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Human Capital Planning in the Business of *X-ray* Screening Detection System: Human Resource Competency and Efficiency Development Strategy

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Abstrak

Peran sumber daya manusia dalam industri pelayanan kesehatan sangat krusial, terutama dalam layanan berbasis teknologi tinggi seperti Sistem Skrining Sinar-X Klinik. Penelitian ini bertujuan untuk merancang perencanaan sumber daya manusia (SDM) yang sesuai dengan kebutuhan operasional, standar keselamatan, dan kepuasan pelanggan dalam bisnis klinik radiologi. Penelitian ini menggunakan metode deskriptif-kualitatif dan pendekatan analisis Perencanaan Sumber Daya Manusia (SDM), Analisis Jabatan, dan Indeks Kesiapan Modal Manusia (IKM). Hasil penelitian menunjukkan bahwa kompetensi teknis operator radiologi, kemampuan soft skills petugas pelayanan, dan kepemimpinan klinis merupakan tiga pilar utama dalam mendukung efisiensi dan mutu pelayanan. Penelitian ini menyarankan strategi rekrutmen berbasis kompetensi, pelatihan berkelanjutan, serta pengukuran produktivitas berdasarkan indikator kinerja utama (KPI).

Kata Kunci: *Sumber Daya Manusia, Klinik Sinar-X, Sumber Daya Manusia Kesehatan, Analisis Jabatan, Kompetensi.*

Abstract

The role of human capital in the healthcare industry is crucial, especially in high-tech based services such as the Clinic *X-ray* Screening System. This research aims to design human resource (HR) planning in accordance with operational needs, safety standards, and customer satisfaction in the radiology clinic business. This study uses descriptive-qualitative methods and Human Resource Planning (HRP), Job Analysis, and Human Capital Readiness Index (HCRI) analysis approaches. The results of the study show that the technical competence of radiology operators, the soft skills capabilities of service personnel, and clinical leadership are the three main pillars in supporting the efficiency and quality of services. The study suggests competency-based recruitment strategies, ongoing training, as well as productivity measurement based on key performance indicators (KPIs).

Keywords: *Human Capital, X-Ray Clinic, Health Human Resources, Job Analysis, Competence*.

INTRODUCTION

Human capital is the main asset in the successful implementation of services, especially in the diagnostic industry such as Clinics *X-ray* Screening System. In the context of radiology services, the success of services is determined not only by technological sophistication, but also by the quality of the human resources who operate the system, interact with patients, and maintain compliance with radiation safety standards (WHO, 2023). Clinic *X-ray* Screening, which focuses on the efficiency and speed of service, requires a lean yet functional organizational structure. Therefore, HR planning from the early stages of clinic establishment is very important so that business processes run optimally, safely, and oriented towards customer satisfaction. The development of the X-ray screening system clinic business in Indonesia requires integrated human capital planning to ensure alignment between technical competence, operational efficiency, and compliance with radiation safety standards. Based on findings from a study on human factors in X-ray image examination (Kierzkowski et al., 2025), the efficiency and accuracy of prohibited object detection is greatly influenced by the operator's ability to interpret complex imagery, including object overlap or angle rotation. Therefore, human resource development strategies must incorporate competency-based selection, technical training, and integration of supporting technologies to minimize the risk of human error.

Operators should be trained in the use of IoT-based X-ray systems for real-time monitoring, including dashboards that display radiation dose and device health data. Studies on radiation exposure in airport security officers (Level_of_exposure_to_X_Ray_in_security_g.pdf) show that although the average dose is

below the threshold (1.3025 μSv/h ± 0.985 μSv/h), regular monitoring and the use of a personal dosimeter are still necessary to prevent long-term risks such as lymphocyte damage or cataracts. The training program should also include simulating emergency scenarios, such as handling a blocked X-ray system or responding to false alarms, to improve operator readiness.

The integration of supporting technologies such as deep learning algorithms can reduce operator workload by providing automatic detection recommendations. However, operators still need a basic understanding of how these algorithms work to validate results and avoid over-reliance on automated systems. A study of the X-ray multi-object detection dataset from AI Hub confirms that training in the use of augmented data (such as copy-paste augmentation) and synthetic image generation can improve operators' ability to recognize illicit objects that are not well documented. Additionally, the use of Threat Image Projection (TIP) to insert fictitious threat images during training helps operators practice in real-world conditions without safety risks.

Human resource efficiency can be improved through flexible shift management and the use of data-driven performance monitoring systems. Analysis of operator fatigue in X-ray examinations (Kierzkowski et al., 2025) suggests that shift rotations every 2–3 hours can maintain a level of alertness. Additionally, the implementation of a real-time dashboard to track response time, detection accuracy, and number of incidents per operator allows for objective performance evaluation. Loyalty programs and performance-based incentives (such as bonuses for critical threat detection) are also effective in increasing talent motivation and retention.

In the long run, collaboration with educational institutions and regulators is key to building a sustainable talent pipeline. Partnerships with universities in certified training programs as well as participation in industry exhibitions such as the Indo Security Expo expand access to skilled aspiring operators. The integration of holistic approaches from data-driven selection, technical and safety training, to technology-based performance management will ensure that the X-ray screening system clinic business is able to maintain service quality while facing growth and regulatory challenges in the digital age. This research aims to formulate human capital planning strategies that are appropriate to clinical operations, including identification of key positions, competency analysis, and long-term HR development strategies.

RESEARCH METHOD

This study uses a qualitative approach with a focus on the use of secondary data to analyze human capital planning in the clinical business of X-ray screening system. The research design is designed through a literature study to build a relevant theoretical framework, followed by the collection of secondary data from sources such as industry and research reports from global and Indonesia, government data bases (BPS, Ministry of Health, Customs), academic articles, as well as internal documents of PT Citra Klinik Seguridad (CKK) which include organizational structure, Human Resource Planning (HRP), Job Analysis & Job Description, Human Capital Readiness Index (HCRI), compensation policies, and marketing strategies. In addition, BAPETEN and ISO regulatory documents are used to understand relevant compliance standards and can provide insight into human factors in object detection through attention patterns and competency-based operator selection strategies. The data analysis process is carried out through the synthesis of information from various sources, including industry reports, regulations, and internal documents of PT CKK. This approach allows for the identification of operational challenges, competency development strategies, and recommendations for improving HR efficiency.

RESULTS AND DISCUSSION

Organizational Structure

In running the company's organization, PT. CKK makes an arrangement of the company's organizational structure that is adjusted to the tasks, functions and authorities in carrying out the company's activities. Planning *Human Capital* and the correct placement of human resources according to the main tasks and functions is expected to create good organizational behavior and the work, coordination and communication system can run (Setiadi et al., 2020). Structure of Duties, Responsibilities and Authorities in the Organizational Structure. In CKK's business engaged in machine repair and maintenance services *X-ray*, every job is not just a technical matter, but a matter of trust and responsibility. CKK is here to ensure crucial detection devices such as machines *X-ray* Airports, ports, hospitals, and security institutions are always in optimal condition. The CKK team works with a proactive approach in conducting periodic maintenance, quick fixes when needed, and the application of technologies such as IoT for remote monitoring. Each task carries an important mission in maintaining the security and smooth operation of clients, with fast,

transparent, and caring service. It's not just about machines, it's about providing a sense of security for everyone who relies on this technology every day.

The organizational structure shows a hierarchy of positions and a stratified distribution of positions, with a consistent composition. The highest level of leadership is held by the President Director, followed by six managerial positions (Managers) consisting of Financial, Marketing, Operational, HC & Legal, and IT Managers, as well as Engineering Managers, respectively. Each managerial position is supported by a supervisory team, such as Spv Tech & Engineering and Spv IT which each have 2 staffs. At the staff level, there is a variation in the number according to operational needs. B2B Marketing Staff and Technicians dominate with 4 and 12 positions in each column, reflecting a focus on market expansion and technical services. Digital Marketing Staff, HC, Legal & HSSE, Acc & Tax, Customer Services, and Warehouse & Shipping Staff fill the daily administrative and operational lines. The Finance Staff has a unique distribution with 1 position for each category, indicating a balanced need between men and women. Each section has a total of 42 positions, signifying a uniform organizational standard for all divisions or regions. This structure depicts a planned business scale, with an emphasis on technical and marketing teams, as well as flexibility in the allocation of human resources to support growth and operational efficiency.

Planning *Human Capital* on Machinery repair service company *X-ray* Focus on developing a skilled and adaptive workforce to support efficient and safe operations. This planning process involves an analysis of human resource needs, including the identification of technical skills and competencies needed in machine repair and maintenance *X-ray* (Kierzkowski & Kisiel, 2021). Furthermore, the company will implement an ongoing training program to ensure employees are up-to-date with the latest technology and security protocols. Recruitment will also be geared towards attracting the best talent who have relevant experience and expertise. In addition, career planning and professional development for employees will be strengthened to increase retention and work motivation. With planning *Human Capital* comprehensive, the company is expected to maintain service quality, respond quickly to technological changes, and ensure maximum safety in its operations.

Recruitment Scheme

In carrying out the recruitment process, there are 2 ways, namely by using talent seekers within the company and the second by using job advertisements (lockers). The advantages of using internal recruitment include relatively low costs, clear career

development, and increased employee motivation and morale so that employees feel cared for and promoted because of a clear career. Furthermore, external recruitment by using job vacancies advertising on social media or print media, employee recommendations, applicants who come directly to the company, *job* fairs, or recruitment service agencies. After the recruitment process is carried out, the next stage is the selection stage, namely the receipt of the application letter, the implementation of psychological tests, *interviews* and the decision of the selection results. In the selection process, after receiving *approval* from the Director, it is forwarded to *Human Capital* for further processing. HC will disseminate the vacancy information through locker advertisements. Next, the vacancy is *published* to the locker advertisement. The results of the application data from the advertisement will be in the process *of screening* prospective employees and selection using *interview methods*, *psychological tests* and *skill tests* (ability) for each field and then *the Medical Test.*

The first step in human capital planning is initial selection and assessment using tools such as the X-Ray Object Recognition Test (ORT), which has been shown to improve operator performance by up to 30% in object detection tests (Hardmeier et al., 2006). This test measures the operator's visual ability to deal with image-based factors such as bag complexity, object overlap, and threat perspective. By prioritizing candidates who score high on these tests, businesses can build a team of operators with resilience to visual fatigue and better detection accuracy. In addition, eye-tracking analysis during initial training can help identify the operator's focus areas, so that the training can be adjusted to correct interpretation weaknesses (Kierzkowski et al., 2025).

Training and Development Strategy

Training and Development Strategy in Service Companies *X-ray* designed to ensure that employees have the necessary skills and knowledge to carry out their duties effectively and efficiently (Armstrong & Taylor, 2020). These strategies include task analysis, individual analysis, training *soft skill*, and functional skills training, tailored to the specific needs of each position and employee (Ambari et al., 2020).

Table 1. Training Needs Analysis *Human Capital* PT. CKK

Strategy Elements	Indicator
Identify Needs	1. Analysis of training needs per division. 2. Prioritize technician training, customer service, and R&D.
Technical Training Program	1. IoT/Chatbot training, technician certification, hands-on workshops. 2. Focus on preventive maintenance and predictive analytics.

Strategy Elements	Indicator
Soft Skills Development	1. Empati, problem-solving, leadership training. 2. Team building and communication workshops.
Platform E-Learning	1. Module online, knowledge base, tracking progress. 2. Mandatory 2 modules/year per employee.

Source: PT CKK (2025)

Soft skills *training* aims to develop interpersonal and managerial skills that are essential for creating a harmonious and productive work environment.

Table 2. Training *Soft Skill* Employee *Human Capital* PT. CKK

Types of *Soft Skills Training*	Description
Effective Communication	Train employees to communicate clearly, precisely, and effectively in a variety of situations.
Leadership	Develop leadership skills, including motivation, delegation, and team management (Indradewa et al., 2020).
Time Management	Improve employees' ability to manage work time and priorities efficiently.
Troubleshooting	Train employees in complex analysis and problem-solving techniques.

Source: PT CKK (2025)

Functional skills training focuses on the development of technical and operational competencies specific to tasks in the repair and maintenance of *X-Ray machines*.

Table 3. Training *Hard Skill* Employee *Human Capital* PT. CKK

Types of *Hard Skill Training*	Description
X-Ray *Machine Maintenance*	Train technicians in preventive maintenance procedures and troubleshooting on *X-Ray machines*. *Engineering* ME *Drawing*
Tool Operation	Training on how to operate *the X-Ray* machine safely and efficiently.
Operational Security	Teach safety procedures and protocols in handling and operating *X-Ray machines*.
The Latest *X-Ray* Technology	Knowledge update on the latest technology and innovation in the field *of X-Ray* machines.

Source: PT CKK (2025)

Compensation System

PT CKK is committed to meeting and exceeding the standards set by labor laws in Indonesia, ensuring that all employees receive fair and appropriate compensation. The

following is PT CKK's compensation scheme in accordance with Indonesian labor regulations.Compensation for PT CKK employees is designed to meet eligibility standards and compliance with labor regulations, with a basic salary determined based on position, responsibilities, and work experience, and must meet the provisions of the Provincial Minimum Wage (UMP) or Regency/City Minimum Wage (UMK) (Baskara et al., 2019). In addition, employees receive transportation allowances that are given according to the number of effective working days to support daily mobility costs, as well as meal allowances in the form of meal money of IDR 25,000 per day during official trips or company canteen facilities available once a day. For employees who work more than the standard working hours (40 hours per week), the right to overtime pay is regulated in accordance with Article 78 of Law No. 13 of 2003, with the requirement to attach an assignment letter signed by the direct supervisor. Hari Raya Allowance (THR) is given to employees who have had a minimum working period of one month, referring to the Regulation of the Minister of Manpower No. 6 of 2016. Furthermore, social security protection includes BPJS Employment which includes Work Accident Insurance, Old Age Insurance, Pension Contributions, and Death Insurance, as well as BPJS Kesehatan for health service coverage for employees and nuclear families. Finally, annual bonuses are given based on the company's performance and individual or team contributions, provided that the employee has completed a minimum of one year of service since being appointed as a permanent employee according to the Performance Index assessment. This policy aims to maintain a balance between employee welfare and business sustainability.

Career Development Scheme

At PT CKK, the career development scheme is divided into 2 main parts, where appointment as a permanent employee and then in the form of promotion to the career level. For career paths, we divide based on first positions and then there are groups. An employee can be eligible to be appointed as a permanent employee if he has passed 3 stages of Short-Term Training, namely, the Orientation Stage, the Training and Development Stage, and the Evaluation Stage at the end to determine from the panel team and HC whether the employee joins as a permanent employee or not during the presentation of the Performance Evaluation. Employees will undergo these 3 stages which are divided into 6 months for supervisor positions and below, 1 year for Assistant Managers and Managers, and 1.5 years for General Managers and above. PT CKK develops internal talent through the Career Promo Scheme. The program begins with new employee onboarding, followed by

skills assessments and specific training recommendations. Employees work closely with managers to create career maps that include both short-term and long-term goals. Mentorship programs connect employees with experienced mentors for career guidance (Mabrouk et al., 2022). Annual performance evaluations assess employee achievement, with promotions based on meritocracy. The award system recognizes outstanding contributions through various awards such as *Employee of the Month*. This scheme creates a dynamic and inspiring work environment, motivates employees to achieve success, and ensures investment in employee career development is an investment in the company's future

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Workload Analysis

In the structure of the CKK, the Director is in charge of formulating a strategic vision, building corporate client relationships such as hospitals or industry, and overseeing financial performance and compliance with industry regulations. Its responsibilities are divided into 40% strategy and networking, 30% internal management, 20% finance and equipment certification, and 10% emergency operational intervention. The challenge is to maintain a balance between business expansion and service quality, and avoid getting too deeply involved in day-to-day technical affairs that could distract from long-term planning. The Operations Manager acts as a liaison between strategic management and the technical team with the main responsibility for coordinating service schedules, managing spare parts inventory, and ensuring service standards according to SOPs. As much as 35% of the time is spent on scheduling and logistics, 25% on team coordination, 20% on administration, and 15% on resolving obstacles in the field. The main challenges involve the uncertainty of component supply from global vendors and the pressure to meet *Service Level Agreements* (SLAs) with clients.

Technical Supervisors are responsible for technical supervision, *troubleshooting* complex issues, and knowledge transfer to junior teams. This job consists of 40% direct technical tasks such as tool servicing and calibration, 30% technician performance supervision, 20% training, and 10% report documentation. The limited time to combine technical and managerial roles is a significant challenge, especially in maintaining technical competence as *X-Ray technology* develops dynamically. Senior Technicians have a dominant workload on technical execution (60%) such as equipment repair and maintenance, with an additional 20% for documentation of work results, 15% *junior mentoring*, and 5% participation in team evaluation meetings. They often face emergency response pressures that affect work schedules, as well as the risk of physical fatigue due to high mobility. Meanwhile, Junior Technicians support daily operations with supporting tasks such as component inspection and tool cleaning (70%), 20% of the time is allocated to technical training, and 10% to simple administration. Adapting to the busy work rhythm and lack of experience is a major challenge, so it requires intensive coaching from seniors.

The distribution of workloads shows a clear hierarchy of responsibilities, management focuses on coordination and strategy, while technicians spearhead execution. However, potential *bottlenecks* arise from the reliance on senior technicians to handle complex issues and emergency calls, as well as the risk of an imbalance between mentorship needs and productivity. To optimize efficiency, businesses need to develop digital management

systems for schedule and inventory tracking, strengthen internal training for junior technicians to level up quickly, and implement rotation shifts to reduce emergency response pressure. In addition, strategic delegation and regular evaluations between management levels can ensure flexible adaptation to market dynamics and client needs. The workload calculation will be attached (*Human Capital attachment*).

Job Evaluation (KPI)

PT CKK implements a comprehensive and sustainable employee work evaluation scheme. Evaluations are carried out periodically every six months by the employee's direct supervisor, including performance appraisals based on the achievement of work targets, technical skills, and *soft skills*. Employees are also expected to participate in self-assessments, providing perspective on personal achievements and areas for improvement. This evaluation uses *the Balanced Scorecard* which refers to the framework from Kaplan and Norton (1996), which states that BSC helps translate the vision and strategy of the organization into measurable operational objectives through four main perspectives: financial, customer, internal processes, and learning and growth.

From a financial perspective, the main focus is cost efficiency and revenue growth. Field technicians have managed to reduce the cost of emergency repairs by more than 10% per year through IoT-based damage prediction. R&D *engineers* increase the ROI of innovative projects by over 20% in two years, while *customer service* drives new customer growth of 15–20% per year through loyalty programs. This supports financial sustainability and profitability. In the customer's perspective, the company is targeting increased satisfaction and loyalty. Technicians provide service response in less than two hours and keep satisfaction scores above 4.5. *The account manager* maintains institutional customer retention above 85%, while the marketing team expands the reach of the ASEAN market with 100 new leads per year. All of this strengthens the market position and improves customer relationships.

In internal processes, the focus is directed to operational efficiency and regulatory compliance. Senior technicians keep *system uptime* above 99% with IoT-based SOPs. Logistics accelerates parts distribution in under 24 hours, while QA *engineers* maintain regulatory compliance with zero critical audit findings. Reliable processes support operational expansion and sustainability. From the perspective of learning and growth, the development of human resource capabilities is a priority. Junior technicians are targeted to complete 100% IoT/AI certification within one year. Project managers follow a leadership

program, and the R&D team launches two technology solutions per year in collaboration with startups. This investment in learning ensures the company's readiness for the future. All of these perspectives form a strategic performance management system that is aligned with the long-term vision, in accordance with the *principles of the Balanced Scorecard* (appendix)
Termination of Employment

PT CKK implements the Termination of Employment (PHK) scheme in accordance with the regulations of Indonesian labor laws, especially Law No. 13 of 2003 concerning Manpower and Government Regulation No. 35 of 2021. The layoff process begins with written notice to employees and unions (if any) at least 30 days before the effective date of layoff. During this period, the company holds persuasive actions with employees to reach an agreement. Legitimate reasons for layoffs include company efficiency, disciplinary violations, or employee health conditions that make it impossible to continue working. In the event of layoffs, PT CKK ensures that employee rights are met, including the provision of severance pay, service award money, and compensation money in accordance with. Mitigating employee turnover in PT CKK's organization requires a holistic approach that combines increased compensation, career development, development of a positive work culture, work-life balance, and performance appreciation. The salary structure that is reviewed periodically (at least once a year) and the addition of benefits such as health insurance, BPJS, and transportation allowances are expected to reduce the turnover rate by 10–15% in one year, accompanied by an increase in employee satisfaction scores of up to ≥80% in internal surveys (Yusuf et al., 2022).

Career development through clear promotion channels, technical and soft skills training programs, and job rotation aims to increase employee retention by up to twofold, with a target of increasing the number of internal promotions by 20% per year. A positive work culture is built through an open door policy, collaborative team activities such as team building, and rapid conflict mediation to reduce workplace complaints by ≤10% and increase team participation ≥70% (Kotler et al., 2022). Work flexibility such as remote/hybrid systems, mandatory overtime restrictions only for emergency situations, and the provision of additional leave (e.g., mental health leave) are designed to reduce burnout absenteeism by 25% and improve employee mental well-being scores. Performance appreciation through monthly/annual awards, public recognition in internal forums, and non-monetary incentives such as vouchers or vacations aims to increase satisfaction with awards by 30% and extend the tenure of employees with >3 years of experience by up to 15% (Nguyen & Kumar, 2019).

The integration of this strategy aims to create a work environment that supports workforce sustainability, employee satisfaction, and long-term productivity. Analysis of operator attention patterns through eye-tracking (Kierzkowski et al., 2025) shows that increased competence and reduced human workload can strengthen threat detection accuracy, which is relevant for technical teams in the clinical X-ray screening system business. In addition, investments in IoT-based technical training and predictive maintenance (Wang et al., 2024) not only improve operational efficiency but also strengthen employee engagement through capacity building. In the X-ray machine maintenance service sector, the availability of spare parts and a one-year service warranty (from PT CKK's internal documents) are a crucial factor in retaining certified technicians who contribute to system stability and customer satisfaction (Pivac et al., 2025). With a combination of these strategies, organizations can build an adaptive, collaborative, and sustainable HR foundation amid fierce industry competition.

CONCLUSION

Human capital is the main pillar in the business planning of the *X-ray* Screening System Clinic. HR planning that refers to job analysis, competencies, and readiness indexes results in an organizational structure that is efficient and responsive to customer needs. This research provides initial guidance for clinic managers in recruiting, training, and assessing team performance in a professional and measurable manner. Further research is recommended to explore the correlation between human capital investment and patient satisfaction and customer loyalty. The results of this study confirm that strategic human capital planning must be carried out before the opening of the clinic, so that efficiency and quality of services are achieved from the beginning of operations. The utilization of the HR readiness index can help managers determine training needs and allocate labor according to daily service capacity. KPI-based performance appraisals are also important to maintain quality standards and customer satisfaction.

The limitations of this study include the dependence on available secondary data and the focus on the local Indonesian context, so the generalization of the results needs to be further studied with primary data in the future. Thus, this research provides a practical framework for building an adaptive human capital management strategy, focusing on technology, regulation, and customer needs.

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