Expert Radiology Application Softwares Enhance Radiology Diagnosis Contributions And Challenges By A Historical Review of Informetric Analysis From 1991To 2021

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Abstract

In all areas of medicine, especially in radiology, computers are increasing year by year. Filmless radiology, speech recognition software, electronic application forms, and teleradiology are recent developments that have greatly improved radiologists' performance. This research explores radiology software trends, predictions, and the challenges posed by informatics and historical trend analysis. The rationale behind this research is that information technology (IT) is overgrowing almost every day. We must continuously seek new ways to apply IT to make more use of resources. Consequently, IT becomes increasingly crucial to radiology organizations' innovative thinking, workflow, and business models. This study aimed to analyze all radiology software publications in the Science Citation Index (SCI). From 1991 to July 2021, SCI was used to search for publications systematically. We have also widely used this historical method in radiology software research. The findings and discussions are base on an assessment of trends, predictions, contributions, and challenges in radiology software, and we are exploring radiology software with six evolutionary stages. The gift of this research is that radiology managers realize that the use of new information technologies is closely related to survival in a competitive environment. Radiology companies can review these new technologies to develop more innovative business models and services to improve operational deficiencies.

Keywords： radiology information systems, radiology education system, radiology operation software, information technology, computer-aided diagnosis system

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I.Introduction

The use of computers is increasing in all fields of medicine, especially in radiology. The latest developments in membraneless radiology, speech recognition software, electronic application forms, and teleradiology have greatly improved the performance of radiologists [1]. This study aimed to explore trends, predictions, information challenges, and historical trend analysis of radiology software. Advances in emerging radiology information technology have made the global radiology business environment a vibrant market. The hospital will continue to face new radiation technologies and competition as well as gradually increase patient expectations. To compete in the new radiology, IT environment, commercial new IT technology alliances, radiology departments, radiology departments, doctors must coordinate inspection activities globally. This situation requires sharing knowledge, new technology drivers and patient inspection mechanisms, and links to radiology innovation design and information technology (IT) to implement these new business models. However, radiologists face fundamental changes in their pursuit of ambitious goals rather than incremental changes. Innovation is rapidly evolving, continually adopting new forms of technology and assessing its value in improving day-to-day operations [2]. Innovation is quickly changing, constantly embracing new technology forms and evaluating its importance in enhancing day-to-day operations [2]. We expect Computer graphics, visualization, and virtual environment applications in the medical field to improve health care and benefits that bring considerable opportunities to patients [3].

The rationale behind this research is that information technology (IT) is increasing more powerful operation almost every day. We must always strive to apply it to new ways of using more resources. Therefore, it is essential to create new ways of thinking about radiology, workflow, and business models. Radiology organizations can not only use intellectual capital and information technology to improve their business deficiencies, but radiology directors are also committed to addressing the ongoing business crisis. They invest in reconfiguring resources and knowledge, creating innovative structures and systems to overcome problems and seek more efficient operations.

There is no doubt that computer and communication hardware have reached a state of complexity and availability, in which any necessary information can be generated, stored, and distributed to healthcare personnel to support their patient care tasks [4]. The understanding and contribution of radiology information technology innovation adopting trends, application history review, and information analysis research methods apply to this study.

This study aims to analyze all radiology software publications in the Science Citation

Index (SCI). From 1991 to July 2021, we used t the Science Citation Index (SCI) to retrieve publications. Research findings and discussion of changing trends, predictions, and challenges of radiology software, we are exploring radiology software with six evolutionary stages; before 1990, most radiology information systems were designed for patient examination purposes. From 1990 to 2009, radiology software was Intranet connected. From 2011 to 2021, mobile devices such as PDAs, laptops, and mobile phones became an essential part of our lives. Then the era of radiation mobile began to innovate, while new business models and long-distance services, patient care became more valuable and efficient. The development of radiology has already started.

Later, Radiation Medical Artificial Intelligence technology was developed to integrate machines and software to achieve better quality and high-performance services, while large-scale integrated development with patient radiation extensive data software services. Since then, the era of machine learning has begun to provide diagnostics for diseases such as radiology. Also, the radiology software informatics review evolved into a strategic style of operations, education, management, and radiology software. It enhances the radiology director's ability to become a blueprint or reference application for emerging radiology software, thereby providing patients with safe, efficient services, improved competitive advantage, and more modern radiology service capabilities. It evolved into a strategic style of operation, education, management, and radiology software. It enhances the radiology director's ability to become a blueprint or reference application for emerging radiology software, thereby providing patients with safe, efficient services, improved competitive advantage, and more modern radiology service capabilities. It evolved into a strategic style of operation, education, management, and radiology software. It enhances the radiology director's ability to become a blueprint or reference application for emerging radiology software, thereby providing patients with safe, efficient services, increased competitive advantage, and more modern radiology service capabilities.

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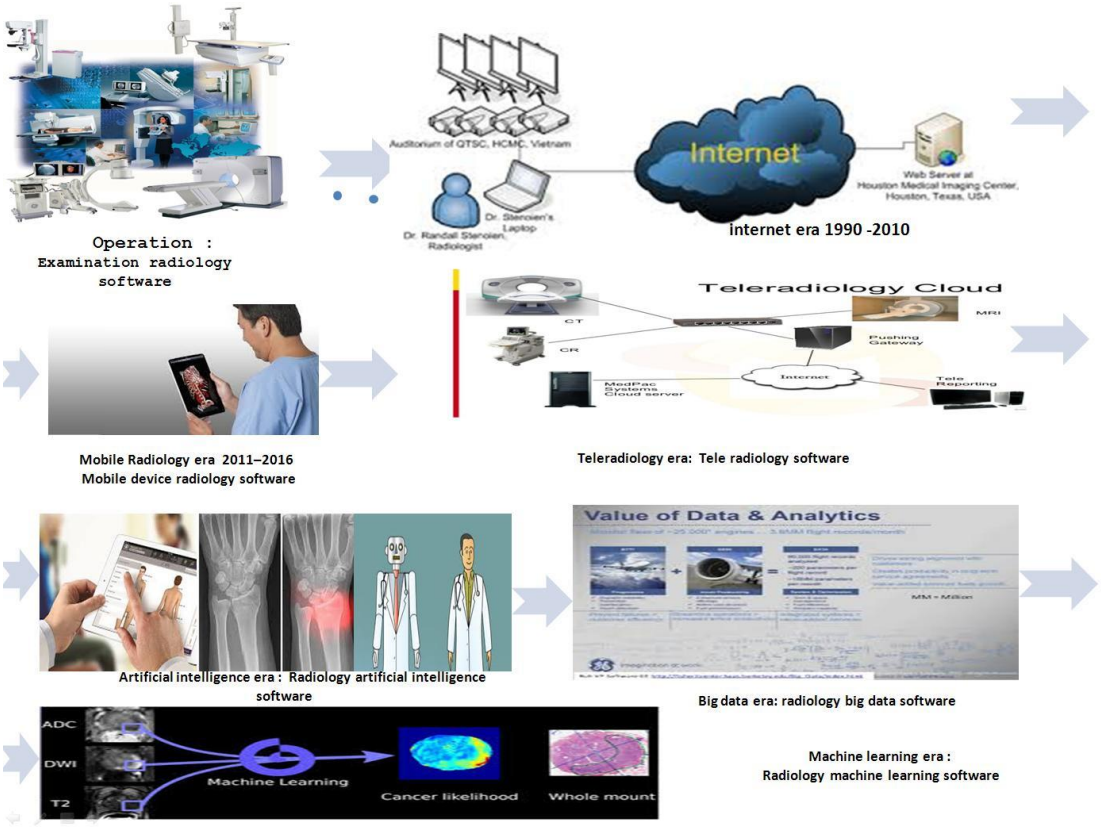

Figure 1 Radiology software evolution trend diagram

The main contribution of this research is to make radiology managers aware of the key to learning to use new information technologies to survive in a competitive environment [5]. The Radiology department director can use this innovative software in his department to improve operational efficiency and service quality. Radiology companies can look at these new technologies to develop further business models and services, strengthen business deficiencies in the past, and generate more business revenue from academic contribution, academic research on the exploration of innovation diffusion theory. It directly guides companies to improve existing machines, software, or operational errors and faces operational problems to improve innovative technologies, provide better services, and improve service quality and performance.

As a result, radiology has also begun to use information technology to solve more effective and accurate problems, such as using new and innovative systems for patient testing and diagnosis and competition for business, education, operations, and service needs. Therefore, radiology software resources and workflow, patient diagnostic safety management solutions, optimize asset utilization, reduce operating costs, and improve patient care in the medical industry; the world is based on various medical radiology applications developed. There are more radiation systems, and this hospital is using them. This article will explore the

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trends through the 1991 Informatics and Historical Review Trends and Radiology Software Technology. By 2021, we will clarify the trends in technology, analyze their contributions, and predict trends and challenges through radiology software.

II. Literature review

Diffusion of Innovation Theory

The diffusion of Everett Rogers defines it as a process through which the social system members propagate innovation through individual channels over time. The definition of Rogers includes four elements of communication that exist in the innovation process: (1) Innovation - by individuals or other adopting units as new ideas, practices, or object perceptions. (2) Communication channel - the message from one person to another device; (3) Time, including (a) the innovative decision-making process; (b) the relative time of innovation of individuals or groups in (b);(4) Three-time factors of the social system - a group of people involved in solving problems together to achieve a common goal.

The Internet is an indispensable part of almost all radiologists' daily lives. Nevertheless, few people fully understand how it works or how to make the most of workplace technology. These analysis tables will explore the basics of computer networks and make the Internet a valuable resource. In addition, we will discuss the process of designing and implementing radiation management and education websites or intranet websites. Developing a website, what it contains, how to use it for ease of use, free provisioning, and two-way cost software to achieve this goal is also an essential point of view for applying this software [6]. Table 1, 2, 3, illustrate the operation type software of radiology for X-ray, CAD, CT, MRI, PACE, speech recognition, 3D, 4D, artificial intelligence, and electronic radiology reporting system.

Table 1 Operation type software of radiology

No	Style Software Type **OPERATION**	Method	Contribution	Author
1.	X-ray ViewDEX (X-ray image digital evaluation viewer)	ViewDEX is compatible with DICOM, and its interface features are versatile and flexible.	An efficient and easy to use observer performance study software	Hakansson, M; Svensson, S; Zachrisson, S; Svalkvist, A; Bath, M; Mansson, LG [7].
2.	**CAD** computer-aided	A method to use a chest X-rays film	This CAD system for chest X-rays helps radiologists	Kakeda, S; Moriya, J;

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	diagnosis (CAD) system EpiSight/XR	for automatically detecting nodules	improve lung nodules caused by lung cancer	Sato, H; Aoki, T; Watanabe, H; Nakata, H; Oda, N; Katsuragawa, S; Yamamoto, K; Doi, K [8].
3.	**CAD**	The CAD environment is subject to the developmental process of three systems: multiple sclerosis CAD, lung nodule CAD, and pneumothorax CAD.	The operators can easily handle CAD designers in a user-friendly manner by choosing various workflow paths.	Pietka, E; Kawa, J; Badura, P; Spinczyk, D [9].
4.	**CAD** a computed tomographic lung nodule is a type of computer-aided detection (CAD) software	As a second reader for radiology residents.	CAD software can aid in refining the sensitivity of residents to detect lung nodules on computed tomography, making them comparable to board-certified radiologists.	Teague, SD; Trilikis, G; Dharaiya, E [10].

Table 2 Operation type software of radiology

No	Style Software Type OPERATION	Method	Contribution	Author
5.	**CT** angiography, volume rendering	With interactive parameter changes	Post-processing applications add to the advantages of spiral CT	Kirchgeorg, MA; Prokop, M

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	techniques (VRT)		3D imaging of soft tissue will also become feasible through interactive parameter changes	[11].
6.	**CT** Micro-computed tomography (Micro-CT)	The analysis tool marks the pattern damage on the bone. Detailed analysis of 3D (3D) architecture using high-resolution Micro-CT and computer software	It is possible and allows for the collecting of microstructured 3D bone information. Analysis of bone damage indicates that Micro-CT provides an opportunity to correlate bone damage with instruments that cause corrosion.	Thali, MJ; Taubenreuther, U; Karolczak, M; Braun, M; Brueschweiler, W; Kalender, WA; Dirnhofer, R , Forensic [12].
7.	**DICOM:** Digital image communication of medicine	It downloads image data from a remote site: requests to retrieve data from long-term storage; view images and perform certain DICOM routing operations.	The existing infrastructure of the Internet is beneficial for developing a low-cost system that can use for teleradiology.	Henri, CJ; Rubin, RK; Cox, RD; Bret, PM [13].
8.	**Dicom** RadPix (R) Video, we can import multi-frame cine DICOM (Digital Imaging and Communications in Medicine)	Users can easily crop and annotate data. Easily create annotated movie ultrasound files.	Successfully incorporated radiology education	Friedkin, AM; Weadock, WJ, [14].

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	files.			

Table 3 Operation type software of radiology

No	Style Software Type OPERATION	Method	Contribution	Author
9.	**MRI** Magnetic Resonance Imaging Workbench MRIW: Parametric analysis software	Monitor changes in disease status and assesses treatment outcomes	Contrast-enhanced analysis during MR imaging is a promising new approach to data analysis in radiology for such qualitative or quantitative parameters.	Parker, GJM; Suckling, J; Tanner, SF; Padhani, AR; Husband, JE; Leach, MO [15].
10.	**MRI** Magnetic resonance imaging (MRI)	It is an imaging modality for detecting disease and pathology. Excellent soft-tissue contrast in MRI can better define pathology.	MRI has been increasingly used to guide, monitor, and control percutaneous surgery and surgery.	Blanco, RT; Ojala, R; Kariniemi, J; Perala, J; Niinimaki, J; Tervonen, O [16].
11.	**PACS** Picture archiving and communication systems (PACS)	It converts film-based radiology into a computer-based digital environment.	It saves costs and improves doctor communication.	Arenson, RL; Chakraborty, DP; Seshadri, SB; Kundel, HL [17].

Table 4 and Table 5 show the operation type software of radiology. Radiology and radiologists consider being an increasingly valuable resource in anatomy teaching. It is a state-of-the-art radiology workstation with industry-standard application software to provide the latest in fascinating pathology and physiology.

PACS diagnostic workstation. This environment includes all the tools used to create the teaching files, including text descriptions, annotations, and image processing [19].

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Understanding informatics principles is crucial because they affect PACS and other supporting software and the model itself [20]. CT and the latest MRI, with software processing (interactive data display, contour detection and summation, imaginary 3D structure, and interactive visualization), provide further analysis improvements that are now available to make a single model [21]. The essential information is needed. Computer-aided detection (CAD) has attracted a wide range of research interests [22]. The following operating software section uses the latest voice-to-text IT technology to design these systems to improve operational efficiency. Speech recognition (SR) in a radiation environment is a way to reduce management costs by reducing or eliminating transcriptional services and reducing reporting time by reducing reporting time [23].

Table 4 Operation type software of radiology

No	Style Software Type **OPERATION Reporting system voice recognition**	Method	Contribution	Author
1.	**Voice recognition systems** used for radiology reporting.	It uses a speech recognition system in the transcription of radiology reports.	The radiologist can use the normal speech mode for dictation while reviewing the film. Reduce the hardware cost to a level acceptable to radiology using a standard personal computer	Schwartz, LH; Kijewski, P; Hertogen, H; Roossin, PS; Castellino, RA [24].
2.	To Making a quantitative computed tomography (QCT) **reporting system**	It illustrates the practical use of the QCT reporting system in a radiology reading environment by using optical character recognition (OCR) and macro programs.	This method is easily adaptable to other QCT applications and PACS / EMR. (1) Save the QCT report as a graphic file; (2) Identify the characters in the image as text; (3) Extract the T-score from the text; (4) Perform error correction; (5) Reformat the value to	Lee, YH; Song, HT; Suh, JS [25].

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		Designed for OCR to report QCT images during radiological reading.	The QCT radiology report template, and (6) paste the report into an electronic medical record (EMR), or it can be a picture archiving and communication system (PACS).	
3.	**computer speech recognition system** (SRS) for clinical reporting	It developed a networked database system for creating, storing, and managing predefined radiology report definitions.	It is a template-type construct that allows radiologists to share standard organ systems or model-specific templates dynamically. It can be triggered from the printed list of barcodes while dictating.	Sistrom, CL; Honeyman, JC; Mancuso, A; Quisling, RG [26].

Table 5 Operation type software of radiology about the reporting system

No	**Style Software Type OPERATION Reporting system voice recognition**	**Method**	**Contribution**	**Author**
4.	**SPIDER** the radiology reporting process, structured entry of radiology reports	It contains a WWW server and two dedicated programs. The WebForm program converts the knowledge of the system into a graphical WWW data input form. The WebReport program.	It is a structured data entry in which information can enter by using predetermined data elements and formats - potentially improving the radiology reporting process, structured entries of radiology reports,	Kahn, CE; Wang, K; Bell, DS [27]

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Table 6 shows the operation type software of radiology about 3D,4D, and AI. The development of telecommunications and computer software led to the development of radiographic image transmission systems. Radiologists can now check X-rays anywhere, and in some cases, this is almost synchronized. It can use the Internet to perform remote imaging such as computed tomography, magnetic resonance imaging, and ultrasound. These systems include systems for transmitting still images and real-time video systems for interactive monitoring through remote radiography. The review workstation (compared to the Picture Archiving and Communication System (PACS)) examines multi-image CT and MRI studies on the iPad tablet [28].

Table 6 Operation type software of radiology about 3D,4D, and AI

No	Style Software Type **OPERATION miscellaneous**	Method	Contribution	Author
1	**STEPanizer** is an easy-to-use computer-based software tool	A simple tool for stereo evaluation of digital images.	STEPanizer is an easy-to-use, computer-based software tool for stereoscopic evaluation of digitally captured images from various microscopes.	Tschanz, SA; Burri, PH; Weibel, ER [29].
2.	**An artificial neural network**	A distributed network of computing elements is modeled on the biological neural system and implemented as a computer software program.	They successfully applied to diagnosing and treating coronary artery disease and myocardial infarction, ECG interpretation and arrhythmia detection, and image analysis in cardiac X-ray and ultrasonography.	Itchhaporia , D; Snow, PB; Almassy, RJ; Oetgen, WJ [30].
6..	**3D surfaces**	It uses to create a	This volume-based	ZUBAL,

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	digital volumetric clinical imaging instruments	3-dimensional surface of human anatomy for use in a computer database.	software phantom depicts internal organs in millimeter resolution and makes them suitable for full 3-dimensional Monte Carlo simulations.	IG; HARREL L, CR [31].
11.	**3D computer-aided, contact-method** cephalometric software a portable 3D computer-aided, contact-method cephalometric system	IT equipped with a newly developed skull measurement software for bedside.	It is used as an adjunct or alternative to existing X-ray cephalometric measurements in the clinic and as an epidemiological tool outside the clinic.	Nagasaka, S; Fujimura, T; Segoshi, K [32].
20.	**4D Dimension NSNT v 1.0** like the Neoplasms of the Sinonasal Tract software package (NSNT v 1.0)	It establishes a complete visual database for patients with sinus tumors.	A dedicated, user-friendly sinus tumor formation database facilitates establishing a multi-center network with significant clinical and research advantages. Histology and endoscopic images can sequence.	Trimarchi, M; Lund, VJ; Nicolai, P; Pini, M; Senna, M; Howard, DJ , [33].

Table 7 shows the operation type software of radiology about the Teleradiology system.

Intranet helps to optimize the organizational efficiency and cost-effectiveness, and daily work of outpatient and hospital radiology departments. The focus is usually on Internet and Intranet technologies to ensure their continued development [34].

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Table 7 Operation type software of radiology about Teleradiology system

No	Style Software Type OPERATION miscellaneous	Method	Contribution	Author
13.	**MASTOS** a software package	It is a software package based on the Monte Carlo method and intends to use as a simulation tool in mammography.	A mammography simulation tool for design optimization studies	Spyrou, G; Panayiotakis, G; Tzanakos, G [35].
19.	**PMCT** Post-mortem computer tomography (PMCT)	It is a valuable procedure that clarifies how the injury is done and provides solid medical evidence, which is very useful during litigation and trials.	It is beneficial to get the essential information to use 3D rendering, for example: accurately depicting the wound trajectory, identifying the entrance and exit wounds, showing the fracture of the bone, and the movement of its fragments in the body.	Maiese, A; Gitto, L; De Matteis, A; Panebianco, V; Bolino, G , [36].
21.	**CR** Computed radiography (CR)	It is a widely used imaging method	It replaces the regular screen/film program in diagnostic radiology radiodiagnosis.	Zhang, JG; Huang, HK [37].
23.	**Teleradiology** Pediatric Teleradiology	It combines teleconferencing with a virtual learning environment for service integration, collaborative research, and continuing education in pediatric radiology.	A new environment for training, learning and interactive discussions	Monteiro, AMV; Correa, DG; Sarmet, AA; Cavalcanti, SA; Sakuno, T; Filgueiras, T; Just, E;

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				Santos, M; Messina, LA; Haddad, AE; Marchiori, E [38]
24.	**MPCSS** multi personal computer storage system (MPCSS)	It is constructed using hardware and software. The image data is archived from the primary server to the personal storage computer (PC) using the Neusoft Picture Archiving and Communication System (PACS) and backed up to the storage PC.	It is a solution for sea-capacity storage. PACS storage is much cheaper than other high-capacity systems or devices. It is possible and suitable for digital image storage.	Guo, QY; Hao, FD; Duan, XL; Xie, XQ; Liao, W [39].
25.	**RODOS**	Its distributed database, geographic information system RoGIS, online connections to radiology and meteorological networks, and software environments for integrating external programs into RODOS systems	It provides tools for processing and managing various types of information, including meteorology, radiology, economics, emergency operations, and countermeasures, rules, preferences, facts, maps, and statistics.	Schule, O; Rafat, M [40].

Table 8 shows the education type of radiology software. Computers have greatly facilitated the processing and storage of radiological information. Manufacturers of radiology information systems (RIS) increasingly connect their products to other computers (for example, hospital information systems). However, the demand for RIS and digital radiology equipment continues to increase, so images (such as X-rays of the chest and bones) will automatically mark the data marked by the technician, thereby eliminating redundant work and reducing appearance marking errors. Data for patients

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with increased radiographic consistency [41]. The artificial neural network is a kind of artificial computer intelligence, which has been a research hotspot in the past ten years [30]. Despite the enthusiasm for software and continuous improvement, some studies clearly show that medical education is superior to traditional methods [5]. These methods are aimed at human-centered social cognitive engineering. It integrates software and tasks. Knowledge and organizational engineering have been improved and tested through developing computer systems to support training and professional work [42]. Although digital technology plays an increasingly important role in radiology, teaching documents are widespread in radiology [43]. Radiologists may be interested in different free (open source) software available via the Internet. Web-based programs provide different levels of radiological anatomy and practical difficulties, allowing users to test and build their knowledge of radiation [45].

Table 8 Education type of radiology software

No.	Style Software Type **EDUCATION**	Method	Contribution	Author
1.	PACE teaching system	It creates an image-based e-learning file to replace the collection of printed film images. Integrate multimedia teaching and reference databases in a PACS environment.	It allows doctors to create reference databases directly from the clinical case reviews on the PACS diagnostic workstation for teaching and research.	Rosset, A; Ratib, O; Geissbuhler, A; Vallee, JP [46].
2.	A software tool-**ViewDEX** (Viewer for Digital Evaluation of X-ray images)	It is developed in Java, making it run on almost all computers.	It is designed to handle many types of research, such as visual grade analysis (VGA), standard image score (ICS), and receiver operating characteristics (ROC). A software tool for	Borjesson, S; Hakansson, M; Bath, M; Kheddache, S; Svensson, S; Tingberg, A; Grahn,

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			improving the efficiency of radiologists' performance studies	A; Ruschin, M; Hemdal, B; Mattsson, S; Mansson, LG [47].
3.	Radiologist multimedia publishing software	It bases on the Internet, the World Wide Web, Mosaic, and Wide Area Information Server software technologies, all of which are in the public domain.	This networked multimedia textbook approach to the global distribution of multimedia radiology information brings today's radiologists the benefits of multimedia publishing on the Internet.	Dalessandro , Mp; Lacey, Dl; Galvin, Jr; Erkonen, We; Santer, Dm [48].
4.	Teaching file software (**TF-Web**)	It was developed for the World Wide Web and used in conjunction with locally produced programs for importing images.	It can access both local and remote (Internet) networks. Another requirement is that it is easy to view existing cases and add new ones.	Wallis, Jw; Miller, Mm; Miller, Tr; VreelanD [49].
5.	**An automated Computerized, the categorization of narrative text** radiograph reports, is illustrated.	A text search algorithm uses dividing a radiographic report into a fracture, typical, neither regular nor fracture.	It is a potent tool for cost-benefit research, healthcare policy, operational assessment, and quality control.	Thomas, BJ; Ouellette, H; Halpern, EF; Rosenthal, DI [50].
6.	A digital teaching file (**DTF**), Computer-based training (CBT) in radiology	DTF is built using established Internet tools and integrated into heterogeneous PACS/RIS environments.	It helps quickly transfer selected images (DICOM_Send) to the DTF during interpretation and access to the DTF application anytime, anywhere.	Trumm, C; Dugas, M; Wirth, S; Treitl, M; Lucke, A; Kuttner, B; Pander, E; Clevert, DA; Glaser,

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				C; Reiser, M [51].
7.	3-dimensional (**3D**) **printing**	It can create a personalized/patient-specific liver 3D physical model from clinical radiology studies for surgical residency education.	rent 3D printing technology can use to develop low-cost personalized/patient-specific liver 3D models for clinical residency education through clinical radiology research.	atson, RA,A [52].
8.	Integrating interactive three-dimensional post-processing software into undergraduate radiology teaching	Collaborative improvement in visual space and radiology skills is a promising approach.	It can effectively reduce students' lack of image interpretation. It can improve diagnostic skills and visual space capabilities.	Rengier, F; Hafner, MF; Unterhinninghofen, R; Nawrotzki, R; Kirsch, J; Kauczor, HU; Giesel, FL[53].
9.	RadNotes: A novel software development tool for radiology education	It enables doctors to develop textbooks that combine text and images in an innovative, highly available format.	Software development tools are for radiology education that does not require programming expertise or the help of a software engineer.	Baxter, AB; Klein, JS; Oesterle, EV , [54].
10	**Artificial intelligence and deep learning**	Track the use of radiology computers, from management functions to image acquisition, storage, and reporting, to trying to improve diagnosis as early as possible,	Imagine new areas that might use in exam interpretation.	Ray CodyMayoJessicaLeung [73]
11	**Proton PACS**	With	It is uniquely engineered	[74]

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		state-of-the-art storage, viewing and voice recognition features,	to eliminate downtime and increase workflow efficiency.	

III. Research method

A historical review of this research application is based on an understanding of trends and radiology IT's innovative contributions. This study aimed to analyze all radiology software publications in the Science Citation Index (SCI). From 1991 to July 2021, SCI was used to search for publications systematically. The selected file includes the radiology software as part of the title, abstract, or keyword. Analysis parameters include authorship, international cooperation mode, magazine, language, file type, research address, reference count, and reprinted author address. The citation analysis is based primarily on the Journaling Citation Report (JCR) and the impact factor defined in each publication citation (CPP) and is used to assess the effect of the journal relative to the entire field and describes it as the ratio. The average per publication quotes at a given time. Also, historical methods have been applied to the study of radiology software. This practice shows that historical phenomena can be costly and complicated. We can raise our awareness by reviewing and investigating the background and development of time, location, and events. From July 1991 to 2021, SCI initiated and used historical methods to develop software radiology publications.

IV.Research finding and discussion

Challenges: Privacy, data security

In the Virtual Radiology Environment (VRE), the information to be protected embeds in three main information components:

(1) Patient information includes fields in the Digital Imaging and Medical Communications (DICOM) format. Patient information is located in the Digital Imaging Mesh Image Archiving and Communication System (DIN-PACS) network in the data vault system, including (a) patient demographic information; (b) patient information; (c) patient image can be by X-ray, computed tomography (CT), magnetic resonance imaging (MRI), and ultrasound (US); (c) previous patient images and related patient medical history.

(2) Meta-manager information to be protected consists of multiple data objects. This information will be distributed to the Meta-Manager node, including (a) radiologist programs; (b) radiologist programs; (c) radiologist programs; (c) radiologist programs; Radiologist program; (c) radiologist program; (b) list of modal words; (c) route case information; (d) information on DIN-PACS and integrated health systems, and meta-management management

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and safety Information; (e) Patient case data.

(3) VRE requires access control and communication security to control who uses the VRE and meta-manager functions and protects messages between VRE elements [68].

Contributions:

CT:

The precise CT technology of the spine covers the smallest area required to answer clinical questions, and individual patients significantly impact the risk of cancer. Cancer risk is decisive, so it is necessary to consider spinal CT imaging based on the total radiation risk over the patient's lifetime [55]. Radiation diagnostics, such as traditional radiography, fluoroscopy, and computed tomography (CT), will continue to bring significant benefits to modern medical care [57].

PACE: It determines the cost of the difference between film-based radiology and the hospital's image archiving and communication system (PACS). If a hospital-wide PACS is implemented in a short period, it will immediately convert to digital movies and archives. The net present value of the Pacs business is $1,598,698, and the net current worth of the film business is $208,856, with a net savings of $485,157. The payback period is four years. The cost of computer radiography and imaging boards accounts for 40% of the initial capital expenditures of Pacs, followed by computer hardware (30%) and software (9%). Explain that implementing Pacs inside the hospital can save costs. The Internet can quickly distribute information to distant users through various computers, making it a definite candidate for electronic medical record system technology solutions. Second-generation Internet technologies, such as the ones described in this article—XML (Extensible Markup Language), XSL (Extensible Style Language), dom (Archive Object Model), CSS (Cascading Style Sheets). Javascript and JavaBeans can significantly reduce the complexity of distributed medical system development [69].

Computer applications in radiology are rapidly evolving and linked to the gradual improvement of hardware, software, and methods. Significant improvements in engineering workstation graphics and computational efficiency have helped to visualize in terms of computer hardware. Substantial changes in networking, storage, and display technologies play an essential role in influencing applications. It reports that it can use 3D digitizers and rapid prototyping methods (such as stereolithography) to locate 3D points and images and object rendering in real-time. The software has made significant progress using a menu-driven or point-and-click user interface, a data flow language, or an application package for a complete turnkey application. This year, imaging methods using advanced computer technology are new technologies, including ct, MR imaging, digital imaging, biomagnetism, and optical

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distance sensing. Image processing for multimodal fusion or image registration, visualization, reconstruction, and image quantification reports in various conferences and publications—a new computer approach proposed for custom orthopedic implants and improved imaging techniques [70].

A smartphone is a telephone device to browse, navigate, and run small computer programs called applications. A tablet or tablet is a fully functional stand-alone computer with a thin LCD to control and input data using the screen itself. To illustrate how experts, radiographers, and residents can diagnose imaging using smartphones and tablets, you can use mobile apps with iTunes, Android Market, BlackBerry App World, and Windows Phone Market Diagnostic Imaging. The following terms apply to search strategies: (1) radiology, (2) X-ray, (3) ultrasound, (4) MRI, (5) CT, (6) technician, and (7) nuclear medicine. Smartphones and tablets offer new opportunities for diagnostic imaging practitioners—these easy-to-use devices are equipped with a display for good reading. The development of research techniques, image processing, workstation monitoring, and analysis tools in the field of radiology is enormous, and the need for valuable tools to evaluate and optimize the quality of images and surveys is significant [7]. Medical imaging is primarily in radiology, but with the advent of virtual pathology and telemedicine, imaging technology has expanded in healthcare companies. As new imaging technologies evolve, they must evaluate them to assess patient care's impact and benefits [72].

V.Conclusion

This study aimed to explore the trends, predictions, and challenges of informatics and historical trend analysis. The development of emerging radiology information technology has made the global radiology business environment a dynamic market. The hospital will continue to face new radiological technology and competition and increasingly complex patient expectations. The basic principle of this research is that information technology is increasing almost every day, and we must continuously seek new ways to use it to create more resources. In light of this, developing new ways of thinking for radiology organizations, workflows, and business models is increasingly important. Radiology organizations not only use intellectual capital and information technology to improve their operational deficiencies, but radiology directors are also committed to addressing ongoing operational crises. They invest resources and knowledge in reconfiguring and creating innovative structures and systems to overcome problems and pursue more efficient operations.

This study used a combination of historical review and data analysis. This study aimed to analyze all radiology software publications in the Science Citation Index (SCI). From 1991 to July 2021, SCI was used to search for publications systematically.

The contribution of this research is that radiology managers recognize that the use of new information technologies is critical to survival in a competitive environment. [5] From the perspective of academic contribution, from discovering the theory of innovation diffusion to

finding embedded academic research, it directly guides enterprises to improve existing machines, software, or operational errors, innovate technologies, provide better services, and enhance the quality of service and performance.

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