prior art documents, its technical classifications as per Cooperative Patent Classification (CPC) or International Patent Classification (IPC). The more advantageous aspect of a patent document is that all this information is searchable not only through paid databases but also through freely available patent databases.

Further, the technical description in each patent is also organised and presented under several subtitles and all of these subtitles of a patent are searchable. There are millions of patent documents publicly available and each of such patent document bears loads of information on most recent technologies. However, searching information from patent documents in itself is a highly skilled job requiring experience, perception and thorough knowledge of databases and search tools. Appropriate use of keywords, classification codes and use of logic gate operators affect the search results. Researchers are not only working on development of searchable databases but also on advanced systems for searching these databases.^{4,5} Like Nidhi, *et al.* have used patent documents to solve a practical R&D problem, wherein, scientists had imposed the problem of developing a drug delivery device for releasing the vapours of drug. A systematic search was performed to extract most relevant patent documents using various patent

analytical tools.⁶ In another study by Nidhi et al., patent information has been used to find out the appropriate collaborators based on their patent portfolios.⁷ Shih, *et al.* have used patent data for competitive intelligence in the area of semiconductor industry in Taiwan. They studied patent trends to understand the R&D activities of a company, the R&D activities of the industry, company activities in the industry and industry activities working in the area of semiconductors.⁸ Also patent information has also been used to identify new business areas, insight into the technology sector, competitors, niche areas, etc. Abbas^{9,10}, *et al.*, have addressed how patent information can be used for competitor monitoring, technology assessment, R&D portfolio management, the identification and assessment of potential sources for the external generation of technological knowledge, especially by means of mergers and acquisitions, and human resource management.¹¹

In the present study, scientists were working for the development of an automated external monitoring and decontamination system for subjects exposed to chemical, biological, radiological and nuclear (CBRN) contamination. Their primary requirement was to understand the state of the art documents which address the problems that may come during the development of such system along with the probable solutions. Patent documents are the best source for this kind of information as patent document, generally, provides a solution to a particular technical problem. Thus, the authors used patent information for two purposes: a) to understand the overall technology trend for such systems which included key areas of research, filing trend over the years, top industry/inventors working in this area etc and b) to identify patent documents addressing different aspects of CBRN Decontamination Device/System so as to provide relevant information to the scientists for their further research work. Patent documents focused on the design aspect of the CBRN Decontamination device were searched and discussed with the scientists.

Initially, CBRN Decontamination Device/System was discussed in detail with the scientists to identify its key features. The system had advantages like higher portability, ease to use and quick to assemble at the required locations for the batch or mass decontamination management before medical treatment. A preliminary prior art search was conducted with the help of freely available databases. This resulted in prior art documents that provided details about various types of decontamination equipment/devices available globally, as shown in table 1. The preliminary search helped in better understanding the many facets of the R&D problem itself.

2. GLOBAL PATENT INDEX SEARCHING TOOLS

Subsequently, a more focused prior art search was conducted on a specialised database, i.e., Global Patent Index (GPI). Global Patent Index is an advanced online tool for searching the European Patent Office (EPO's)

Table 1. Detail about various types of decontamination equipment/devices available globally

Patent	Brief Disclosure
EP2029838	Mobile mass decontamination unit for use in nuclear, radiological, biological or chemical (NRBC) accidents for evacuating categorising and decontaminating victims.
WO2012/134960	Mobile unit for responding to radiological emergency situations that employs automatic whole body personnel contamination monitors for alpha and/or beta emitting contaminants.
US6446277	A high capacity chemical and/or radiological decontamination system comprising showering the contaminated persons individually with a regeneratable active product for a predetermined period ranging between 5 and 20 seconds, continuously collecting the used shower liquid and regenerating the collected liquid to store its active capacity with a view to recycling
US 7203979	An apparatus for decontaminating persons and objects, and securing and limiting access to specific areas.
US 20030037812	A personnel decontamination system. The system includes a plurality of components for establishment of a multi-station decontamination facility to decontaminate personnel and to collect the contaminants during decontamination process.

worldwide bibliographic data collection catering more than 80 million patents from the EPO's worldwide patent data collection (over 90 patent granting authorities).¹² GPI searches are concentrated on the Bibliographic data and abstracts of the patent documents and the keyword or the classification or any other search is done in the first page of a patent document. GPI is updated regularly and searching is fast, precise, simple, and can be customised as per the requirement. GPI has the capability to search even long and complex queries.

3. METHODOLOGY

3.1 Method of Patent Search

The first step was to make a list of keywords and find out the best fit classifications for the problem to retrieve best possible results. The keyword selection is a very important part of search as it must include not only the narrower terms but also the broadest possible terms. In the present case, the technical field was automated external contamination monitoring and decontamination system. Further, the followings could be enumerated as characterising features of this system:

- i. It is to be used for chemical, biological, radiological, and nuclear contamination
- ii. It is a portable system
- iii. It can decontaminate group of people

- iv. It requires minimal time for scanning and decontaminating the contaminated human, and
- v. It ensures safe collection & handling of the effluents with customised storage effluent bag.

Based on these key features of the decontamination system, the keywords were identified and their synonyms including the specific and generic words were captured. The web of these keywords is shown in Table 2. Another aspect of searching includes the use of classification based searching. The patent offices worldwide use the International Patent Classification (IPC). There are approximately 70,000 different IPC codes for different technical areas. Each patent, depending upon the technical field/fields that it covers, is assigned an international patent classification. The IPC class of each patent is an important part of the bibliographic data, which is also the searchable field in patent databases. In case of complex systems, more than one IPC class may be assigned to a single patent. Similarly, searching patent databases for any system or technical field require the combinations of the IPC class. The IPC class of a system may be determined online.¹³

appropriate algorithms. Appropriate combinations of the keywords and the classification are very important as the search results will be dependent upon the same. However, to begin the search, it is desirable to use more generic keywords so as to cover maximum possible relevant patent documents. In the present case, patent search was initially carried out with the keywords *viz.* mobile, decontamination, chemical, biological, and nuclear. Additionally, even single keyword or a phrase as such may be used to get prior art documents related to the system. As such, the search was carried out with the following word/phrase:

1. Mobile Decontamination System
2. Removal of Chemical
3. Removal of Biological
4. Removal of Nuclear
5. Chemical Biological Nuclear
6. Decontaminate Human/Subject
7. Contaminate Human
8. Radiation Exposure Decontamination

Table 2. Semantic keywords for the present technical problem

Mobile	Decontamination	Chemical	Biological	Nuclear	Human	Radiation
Transportable	Contamination	Compound	Bacteria	Radio	Subject	Emission
Portable	Cleansing	Element	Bacterial	Radiation	Personal	Ray
Stationary	Purification	substance	Virus	Beam	Individual	Atomic
Shifting	Dressing	Metal	Viral	Emission	Animal	Explosion
Removable	Shower	Heavy metal	Disease	Heavy material	Mammals	High energy
Folding	Bathing	Material	Natural	Transmission	Being	Waves
Aircraft ambulance	Surgical		Live-forms	Radionuclide	Creature	Nuclear waves
Movable	Sanitisation		Genetic	Radioactive	Human-being	
Itinerant	Poisoning		Mutated	Uranium	Someone	
Fixed	Detoxification		Organism	Fission products	Living being	
Roaming			Micro-organism		Man	
Travelling					Woman	

Apart from IPC classification, other classifications developed and managed by national patent offices also exist. Cooperative Patent Classification (CPC) is an extension of the IPC and has been jointly developed by the European Patent Office and the US Patent and Trademark Office. CPC includes an additional section Y related to general tagging of new technological developments, which is also sub-divided into classes, sub-classes, groups and sub-groups. USPTO has US patent classification termed as current US Classification. For the present case, patent search based on IPC classification was conducted after identifying the relevant classes for the decontamination systems. Search was carried out alone as well as in combination with the keywords. Table 3 provides the details of the IPC classification.

Once the keywords and the classifications were identified, the search was carried out on GPI after making

The search with above keywords resulted into more than 50,000 patent documents. This was followed by the narrower keywords in combination with the IPC classification codes. Table 4 enlists the results with respect to each algorithm. The search results having less than 500 hits were analysed. A cursory analysis of these results indicated that the searched algorithms need to be refined further and a better set of patent documents using more appropriate keyword should be searched. Keeping in view the hints captured from the already done searches, many combinations were made and searched. The serial number 1-4 of the table 4 yielded most appropriate search results, as patent documents in these sets were found to be most relevant. Further analysis of these sets was carried out to deduce useful information about the mobile decontamination system.

Table 3. Definitions of relevant IPC classes

S. No.	Classification	Description
1.	A47K 3/28	Showers
2.	B08B	Cleaning In General; Prevention Of Fouling In General
3.	B60P3005	Vehicles adapted to transport, to carry or to comprise special loads or objects
4.	G21F9	Treating radioactively contaminated material; Decontamination arrangements
5.	E04H2	Buildings or like structures for particular purposes; swimming or splash baths or pools; masts; fencing; tents or canopies
6.	G01T1	Measuring X-radiation, gamma radiation, corpuscular radiation, or cosmic radiation (G01T 3/00, G01T 5/00 take precedence)
7.	A47K3	Baths: Showers; Appurtenances therefore
8.	A47K7	Body washing or cleaning implements
9.	B60P3/005	for use in contaminated areas, e.g. N.B.C. intervention vehicles
10.	B60P3	Vehicles adapted to transport, to carry or to comprise special loads or objects
11.	G01	Instruments, Measuring; Testing
12.	G21F	Protection against x-radiation, gamma radiation, corpuscular radiation or particle bombardment; treating radioactively contaminated material; decontamination arrangements therefore
13.	C23G	Cleaning or de-greasing of metallic material by chemical methods other than electrolysis
14.	G06	Computing; calculating; counting
15.	G01N	Investigating or analysing materials by determining their chemical or physical properties
16.	B60H	Arrangements or adaptations of heating, cooling, ventilating, or other air-treating devices specially for passenger or goods spaces of vehicles

4. RESULTS & DISCUSSIONS

4.1 Patent Data Analysis

Subsequent to the search, many methodologies are employed to draw a meaning of the search result. These methodologies have been developed to recognise those progresses of technologies, and one of them is to analyse patent information. Visualisation methods are considered to be proper for representing patent information and its analysis results.¹⁴ Statistical analysis of the relevant patent dataset provides visualisation of the results using patent maps. Different patent maps help in understanding the various aspects about the searched system/technology like top patent assignees, top inventors, time based analysis provides the trends of information. In general, Statistical

Table 4. Search algorithms comprising keyword and IPC classifications and their hits achieved on GPI, EPO.

S. No.	Result	Query
1.	46	Word= "Mobile Decontamination" +(B60P3005 AND G21F9)+(G01T1 OR E04H2 OR A47K OR B08B)
2.	97	Word=human AND B08B OR G01 OR G21F9 OR C23G
3.	150	Word= Mobile AND Decontamination OR B60P3 OR G21F9 OR G01T1 OR E04H2
4.	156	Word= Mobile AND Decontamination OR B60P3 OR G21F9 OR G01T1 OR E04H2 OR A47K
5.	157	Word= Mobile AND Decontamination OR B60P3005 OR G21F9 OR G01T1 OR E04H2 OR A47K OR B08B
6.	270	Word= Mobile AND Decontamination OR B60P3 OR G21F9 OR G01T1 OR E04H2
7.	6079	Word= Human AND *Mobile Decontamination* +1w B60P3
8.	6080	Word= Human AND *Mobile Decontamination* +1w B60P3 OR G21F9 + G01T1
9.	12996	Word= Human AND *Mobile Decontamination* AND/OR B60P3
10.	0	Word=human AND decontamination AND apparatus AND chemical and radiation
11.	21924	Word=human AND decontamination AND apparatus ND chemical and radiation
12.	283472	Word= Mobile AND Decontamination OR B60P3/005 OR G21F9 OR G01T1 OR E04H2 OR A47K OR B08B
13.	1541931	Word= *Mobile Decontamination* +1W B60P3 AND G21F9 OR G01T1 OR E04H2
14.	14838835	Word=*Mobile Decontamination* +1W B60P3 OR G21F9 OR G01T1 OR E04H2

Analysis Map includes Rate Map, Number Map, Trend Map, Relation Map, Radar Map, Portion Map, etc.¹⁵ The trend patent map of the broadest dataset with the year of priority/filing/publication on x scale and inventors/assignee name on y scale provided a key insight of the technology. Cross-mapping of the patent document further provides useful information, etc.

Patent statistics can be used to ascertain the maturity of certain technologies or to identify technological trends. By comparing the number of applications with the number of applicants, it is possible to identify whether research activities are clustered or scattered. This can then be illustrated in a patent map. In the present case, patent maps of the selected patent dataset were prepared and analysed to understand the status of the state-of-art of the decontamination systems worldwide. It may be noted that different types of maps may be prepared as

per the requirement. Figure 1 provides the time scale map of the international patent classification (IPC) and technology on the time scale. As evident from the trend map, although patents in various fields had been filed over the years, the focus of the technology could be defined by A61K, B01J, G01N, G03F, and H01L and these IPC codes described as under:

- (a) A61k: Preparations for medical, dental or toilet purposes
- (b) B01J: Chemical or physical processes
- (c) G01N: Investigating or analysing materials by determining their chemical or physical properties
- (d) G03F: Photomechanical production of textured or patterned surfaces
- (e) H01L-Semiconductor devices; electric Solid State Devices

These technology areas are of prime interest for the researchers and lot of patents have been generated in these technology areas. Class A61K encompasses patents in the area of medical, dental or toilet purposes, which is among the most relevant IPC classification for a mobile decontamination apparatus. Also, the IPC classification B01J and G01N relate to patents in the area of chemical or physical processes/properties which are again closely relevant classes for this present apparatus. The classes G03F and H01L were maximally exploited by the researchers as seen in Fig. 1. It requires further detailing to understand the relevant aspects of the present decontamination apparatus. Apart from these classifications, other IPC classes also show quite a good number of patents filed during the period 2000-2004. These IPC classes are:

- (a) C08F: Macromolecular Compounds Obtained By Reactions Only Involving Carbon-To-Carbon Unsaturated Bonds.
- (b) C08J: Working-up; general processes of compounding; after-treatment.
- (c) C08K: Use of inorganic or non-macromolecular organic substances as compounding ingredients (paints, inks, varnishes, dyes, polishes, adhesive).

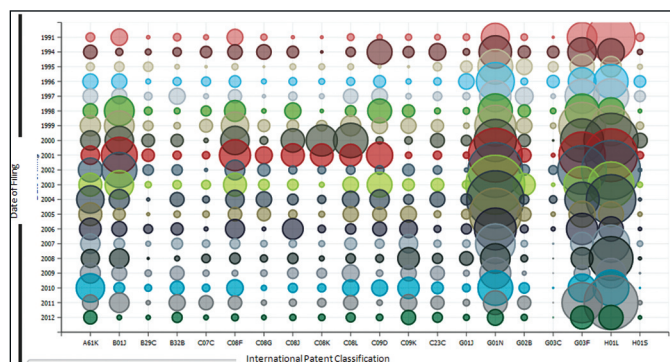


Figure 1. Technology trend map(date of filing vs IPC classification).

- (d) C08L: Compositions of macromolecular compounds.

The decreasing trend in patent filing indicates that the technology has not been worked upon further after 2004 in these areas. To understand the applicants' technology focus, their research work, strategy, planning in a particular area of technology, study of patent maps overlapping one over another is an useful technique. Overlapping the information deduced from one patent map over another yields useful results and provide interesting facts not only about the technology but also about the assignees/inventors. Similarly, in the present study, patent-map overlapping with time was used to understand the global status of the research activities in the CBRN decontamination technology area. Patents maps of the top 20 applicants/inventors over the time scale, i.e., date of filing and IPC classification were prepared using statistical tools of GPI database. These patent maps are found useful in analysing the growth of the technology with respect to each applicant/inventor over the years. The time scale map (Fig. 2) of the applicants indicated that Tokyo Ohka Kogyo Co. Ltd, Fuji Photo Film Co. Ltd, Fujifilm Corpo., Cem Corporation, JSR Corp, 3D System Inc., and ASML Netherlands are among top applicants in this area of technology. The IPC classification based patent map indicates that the above applicants have filed patents mostly in the technology areas as covered within IPC classes B01J, B29C (shaping or joining of plastics; shaping of substances in a plastic state, in general; after-treatment of the shaped products), G03F, and H01L.

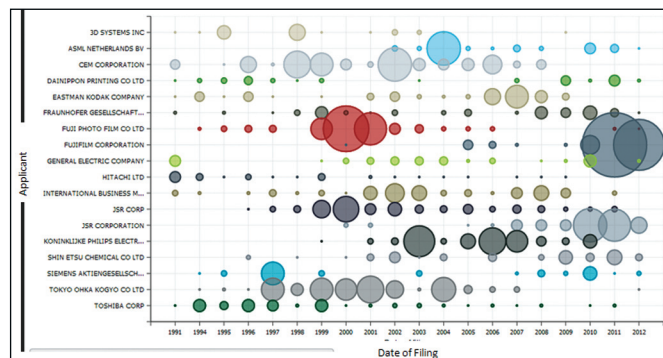


Figure 2. Patent map showing Top twenty applicant vs date of filing.

The time scale for inventors indicates that all the top twenty inventors of this technology area are very active as shown in the patent map (Fig. 3) The scattered bubble diagram shows no peculiar trend, however, it does show the fairly good amount of work done by each inventor as measured by the number of patents filed by them. It is observed that inventors interest area are similar to applicant's key interest area and the technology trend (as shown in trend map (Fig. 1)). The inventors' interest areas are A61K, B01J, B29C, C09K, G01N, G03F, and H01L.

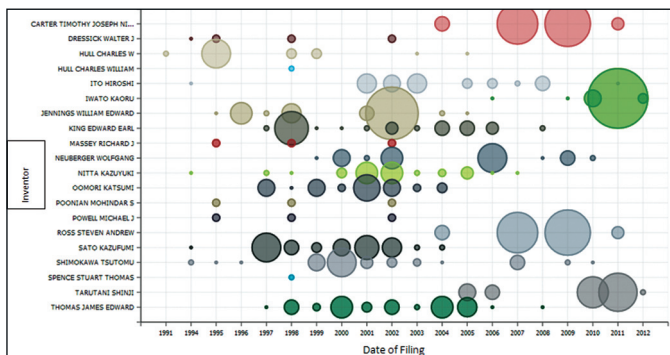


Figure 3. Patent map showing 3 top twenty inventors vs date of filing.

Another Patent relation map was prepared to capture the relationship between the inventors and the applicants. The relation map as shown in Fig. 4. provided an interesting piece of information. Thirteen among the top twenty inventors had affiliations to the top applicants namely Tokyo Ohka Kogyo Co. Ltd, Fuji Photo Film Co. Ltd, Fujifilm Corpo., Cem Corporation, JSR Corpo, and 3D System Inc.

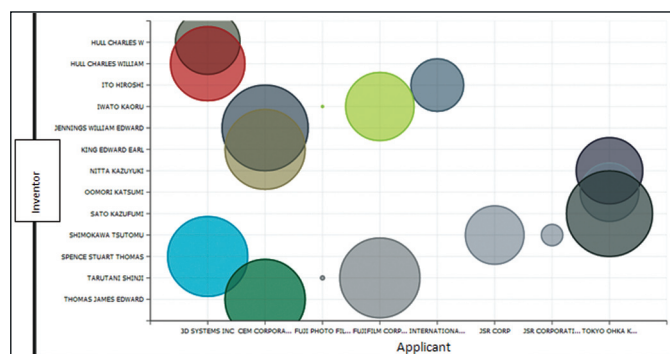


Figure 4. Patent map showing top twenty inventors vs applicants.

5. DEDUCING INFORMATION FOR CBRN DECONTAMINATION DEVICE/SYSTEM

CBRN Decontamination Device/Systems are unique systems required for very specific purposes and are not commonly available. These systems are required to decontaminate the persons, equipment, vehicles, animals etc which get chemical, biological, radiological and nuclear (CBRN) contamination. To assure safety of human, they are required to be decontaminated as soon as possible. Further, the decontamination process should be conducted in the best manner possible without further contamination of other people including volunteers and equipment. With the increased perception of terrorist threats and possibility of mass casualty events like incidents of nuclear power plants involving chemical, biological, radiological and nuclear (CBRN) agents, medical preparedness is a dire necessity. The triple disaster in Japan and chemical attack in Syria and Iraq leading to world’s most critical nuclear and chemical emergencies in the recent years has exposed the lack

of efficient decontamination technologies and safe skin formulation at global level in civilian domains.

There may be two types of contamination during the nuclear fallout and/or radiological dispersal incidents viz external and internal contamination. The external contamination is internalised through broken/intact skin, inhalation or ingestion of radioactive material. The material resides in the lungs or gastrointestinal tract for a while and slowly absorbed by the blood and eventually become resident in an organ or tissue depending on its biological and chemical affinity. The external radiological contamination has higher probability of spread and can be dangerous to the co-workers and responders; hence, its quick and safe decontamination is an absolute necessity. Therefore, due to increasing possibilities of intentional and unintentional events of radiological/nuclear contamination, it is highly desirable to set up a portable decontamination facility close to the site of accident where people have been exposed to CBRN agents, so that the contaminated people are not required to be transported to a remote decontamination centres/facilities and delay in the required medical treatment can be avoided. It will enhance the confidence level of the nation.

As a case study, it was decided to identify the state-of-the for such systems through patent documents addressing different aspect of CBRN Decontamination Device/System so as to provide a lead to the scientists for their further research work. Initially, the patent documents searched using different combinations of the keywords and IPC classification resulted in datasets comprising large number of patents. Four Patent datasets mentioned at point 1-4 were found to be most relevant for the decontamination system. Therefore, patent maps were prepared of the selected datasets to understand the progress of technology over the years. However, for the purposes of product design, a thorough study of these selected datasets was done by manual text mining. The set of patent documents received at point number 1-4 of the Table 4 were collated and the abstract of each document was studied to find out the most relevant patents documents so as to provide leads for the R&D work in the area of development of an Automated CBRN External Contamination Monitoring and Decontamination System. 12 patent documents were of direct relevance for the present work listed in Table 5 and Table 6. These patent documents were studied in details.

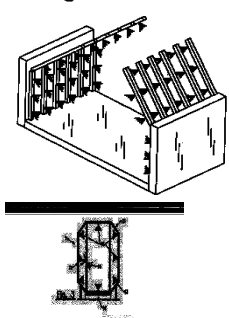
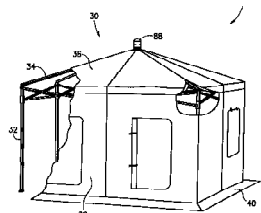
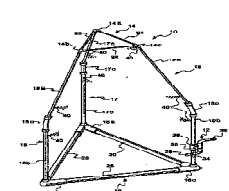
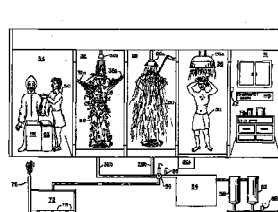
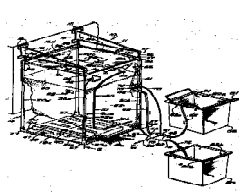
Based on information disclosed in these patent documents, a novel Decontamination System- the Automated CBRN External Contamination Monitoring and Decontamination System was designed and developed as shown in Fig. 5 with the following feature:

- (1) The device can detect the external CBRN contamination and subsequently decontaminate the victim on a single platform
- (2) Fully Automated and self operated device

Table 5. Patented inventions for CBRN decontamination system

System/process	Title	Patent/Application no.	Applicant
CBRN detection	CBRN attack detection system	U.S. 0269770 A1	Lockheed Martin Corporation
Decontamination system	High-capacity method and system of chemical and/or radiological decontamination	U.S. 6446277	Prevor International
Containment device	Chemical biological explosive containment system	U.S. 5864767	U.S. Army
CBRN detection	CBRN attack detection system	U.S.0294060 A1	Lockheed Martin Corporation
Micro emulsion system	Aqueous based chemical & biological warfare decontaminating systemfor extreme temperature applications	U.S. 7829520.	U.S Navy
Decontaminating Kit	Kit systems for granulated decontamination formulations	U.S. 7750199	Sandia Corp
Nano particle System	Reactive nanoparticles as destructive adsorbents for biological and chemical contamination	WO20020073 A2	Univ Kansas State

Table 6. Patented CBRN decontamination system with salient features

S. No.	Figure/Concept	Patent No and date	Salient Features
	<p>Fig.12</p> 	<p>Decontamination gate apparatus (water gateTM) US 7203979 Apr 2007</p>	<ul style="list-style-type: none"> • Combination of security &decontamination gate for large venues/ areas • Contains a plurality of liquid conduits and spray heads • Decontamination by walking through the activated water gate • Faster rate of decontamination minimizes the potential harm from the exposure • Have different types of nozzles for different volumes & pressures of liquid • Fixed Structure
		<p>Decontamination and Contaminant Processing System Method US 37812, Feb.27,2003</p>	<ul style="list-style-type: none"> • Collapsible frame • Decontamination agent to be disposed from the dispenser container while remaining in the holster portion
		<p>Portable Emergency Decontamination Shower US 5469587 Nov, 1995</p>	<ul style="list-style-type: none"> • Portable • Quickly deployed on site • Designed to decontaminate the responders from chemical spill
		<p>Chemical & radiation Decontamination US 4796311, Jan, 1989</p>	<ul style="list-style-type: none"> • Mobile or prefabricated unit design • Handles victims of a chemical contamination disaster without exposing the emergency room • Easy to operate
		<p>Portable Shower US 3925828 Dec, 1975</p>	<ul style="list-style-type: none"> • Collapsible frame structure • Shower head with in housing • Pump used with desired input and output for specific container

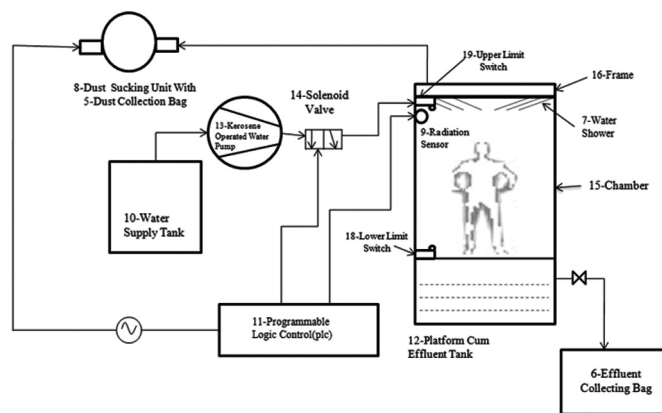


Figure 5. Block diagram of SUSNAN the automated CBRN external contamination monitoring and decontamination system.

- (3) No cross contamination
- (4) Portable, easy to transport, assemble and use
- (5) Suitable for field conditions (Petrol run kerosene operated water supply pump)
- (6) Power/Battery operated
- (7) Minimal requirement of liquid (Water/Chemical Solution)
- (8) Minimal quantity of liquid effluent, and
- (9) Environment friendly

6. CONCLUSIONS

Patent documents provide very important information which may help researchers to know the state of art in any technological area as 80% of all available technical information is published often only in Patents and nowhere else.¹⁶ It may help them to identify potential collaborators, source of chemicals/devices/products, joint development partners, licensors/licensees etc. However, conducting patent search demands certain skill sets and, generally, it is done by an IPR Expert in cooperation with the researchers having domain expertise. With an effective searching method researchers have more information and opportunities to allocate their resources in the early stage of new product development. In the present paper, a search methodology based on keywords and IPC classification was used. From generic search to specific search for the CBRN decontamination system, 200 patents were found to be relevant. This patent dataset of 200 patent documents was used to generate patent maps to understand progress of the technology over the years. Key focus areas of researchers were identified as the IPC classes A61K, B01J, B29C, C09K, G01N, G03F and H01L. The major stakeholders in this technology were Tokyo Ohka Kogyo Co. Ltd, Fuji Photo Film Co Ltd, Fujifilm Corp., Cem Corporation, JSR Corp, 3D System Inc., and ASML, Netherlands as evident by their patent filing trend over the years. The researchers were also appraised about the other researchers who were

working in similar areas. However, out of around 200 searched patent documents, 13 disclose the most relevant information about a CBRN decontamination system. Researchers used this information gathered from the patent documents and developed a novel Decontamination System-the Automated CBRN External Contamination Monitoring and Decontamination System which has been further protected *via* 02 patent applications.

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