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A MODEL OF TECHNOLOGICALLY CHOOSING EMPLOYEES IN AN AEROSPACE INDUSTRY PROJECT

The challenges of interviewing candidates for positions in cybersecure communications of aerospace industry. Data and experiments conducted as evidence that the improvements to the current model of selecting employees are needed in the real-world applications. A proposal of a newly developed method of selecting job candidates using information technology.

Keywords: aerospace, hiring process, cybersecurity, communications, project management.

Statement of the Problem (Introduction)

In a developing industry that is information technology, the model of selecting candidates for an aerospace position can be considered obsolete. Therefore, improvements need to be made to the current method of selecting professionals, whether via online recruiting websites, industry social media, regular social media, virtual interviews, interviews in-person, resume reading, asking open-ended questions, and many more. The novel method discussed in this paper will explain how the implementation of information technology and computer science can greatly improve the process for selecting employees for the aerospace industry.

Analysis of recent research and publications

Choosing employees technologically means applying information technology in the hiring process in order to improve the chances of hiring the right applicant [1].

In paper [2], an analysis of how human factors can impact the hiring process is presented. The main human factors that impact the reliability of the hiring, interview, and review processes are:

- intentional destruction;
- detrimental misuse;
- dangerous tinkering;
- naïve mistakes;
- aware assurance;
- basic hygiene.

The first two human factors are made by people intentionally and they are considered to be malicious. *Intentional destruction* refers to people with technical background who are trying to do harm during the interview process, for example, make one candidate seem better than the other by adding untrue things to their application even when it's already in the company's database [3].

Detrimental misuse refers to people who want to cheat on the hiring process, but lack the technical experience to do so [4], for example, if the person wants to add their favorite candidate to the top of the candidates' list, they might not know how to do that technically, so they might do so by manually adding all the candidates in the order that the person wishes them to be in.

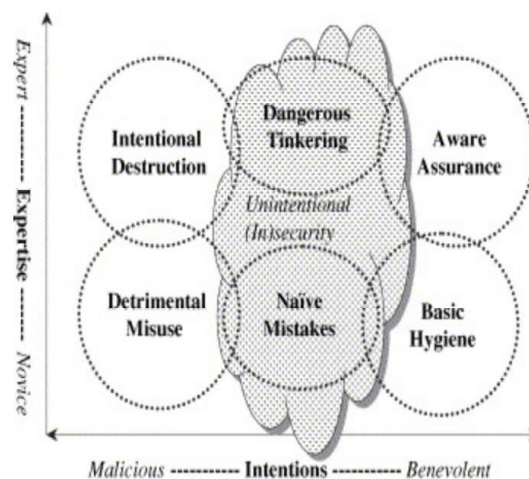


Fig. 1. End-user security behaviors [5]

The second two human factors are made by people unintentionally, meaning that people did not mean to cause the system, in this case the hiring process, any harm. *Dangerous tinkering* refers to people who are experts in the information technology field and are simply playing around the system for various reasons, for example, such person might be trying to make the system work quicker or more efficiently, but instead they make a mistake and therefore pose a threat to the entire process of selecting candidates for the organization's new full-time or part-time position.

Naïve mistakes refers to people who do not want to do any harm, but also lack any technical expertise, so they might cause harm simply by clicking on the wrong button or folder. Naïve mistakes is considered to be the

most common behavior since any person in the company can be a part of it, even if they lack computer knowledge [6].

The last two human factors are positive and benevolent. *Aware assurance* and *Basic hygiene* are two things that make the people working with the process more aware of what they are doing at all times and also make sure that they close all windows on their computer, therefore “cleaning” the area so that unauthorized people would not be able to access sensitive data.

Isolation of previously unresolved parts of a common problem. Objective

In this paper, an analysis of how the technology can at times help to not only speed up the initial process and therefore give more time to employers to communicate with applicants individually, but also be more thorough in looking into the candidate’s background, simply because the computer can typically do that faster than a human being.

The purpose of this article is to create models and methods of technological hiring process, meaning the process that will implement information technology and computer science to its benefit in order to find the best candidates for a particular job in aerospace industry.

The article solves the following tasks:

- creation of a novel method of technologically selecting candidates, specific to the aerospace industry;
- developing models on how to make such a computerized process quick, efficient, and with as less mistakes as possible;
- proving that the current method of selecting candidates lacks the use of computerized systems for the hiring process, as that will greatly decrease the possibility of a human error.

In this study, different types of analysis were used to provide evidence for the claims in this paper. Theoretical and experimental data are both shown in this paper to solve various problems which can be encountered throughout the hiring process in any aerospace organization, specifically in the department which is responsible for making sure the communications are secure.

The main research material

The task to accomplish the goal of finding the most suitable employees to work in aerospace industry, specifically in the communication department of cybersecurity can be achieved by taking the following steps:

- define a clear path of the hiring process {4.1};
- understand how to follow the strategy behind the process {4.2};
- define which improvements need to be made to the current method of selecting professionals, whether via online recruiting websites, industry so-

cial media, regular social media, virtual interviews, interviews in-person, resume reading, asking open-ended questions;

- propose new ideas which will help integrate technology into the process of selecting candidates; for example, artificial intelligence, database configuration, the randomness of interview questions, as well as their order and whether they are open-ended or not, the establishment of time limits and making sure that those are equal for each and every candidate {4.3} [7];

- distribute the hiring process resources more efficiently [8];

- analyze the information in every hiring process to make the next one even more organized and regulated using the technology available at the time of the process.

4.1 Model of a clear path of the hiring process

The proposed recruitment process system is to have thirteen steps, starting with the initial desire to hire a new cyber security professional and finishing off the process with the review of the applicant’s interview before deciding whether or not to hire the individual. The first step is to identify that a new hire is needed. The first step is almost always done by the hiring manager. In rare cases, a respective department may recommend that a new hire be added to their team, but the hiring process would still be officially started by the hiring manager. After the initial need is identified, it is crucial to create a correct and precise job description which would include the newly developed job’s duties and responsibilities, as well as information on what the department is looking for in the new professional. Some of the examples might include but are not limited to: a Bachelor’s or a Master’s degree, a certain type of technology or/and cybersecurity certification, a number of years in the computer science or information technology field, the years and type of expertise with a particular type of equipment, and others.

The next step in this newly developed recruitment system would be to upload the job description to the recruitment system on the computer. This step ensures that all the information about applicants is in the computer’s system. Thus, it can be classified which would save time and the recruitment department’s energy and resources. For instance, by using a computerized recruitment system, all applicants can be sorted by their name, by their number of years of experience in the field, by their preferred salary, and by other filters which can be customized when creating the software for the recruitment system. The next step is to post the job description on different websites and various social media platforms. This is the time to publish the job alert on the company’s official website and, if the company desires to get more people to see their job opening, to promote the job alert on various Internet search

platforms, such as Google, Yahoo, Yandex, Bing, and many others. Then the applicants' information is collected from all the websites and social media platforms and organized in the company's recruitment system on the company computers in order to provide the best cyber security during the hiring process.

The sixth step is done by the human resources department or a recruiter. The recruiter can be outsourced (come from an outside organization) or the company can have its own technology recruiters, which is usually the case with major technology organizations. The first thing that recruiters look at while going through application files is whether or not the applicant meets the basic requirements. Those requirements are usually included in the job description, but some people might overlook them and apply for the job without having the needed experience or specific expertise. If the applicant does not meet basic requirements, a rejection email is sent to that applicant. The rejection email can be sent automatically by the recruitment software if it is customized and set up to do so. If the applicant does meet the basic requirements, usually the applicant is invited to an initial phone interview. The phone interview usually lasts anywhere from ten to thirty minutes and can include basic questions regarding the applicant's previous experience or, if the applicant is fresh out of college, the questions asked can be about the classes the professional took as a student.

After the phone interview the recruiter determines if the applicant meets the job requirements which are a tad more specific than the basic requirements mentioned in the job opening advertisement. If the interview is successful, the applicant is invited for an in-person interview with the recruiter. In some cases, the face-to-face interview can also include members of different departments, however, as a rule, it is the recruiter who conducts and leads those in-person interviews with the applicants.

The recruitment system suggests multiple time slots for the applicant to choose (the time slots are put in the system manually by the recruiter who will be conducting the face-to-face interview directly).

After the applicant chooses their preferred time slot, comes in for the actual in-person interview, the interview is conducted. Such an interview is typically longer than the phone interview and can take anywhere from thirty minutes to an hour and a half. The length of the interview depends on whether or not the department wants to confirm that the applicant has the exact type of knowledge and expertise the department is looking for. For example, the department might ask the applicant to complete a coding test which would show as evidence

that the applicant has the skills the department wants to have in the new hire. Because of the newly developed computerized recruitment system, the interview can be mostly digitized.

The video and audio of the face-to-face interview can be recorded and reviewed later after the applicant has left the company premises. It is usually required that a company let the applicant know that they are being recorded. Overall, the recruiter makes a decision within a few days after the in-person interview is conducted, but it may take a longer amount of time for larger technology companies.

The figure 2 above explains the steps necessary to conduct a fair and efficient hiring process in order to find a new team member, applicable to aerospace industry. A few steps that should be noted are:

- *Identify hiring need and determine the job requirements* - This is the very first step and it would be fair to say that the efficiency of the entire process depends on how well and clear the job requirements are presented. This can help find the most suitable candidates and might even attract more qualified people to apply;

- *Post job opening to company website, preferred job boards, and social media* - Promoting the job on the Internet, especially on social media, can guarantee a higher chance of more people knowing that such a position is available. However, it is important to post the job opening on websites and in social media groups which are related to the job occupation desired. For example, it would be smarter to post a Cybersecurity Specialist job opening in a Computer Science group instead of posting it in a Photography group. There is not enough statistical data to provide the evidence that the potential employee might be or might not be involved in both groups, but there has been some research that media success in the information technology industry depends on people's preferences of the subject [9];

- *Conduct phone screening* - It is extremely important to understand that the potential employee might not show their best over the phone. Thus, in order to avoid deleting the right candidate from the database after the initial phone call, it is crucial to ask the candidate questions which are close to the basic requirement questions and questions that are open-ended [10];

- *Review top candidates and interview notes to determine the best fit* - This step requires not only to pay attention during the candidates interview, but also write down some notes which could be reviewed later. The interview notes can potentially help greatly with choosing the right candidate, especially helpful while comparing multiple candidates.

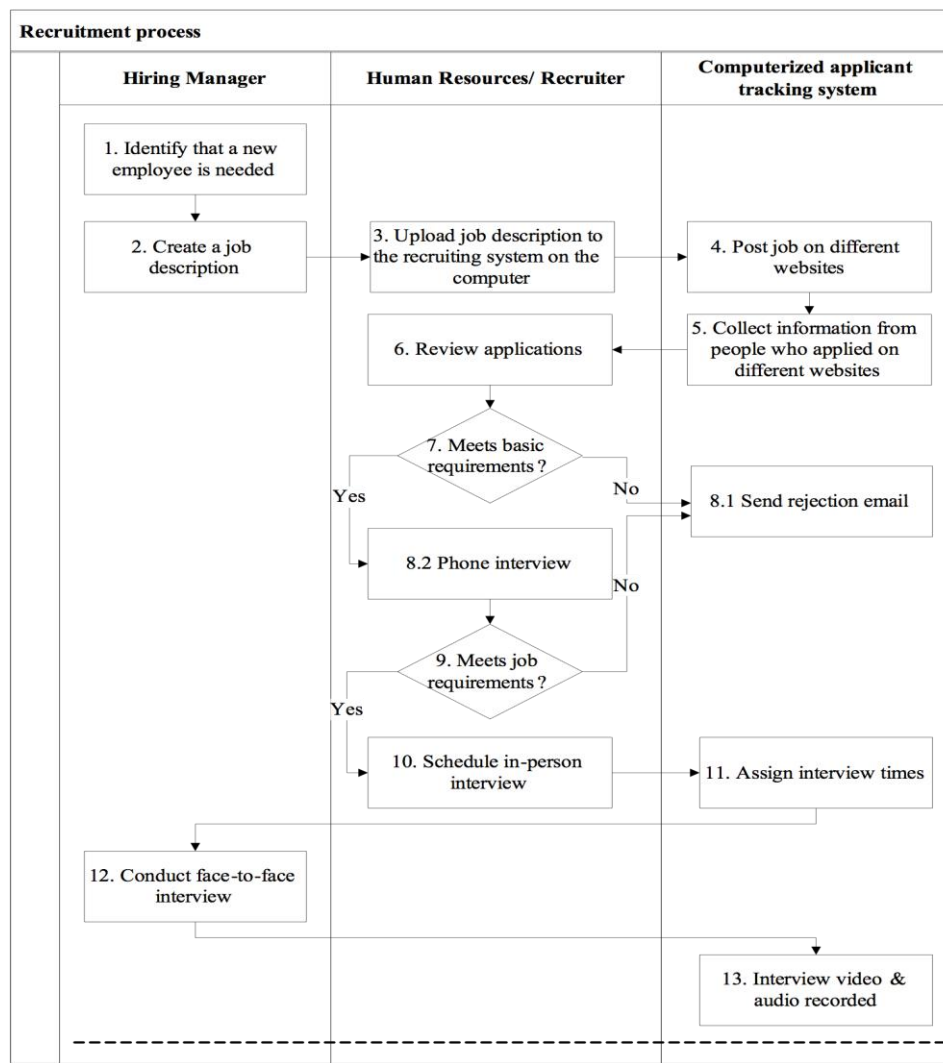


Fig. 2. A flowchart of the recruitment process [11]

4.2 Approach to following the strategy behind the process

One approach to following the model of the newly developed hiring process is thoroughly discussed in [12]. The approach uses multiple important points:

- *Demographic questions* - These kind of questions help determine how many years the candidate has been in the field, the highest level of education they have completed, their major in college, and what area of the potential job would be most interesting and suitable for the professional;

- *Knowledge, Skills, and Abilities (KSA) questions*

- The 32 KSA questions (a few of those are listed in Figure 3 below) determine how important each skill of the 32 information technology skills is and where the candidate learned that skill;

- *Open-ended questions* - These questions were mostly designed to determine if anything was missed in the 32 KSA questions and to get more general knowledge information related to the candidate.

A part of static data which is provided in [12] is shown above. The data describes the results of a ques-

tionnaire about how important certain technological skills are and when the skills were learned by the potential employers. In Figure 3, under the “*Importance to Job*” column, we have **n** which is the number of people who responded to this question, **M** which is the mean of all the answers, **SD** which is the standard deviation of the importance ratings for each Knowledge, Skills, and Abilities question (KSA question). A little over to the right we have **t values** which show the result of single-sample t-tests, and we have **d** which is the effect size and it indicates what the difference between the mean (M) and the a neutral importance rating is, when expressed in terms of standard deviations (SDs). Under the “*Where the KSA Was Learned*” column, we have **n** which is the number of people who responded to the questions and different percentages of the answers given: **job** if they learned the skill at work, **school** if they acquired the skill while being at school or university, **self** if they learned the skill through self-study, **other** if they had gotten the skill somewhere else, or **n/a** which means they did not have that particular skill at the time of the questionnaire.

Knowledge, Skill, or Ability (KSA)	Importance to Job				Where the KSA Was Learned					
	<i>n</i>	<i>M</i> (<i>SD</i>)	<i>t</i>	<i>d</i>	<i>n</i>	job	school	self	other	n/a
1. How traffic flows across the network	43	5.14 (1.57)	6.860*	1.05	43	44.19	23.26	16.28	9.30	6.98
2. Network protocols	43	5.09 (1.48)	7.072*	1.08	43	48.84	27.91	16.28	2.33	4.65
3. System and application security threats and vulnerabilities	42	5.00 (1.29)	7.548*	1.16	42	52.38	9.52	28.57	7.14	2.38
4. Basic system administration, network, and operating system hardening techniques	44	4.95 (1.46)	6.599*	0.99	44	54.55	6.82	31.82	6.82	0.00
5. Network security architecture concepts	43	4.93 (1.40)	6.680*	1.02	43	44.19	32.56	11.63	4.65	6.98
6. General attack stages	43	4.91 (1.52)	6.051*	0.92	44	61.36	6.82	18.18	13.63	0.00
7. Different classes of attacks and recovery concepts and tools	42	4.86 (1.42)	6.176*	0.95	42	57.14	4.76	21.43	11.9	4.76

Fig. 3. Results of a questionnaire, answered by hiring candidates [12]

The total number of participants who took part in this KSA study was forty-four cyber security professionals. It is seen that that number *n* can change depending on whether each and every one of the professionals chose to answer each question. The participants remained anonymous, however, the two conferences where the questionnaires took place, Black Hat and DEF CON, were held in the United States, so it is safe to assume that the professionals worked at companies or governments mostly pertaining to the United States of America. It is worth noting that the majority of participants had completed some kind of higher education (associate's, bachelor's, master's, or other kind of university or higher education degree or/and certification) and the average age of how long the participant's been in the cyber security field was 13.79 years [12]. The participants were said to had worked at fields such as computer network defense analysis, computer network defense infrastructure support, incident response, vulnerability assessment and management.

The complicated results included the 32 KSA questions, the first seven of which will be discussed below. For each of the 32 KSA questions, the participants rated how important that particular skill in question was on a scale of 1 to 6 and stated where they had learned that language or soft skill. For the first Knowledge, Skills, and Abilities question which was to rate the important of traffic flow through the network, the mean of all given answers (the total number of answers to that question was 43, given that each participant could only rate this question once) was 5.14 on a scale of 1 to 6. From that we can conclude that cyber security professionals consider the knowledge of the system's traffic flow a valuable skill to have. If we take the next KSA question which is the important of network protocols on a scale of 1 to 6, we can see that even though the same number of participants (43 people) answered this question, the mean went down to 5.09. That means that, generally speaking, professionals in the cybersecurity world consider network protocol to be somewhat less of an important skill compared to the knowledge of how traffic flows through the system. All the other KSA questions can be explained similarly and

a more detailed description of all the data acquired can be found in [12].

4.3 Proposal of new ideas which will help integrate technology into the process of selecting candidates

Some of the things in the current method of selecting professionals simply need to be improved, but there are also some things which need to be added. Some of the things that need to be improved are open-ended questions, the format of the interview, the strategy to understand and correctly interpret what the speaking is saying. The format of the interview needs to be smooth and have an even distribution of the hiring process resources to every topic that needs to be discussed [13]. The correct understanding of what the candidate is saying is crucial to understand what the candidate genuinely knows and what information the candidate is simply guessing [14]. Some of the things which should be added to the hiring process are the ability to record the initial phone calls and interviews (with both audio and video), the design of the interview which should be created in advance and personalized for each job candidate, the transcript of the interview which is a verbatim text of every question and answer that was said during the phone or in-person interview, the analysis which means that time right after the interview should be devoted to once again reviewing the professionals' qualifications, their ability to correctly communicate and their ability to answer questions [15].

Conclusions and prospects for further development

The newly developed method discussed in this paper explains how the implementation of information technology and computer science can greatly improve the process for selecting employees in the aerospace industry.

A model of a new hiring process has been developed and improvements have been proposed to the current method of selecting candidates. After conducting research and analyzing statistical data, it is clear that open-ended questions are one of the priorities while interviewing potential candidates in aerospace industry. The information taken from each hiring process needs to

be analyzed in order to make the next hiring process go smoother and in order to give the hiring company or organization the best possible chance of choosing the right person for the job.

The proposed models and methods of this newly developed hiring process with the implementation of information technology will improve the efficiency of selecting the most suitable candidates for jobs in aerospace industry, especially in the cybersecurity department of communications.

A promising prospect which can be developed based on this paper is the creation of computer software which can fully automate the recruitment process and better regulate the use of human resources.

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МОДЕЛЬ ТЕХНОЛОГІЧНОГО ВІДБОРУ ПРАЦІВНИКІВ В ПРОЕКТІ АЕРОКОСМІЧНОЇ ГАЛУЗІ

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В роботі проведено аналіз літературних джерел з управління проектами, визначена специфіка забезпечення процесу відбору кандидатів в проекти аерокосмічної галузі. Визначено напрями удосконалення

сучасних способів відбору професіоналів для проектів аерокосмічної галузі. Проаналізовано вплив людського чиннику на процес найму.

Метою статті є розробка рекомендації щодо удосконалення процесів найму людських ресурсів в проєктах авіаційної галузі з метою підвищення ефективності управління проєктами.

Розроблена методика відбору кандидатів на роботу з використанням інформаційних технологій.

У статті запропоновано метод технологічного відбору кандидатів, специфічний для аерокосмічної галузі. Проведено аналіз існуючих методів відбору персоналу та доведено, що нинішній спосіб відбору кандидатів позбавлений належного використання комп'ютеризованих систем при прийомі на роботу.

Розроблено модель процесу найму та запропоновано вдосконалення існуючого методу відбору кандидатів. Проведено моделювання процесу найму персоналу для проєктів аерокосмічної галузі. Залежно від власника процесу, етапи моделі поділяються на три категорії: кроки, здійснені менеджером з найму, кроки, здійснені відділом людських ресурсів або рекрутером, і етапи, які здійснює нова розроблена комп'ютеризована система відстеження заявників. Запропонована система процесу набору персоналу має тринадцять етапів, починаючи з ініціації найма нового спеціаліста з кібербезпеки і закінчуючи процес переглядом співбесіди заявника перед тим, як прийняти рішення щодо прийому спеціаліста в команду проєкту.

Проведено аналіз процедури проведення опитування. Після проведення досліджень та аналізу статистичних даних визначено, що відкриті питання є пріоритетними під час опитування потенційних кандидатів в аерокосмічній галузі. Розглянуто підходи до дотримання стратегії управління людськими ресурсами, що лежать в основі процесу.

Ключові слова: аерокосмічна галузь, процес найму, кібербезпека, комунікації, управління проєктами.