Lecture Notes in Networks and Systems 303

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Preface

We are pleased to present this volume of the selected contributed articles, submitted and presented in the 3rd International Conference on Information Systems and Management Science (ISMS) 2020, which held on December 15 and 16, 2020, at The faculty of ICT, University of Malta, Msida, Malta, in collaboration with the International Association of Academicians (IAASSE), USA. (Conference link: http://isms.iaasse.org/.). The 3rd International Conference on Information Systems and Management Science (ISMS 2020) is a platform for researchers, engineers, academicians as well as industrial professionals from all over the world to present their research results and development activities in information systems and management sciences. The event (ISMS 2020) took place in hybrid model, thereby allowing some authors to present their papers virtually because of COVID-19 and the government's restriction on any gathering. And by that, organizers fulfilled their commitments with researchers and supports the scientific research.

The papers presented in the ISMS 2020 went through strict refereeing and examination resulting in a current acceptance rate of 48.9%. All papers were selected for oral presentation in the conference after an initial review. Every submitted full length paper was sent for peer review to at least two potential reviewers of related areas of expertise once it was passed by the program committee. We are delighted to say that this is in no small part due to the hard work the editorial board and reviewers, in not only refereeing the papers submitted but raising the standard of the quality of papers that are to be published. Last but not least, as the guest editors of ISMS 2020 proceedings, we are thankful to people who have worked with us in planning and organizing both technical arrangements. We also thank all

learned authors for their kind cooperation and contribution. Hope that the quality research work published in this issue will be able to serve something new to Humanity and Science.

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Contents

Creating High-Performance Work System in Technology Startups

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Abstract. Modern manufacturing provides an opportunity to invest in the latest technologies and systems for improving productivity. Innovative technologies and systems such as the High-performance work system enhance the skills of the employees. This study is undertaken to understand the relationship between objectives of the implementation of High-performance works system and its application in technology startups, and to gain a deeper understanding of the implementation of High-performance works system in technology startups further, the study also considers the role of managerial capabilities required for the effective implementation of a High performance works system in technology startups. The data used for the study was collected from 28 Technology start-ups in Karnataka, India, using a structured questionnaire. The results have indicated that the role of managerial capabilities and clarity with regards to objectives of the implementation of a High-performance works system is paramount for effective implementation in technology startups.

Keywords: High-performance work system · Technology startups · Managerial capabilities · Human resource management · Manufacturing capabilities · Competency

1 Introduction

High-performance works systems are a block of HRM practices that characteristically consist of the following emphases: staffing, training, flexible work assignments, communication, decentralized decision making, self-management teams, and compensation [1]. A high-performance works system is influencing the technology startups, for realizing the full potential of a High-performance works system requires an integration of managerial capabilities and manufacturing capabilities. One of the most common factors that influence realizing managerial capabilities and manufacturing capabilities is the investment in this Human resource and technology.

Technology startups have become the foundation for economic growth in today's world of business. Yet only a few factors are known that contribute to the success or

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failure of a startup [2]. Most of the research work done in the area of High-Performance Work System attempts toward the study of direct association amongst the management practices and the Performance outcomes [3]. This research study reports this expansive inquiry by exploring the role that high-performance work systems (HPWS) with special consideration to managerial capabilities and clarity and the objectives of the organization.

A high-performance work system comprises of the most important task of Staffing, which take into consideration the courses of actions wherein the capabilities for job fit and organization fit are appraised. The comprehensiveness of this procedure is based on the evaluations at three different levels. These assessments are established on basis of "knowledge, skills, and abilities (KSAs)", which ultimately result in selecting the best candidate for the specified position. The technology Startups do not have time to undergo a very detailed staffing process [4] whereas it is argued that staffing is the most important portion of HPWS which enables the organization in achieving competitive advantage. Highest, KSA value and distinctiveness is conceivably not essential for every single position, but the significance is in determining the appropriate Job fit and organization fit to augment augmented performance of both organization and individuals. Finally, as a prologue to careful staffing, thoughtfulness in attracting the right applicants from an organizational level [5] may be a significant and disheveled characteristic to confirm selection from the best talent pools.

2 Literature Review

In this section, the study presents a literature review on the application of a High-performance works system, managerial capabilities related to a High-performance works system, and factors associated with objectives of the implementation of a High-performance works system in SMEs.

2.1 High-Performance Work System

The theory of a high-performance work system (HPWS) creates a prerogative that there subsists a structure of work practices for basic workforces in a business that points in some manner to superior performance [5]. Both high-performance work systems and technology Startups have established increasing consideration in HRM research. Conversely, the works on HRM in technology Startups have largely fixated on the problems of "homogeneity" versus "heterogeneity" behaviours, on the one hand, and the opposite amongst the "small is beautiful" and the "bleak-house" perspectives on the other [6]. The stakeholder associations and the assurance of owners to human resource management (HRM) are the two key facets defining the implementation of HPWS [7]. The basic social structure of an organization can arbitrate the relationship between high-performance work systems (HPWS) and organizational performance. HPWS impacts the core social structure by expediting associating network ties, universal rules of reciprocity, shared role making, organizational citizenship behavior, and mental models [1]. HPWS employment is certainly connected with the growth in sales and innovation; conversely, a postulated arbitrating role for employee voluntary turnover is not supported [2]. Lastly, High-Performance Work Systems are deliberated to augment organizational

performance by fostering employee proficiency, commitment, and efficiency. The potential of a high-performance work system to assist as an incomparable resource associate with the effective application of corporate strategy and the accomplishment of operative goals [8].

2.2 Technology Startups

New-fangled technology startups are seen as an essential element of the economy [9], technology startups present a fascinating medium, distant from main markets but opulently gifted with human capital. A technology startup can be run on a personal basis in its initial days. The corporate mission and chosen strategy of a technology startup can be successfully carried through direct communication with each employee [10]. An interconnected set of policies focusing on the ensuing problems must be established improving job training, growing employee and union involvement; Growing firms' assurances to stakeholders, building inter-firm collaboration and quality standards and ruling out the low-wage path [11]. Enticing, choosing, and training employees are time and again precarious actions for most technology startups. The study recommends that high-performance work systems enhance organizational performance [4]. Industry 4.0 delivers new standards for the industrial management of technology startups. Sustained by a developing number of innovative technologies, this theory seems more flexible and less costly than traditional enterprise information systems such as ERP and MES [12]. However, technology startups catch themselves ill-equipped to face these new-fangled prospects concerning their production planning and control practices.

The tactical role of HRM, and precisely, the stimulus of an organization's HRM structure on the financial performance, has created significant curiosity within the academic groups [8].

2.3 Objectives of the Implementation of High Performance Works System

Technology startups implement High performance works system with specific goals to achieve, these goals consist (i) Flexibility (ii) Cost reduction (iii) Enhancing productivity (iv) Improving quality (v) Reduce time of delivery. These factors are well documented in the study of Moeuf et al. (2018). The flexibility goal is concentrated towards the ability of the human resource to get adjusted to varied works and situations [13]. The second goal is the reduction of cost through a High-performance works system which has resulted in reducing the cost of manufacturing [14]. Thirdly, improving the productivity in manufacturing through High performance works system [15]. Product quality can be enhanced through training and developing the skills of employees, hence a high-performance works system plays a key role in improving the product quality [16]. Application of a High-performance works system to lean manufacturing improves the production flow and improves delivery [17, 18].

2.4 Industrial Managerial Capacity

Managerial capabilities are significant for the effective employment of technology in technology startups. Alexandre M et al. presented the managerial capabilities structure

for understanding Industry 4.0, which also embraces High performance works system, the aspects related to managerial capabilities are (a) monitoring (b) control (c) optimization (d) autonomy. The factor of monitoring in the manufacturing process is achieved through monitoring capabilities. Control as managerial competencies, which offers past data of manufacturing and also indicates the level of acceptance in manufacturing [16, 19]. The subsequent variable of managerial capabilities contains optimization which is dedicated in the direction of refining the process and accomplish a higher level of productivity of manufacturing, outcomes with regards to technology startups have shown an optimistic relationship with regards to productivity and High performance works system. The last, variable related to managerial capabilities is autonomy, which specifies that execution of a High-performance works system entails several techniques and technologies for effective implementation [13, 20–23].

The literature mentioned above on application of High performance works system, objectives of adopting High performance works system and role of managerial capabilities for implementation of High-performance works system, specifies the following questions for the study, which are as under:

Q1: The association amongst application of High performance works system and managerial capabilities in technology startups.
Q2: The role of managerial capabilities in achieving the goals of implementing a High-performance works system in technology startups.

The above discussion through literature review makes this study unique as it shows a combination of the application of High-performance works system to Objectives of High performance works system and role of managerial capabilities in the adoption of High performance works system in technology startups.

3 Research Methods

Based on the literature survey conducted, the following research methodology was adopted to collect and analyze the data.

3.1 Research Design and Instrument

In this research, an exploratory research design is used to comprehend the implementation of a High-performance works system in technology startups. The data were assimilated using a structured questionnaire on a 5 pointer Likert scale.

3.2 Data Collection

The data for the study was collected from 28 technology startups (Break-up is provided in Table 1) that employed a High-performance works system in Karnataka, India.

3.3 Data Analysis Tools

The data collected is studied through a paired sample t-test, which decides the variance between a set of observations. Therefore, in this research variance between the implementation of High performance works system to Goals of application of High-performance works system and managerial capabilities are studied. The use of paired sample t-test is suitable as the data is collected through a Likert scale from technology startups who have implemented a High-performance works system [24]. The summary of the respondents for this research is presented in Table 1. The profile is established on the number of employees working in the organizations under consideration for the present study.

Table 1. Profile of respondents for the study based on "number of employees"

Sl. no.	Profile of the respondents	N	%
1	100–150 employees	11	39.29
2	70–100 employees	7	25.00
3	50–70 employees	4	14.29
4	<50 employees	6	21.42
	Total	28	100

4 Results and Discussions

The results of the study are represented in this segment. Results are shown in Table 2 and Table 3. The results of the analysis are presented concerning the association between the application of the High-performance works system and managerial capabilities essential for effective implementation of HPWS (High-performance works system) and in addition with regards to managerial capabilities and objectives of the implementation of HPWS (High-performance works system).

Operational performance in technology startups with High performance works system and relationship with the managerial capability of Optimization (CAP3) has shown a positive association with Sig. of 0.002 which is less than 0.05 value of significance, though there is an adverse relationship with respect to monitoring where Sig. of 0.129 is greater than 0.05, In the case of Control the Sig. is 0.020 which is less than 0.05 and for Autonomy, the Sig. is 0.025 which is again less than the 0.05 value of significance. The Flow of information has displayed a positive association with monitoring.

The outcomes concerning the flow of information with a High-performance works system and monitoring have presented positive results with a Sig. of 0.00 which is less than 0.05. Conversely, outcomes with respect to control and autonomy are not significantly associated with a value of 0.38 for control and 0.96 for autonomy respectively which is greater than 0.05. However, for the flow of information and optimization, the results have shown a positive association with a Sig. value of 0.004 which is less than

Table 2. Association between the implementation of High performance works system and managerial capability

Groups	Association	Mean	SD	Error	95% confidence interval of the difference		t	DF	Sig. (2-tailed)
					Lower	Upper			
1	HP1 – CAP 1	0.21	1.14	0.13	−0.06	0.47	1.54	72	0.13
2	HP1 – CAP 2	0.43	1.53	0.18	0.07	0.78	2.38	72	0.02
3	HP1 – CAP 3	−0.43	1.11	0.13	−0.68	−0.17	−3.29	72	0.00
4	HP1 – CAP 4	0.37	1.38	0.16	0.05	0.69	2.29	72	0.03
5	HP2 – CAP 1	0.95	1.41	0.17	0.62	1.28	5.72	72	0.00
6	HP2 – CAP 2	0.36	1.44	0.17	0.02	0.69	2.12	72	0.04
7	HP2 – CAP 3	0.58	1.76	0.21	0.17	0.99	2.80	72	0.00
8	HP2 – CAP 4	−0.27	1.39	0.16	−0.60	0.05	−1.69	72	0.10
9	HP3 – CAP 1	0.52	1.69	0.20	0.13	0.92	2.63	72	0.01
10	HP3 – CAP 2	1.10	1.87	0.22	0.66	1.53	5.02	72	0.00
11	HP3 – CAP 3	−1.22	1.60	0.19	−1.59	−0.85	−6.51	72	0.00
12	HP3 – CAP 4	−1.00	1.78	0.21	−1.42	−0.59	−4.80	72	0.00
13	HP4 – CAP 1	−1.85	1.39	0.16	−2.17	−1.53	−11.35	72	0.00
14	HP4 – CAP 2	−1.06	1.86	0.22	−1.49	−0.62	−4.84	72	0.00
15	HP4 – CAP 3	−0.48	1.80	0.21	−0.90	−0.06	−2.28	72	0.03
16	HP4 – CAP 4	0.66	1.63	0.19	0.28	1.04	3.45	72	0.00
17	HP5 – CAP 1	0.88	1.86	0.22	0.44	1.31	4.02	72	0.00
18	HP5 – CAP 2	0.03	1.48	0.17	−0.32	0.37	0.16	72	0.88
19	HP5 – CAP 3	0.82	1.83	0.21	0.40	1.25	3.84	72	0.00
20	HP5 – CAP 4	1.40	1.98	0.23	0.93	1.86	6.02	72	0.00

(Aberrations: HP1: Operational performance, HP2: Flow of information, HP3: Fast evaluation of performance, HP4 Improved decision making, HP5 Integration of work, CAP1 Monitoring, CAP2 Control, CAP3 Optimisation, CAP4 Autonomy, I: Mean, σ: Standard deviation, ϵ: Standard error, DF: Degree of freedom).

0.005. Fast assessment of manufacturing performance has indicated a positive association with respect to control, optimization, and autonomy with Sig. of 0.000 which is less than 0.05. Conversely, with respect to monitoring the results have indicated a negative relationship with a Sig. of 0.10 which is greater than 0.05. Decision making with High performance works system and Managerial capability has presented a positive association with regards to monitoring, control, and autonomy with a Sig. of 0.000 which is less

Table 3. Relationship between managerial capability and objectives of the implementation of high-performance works system

Groups	Association	Mean	SD	Error	95% Confidence interval of the difference		t	DF	Sig. (2-tailed)
					Lower	Upper			
1	CAP1 - OBJ1	−0.38	1.43	0.17	−0.72	−0.05	−2.29	72	0.03
2	CAP1- OBJ2	−0.16	1.29	0.15	−0.47	0.14	−1.09	72	0.28
3	CAP1- OBJ3	−1.01	1.54	0.18	−1.37	−0.65	−5.62	72	0.00
4	CAP1 - OBJ4	−0.22	1.46	0.17	−0.56	0.12	−1.29	72	0.20
5	CAP1 - OBJ5	0.36	1.47	0.17	0.01	0.70	2.08	72	0.04
6	CAP2 - OBJ1	0.27	1.10	0.13	0.02	0.53	2.14	72	0.04
7	CAP2 - OBJ2	0.49	1.49	0.18	0.15	0.84	2.82	72	0.00
8	CAP2 - OBJ3	−0.36	1.15	0.13	−0.62	−0.09	−2.65	72	0.01
9	CAP2 - OBJ4	0.44	1.41	0.17	0.11	0.77	2.65	72	0.01
10	CAP2 - OBJ5	1.01	1.41	0.17	0.69	1.34	6.15	72	0.00
11	CAP3 - OBJ1	0.27	1.11	0.13	0.02	0.53	2.11	72	0.04
12	CAP3- OBJ2	0.49	1.19	0.14	0.22	0.77	3.54	72	0.00
13	CAP3 - OBJ3	−0.36	1.25	0.15	−0.65	−0.06	−2.43	72	0.02
14	CAP3 - OBJ4	0.44	1.21	0.14	0.16	0.72	3.09	72	0.00
15	CAP3 - OBJ5	1.01	1.24	0.15	0.72	1.30	6.98	72	0.00
16	CAP4 - OBJ1	−0.18	1.22	0.14	−0.46	0.11	−1.25	72	0.22
17	CAP4 - OBJ2	0.04	1.55	0.18	−0.32	0.40	0.23	72	0.82
18	CAP4 - OBJ3	−0.81	1.39	0.16	−1.13	−0.48	−4.96	72	0.00
19	CAP4 - OBJ4	−0.01	1.47	0.17	−0.36	0.33	−0.08	72	0.94
20	CAP4 - OBJ5	0.56	1.44	0.17	0.23	0.90	3.33	72	0.00

(Aberrations: CAP1 Monitoring, CAP2 Control, CAP3 Optimisation, CAP4 Autonomy, OBJ1 Flexibility, OBJ2 Cost reduction, OBJ3 improving productivity, OBJ4 Improving quality, OBJ5 delivery time reduction, I: Mean, σ: Standard deviation, ϵ: Standard error, DF: Degree of freedom).

than 0.05. Outcomes concerning optimization and decision making are showing negative results with Sig. of 0.26 which is greater than 0.05. Integration into manufacturing with a High-performance works system and managerial capabilities has shown a positive association with respect to monitoring, optimization, and autonomy with a Sig. of 0.00 $>$ 0.05. But, integration and control of manufacturing activity have shown a negative association with a Sig. of 0.875 which is greater than 0.05.

The results of attaining the goals of employment of a High-performance works system and the role of managerial capabilities are specified in this section. Outcomes

with respect to monitoring managerial capabilities and goals of High-performance works system has indicated a positive relationship with respect to improving productivity with Sig. of 0.00 which is less than 0.05 value of significance. Conversely, it shows a negative relationship with respect to flexibility, cost reduction, improving quality, and delivery time with Sig. of 0.25,0.28,0.20 and 0.41 respectively which are greater than 0.05. Managerial control abilities show a positive association concerning cost reduction and delivery time reduction with a Sig. of 0.00 for both which is less than 0.05. The managerial capability of optimization shows a positive association for cost reduction, improving productivity, and reduction in delivery time with Sig. Value of 0.00 which is less than 0.05. Though, a negative relationship is observed concerning flexibility and improved productivity with 0.38 and 0.18 respectively, and which are greater than 0.05. Outcomes with respect to autonomy show a positive association with improving productivity and reduction in delivery time with a Sig. of 0.00 for both and which are less than 0.05 value of significance. On the other hand, it shows a negative association with respect to flexibility, cost reduction and improving quality with a Sig. of 0.215, 0.821 and 0.937 respectively and which are greater than 0.05 value of significance.

4.1 Discussions

The latitude of High-performance works system is further than its application in the technology startups, the areas of research for this study were hooked on to two areas, that is, the relationship between the application of High performance works system and the objective of adopting High performance works system in technology startups and besides, the study was also associated to managerial capabilities essential to implement High performance works system and mapping with goals of application of High performance works system. The outcomes with respect to the implementation of High performance works system and its association with respect to goals of High-performance works system show that the process in technology startups is diligently associated with managerial capabilities i.e., monitoring, control, optimization, autonomy, and the identical is echoed with respect to improved decision making in the process technology startups. Conversely, there are some capacities which necessitate consideration to gain wide-ranging benefits of High-performance works system, which are the integration of human and machines, this would augment operational performance and develop managerial capabilities of technology startups in the attainment of benefits from high performance works system. Consequently, the investigation question with respect to the implementation of a High-performance works system and managerial capabilities show a reasonable level of association and necessitates additional improvement in the flow of information and enhance operational performance.

An additional viewpoint of this research was with respect to managerial capabilities and goals of application of High-performance works system. The results show that managerial capabilities need improvement to attain the goal of the application of High-performance works system technology startups. Despite the fact that the implementation is reasonably effective, this indicates that technology startups have to improve their managerial capabilities for effective application of High-performance works system. Especially with respect to optimization and autonomy.

The alternative role for effective implementation of High performance works system in technology startups is with respect to ascertaining the precise goal for application of High-performance works system. Several firms in the study were not clear with respect to the choice of goals, Most of the technology startups were having multiple objectives, and therefore there was a moderate level of attainment in the application of the High-performance works system.

5 Conclusions

To realize competitive advantage, technology startups must attempt to develop their HRM systems by adopting cutting-edge technology and systems. The current study indicates that technology startups have implemented HPWS (High-performance works system) for augmenting their process. The outcomes of this study have specified that technology startups should understand the association with respect to goals of application of High performance works system in technology startups. The association amongst implementation of High-performance works system and managerial capabilities show that technology startups need to improve managerial skill-sets for effective implementation of High-performance works system. Whereas, the results show that lucidity should be developed with respect to the goals of implementing a High-performance works system in technology startups. The study will further sustain the ineffective implementation of a High-performance works system. Additionally, the study will also make available comprehensive information for augmenting the board area of operations in the added functional area of the technology startups, which will make available a comprehensive understanding of the factors that influence the application of High performance works system in technology startups.

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Optimization of Support Vector Machine for Classification of Spyware Using Symbiotic Organism Search for Features Selection

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Abstract. Malware's key target is to compromise system security pillars, the confidentiality, integrity and availability. Spyware is a form of malware program that collect entity's information including personal confidential information, activity logs on computing system, financial transaction, password and geolocation precision through monitoring target without prior knowledge of victim. The integration of computing devices into daily existence, as well as the exponential development experienced in application development including the expansion of interconnected computing devices serve as goldmine to malicious entities for target and exploit using spyware. In previous literature, Support Vector Machine (SVM) was employed for the classification of spyware, but has suffered setbacks of low performance as a result of untuned parameters as well as the use of irrelevant dataset features for training and classification. The optimization of SVM for classification of spyware using Symbiotic Organisms Search (SOS) algorithm for feature selection was therefore deployed to enhance performance. The results obtained from the study indicate that the technique performed optimally in spyware classification recording the following; 97.40% and 2.3% respectively for accuracy and false positive rate respectively. Therefore, revealed that the optimization of SVM with SOS for classification enhances performance and reduces the rate of false alarm which is an improvement on existing literatures. This points the fact that tuned parameters of the model can be implemented for proper classification of spyware attacks.

Keywords: SVM · SOS · Spyware classification · Accuracy · False positive rate

1 Introduction

Sustainability Compromise of system Confidentiality, Integrity and Availability (CIA) is normally the key target of malware according to [1]. A malware can be referred to as

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malicious software that execute series of codes in systems that have been compromised by its nefarious activities, exploiting the security defense mechanism in place. Virus, worm, trojan, rootkit and ransom-ware according to [2, 27], are examples of malware for which this research focuses mainly on spyware.

Spyware is a program that collects entity's information ranging from personal information, activities performed by entity, financial transaction, password, geo-location precision through monitoring without entity's prior knowledge [3]. Spyware was first recorded in 1995 by Microsoft's business model which denotes as an espionage software, also spyware is an espionage ransomware code that exfiltrates sensitive information.

Spyware software are akin to malicious program as it entices users into application execution, while being stealthy by circumventing removal activities as it uses subliminal channel. Although some spyware program is embedded in End User License Agreement (EULA) as backdoors to obtain user's consent, some spyware is installed without the user's consent. Spyware also have the capability of transmitting harvested information to third party after stealthily monitoring user behavior, web surfing habits, confidential details and user profile.

The exponential engagement of the world population in Information Communication and Technology (ICT) usage as at the 2018 was 51.2% which is 3.9 billion population, there have been a steady upward trend in the incorporation and usage of ICT, likewise cybercrime projection is estimated at USD 2 billion by the end of 2019, as a result of skyrocketing rate of ICT usage [4]. This becomes a challenge to ICT users based on the fact that malicious activities need to be exterminated to avoid breach of CIA, spyware which is one of the stealthy unwitting trending malicious activity needs to be checkmated.

Support Vector Machine (SVM) a supervised machine learning model and noted for a, map feature vectors from nonlinear space to a higher multidimensional dimensional space, thereby making use of linear classifier obtained from the new space, suppose H represents the generated new feature space and $\varnothing$ represents mapping function so that $\varnothing : R^d \rightarrow H$, the feature vector $\bar{x} \in R^d$, the mapping of feature vector is denoted by $\varnothing(\bar{x})$, while the y label stands same, thus, $(\bar{x}_i, y)$ which is the training sample becomes$(\varnothing(\bar{x}_i), y)$, furthermore, H defines the hyperplane in the transformed space, which segregates the training sample $(\varnothing(\bar{x}_i), y_i)$, ..., $(\varnothing(\bar{x}_n), y_n)$. This leads to obtaining a hyperplane in the space H which permits the mapping of feature vector $\varnothing(\bar{x}_i)$ to be segregated on one side of the hyperplane for label $y_i = -1$, and $\varnothing(\bar{x}_i)$ to the other side of the hyperplane for $y_i = 1$, [5, 6].

However, SVM perform better once the parameters such as the kernel function are optimized and optimal feature for classification are also well defined [7–9, 25].

Symbiotic Organism Search (SOS) is a metaheuristic algorithm that is based on organism symbiotic association in an ecosystem widely employed in various fields for optimization of problems ranging from scheduling of task, construction project and engineering structure design optimization. SOS was first introduced by [10, 11] and refer to as a symbiotic based relation of organisms in ecosystem for numerical optimization and engineering design problem, an initial population known as the ecosystem is defined at the initialization stage, which further generates a random organism population, for each related problem, an organism stands as a candidate solution which indicates the

adaptiveness degree of an organism, each organism is bound to pass through the three major phases of symbiotic interaction namely; mutualism, commensalism and parasitism respectively in an iterative process, symbiotic organism search algorithm is effective solution to solve complex numeric computations regardless of it few control parameters compared to some other optimization algorithms [12].

Grid search algorithm to an exhaustive search algorithm, which completely explores a search space, while the variable to be optimized is represented by each dimension of a grid coordinate, the grid search works with a define range of value, known as the maximum and minimum value, that aids in establishing an optimal variable [13].

Grid search algorithms concept is based on setting the parameter values such as the SVM kernel function of C, γ and step sizing, in order to determine a grid search points. Thus, for each parameters (C, γ) in the grid Support Vector Machine model is trained, in which the sample data is evaluated using the optimal selected model of training results [14, 26]. Therefore, this research intends to apply SOS for selection of optimal spyware features that will be trained for classification.

Summary of the key contribution of this study are outlined below;

- We design SOS metaheuristic algorithm for spyware feature selection which obtain optimal features
- We Optimized SVM classifier in order to achieve a superior classification performance over default SVM parameter.

United the remaining sections of the paper were organized as follow Section 2 presents related literature in spyware classification, Sect. 3 reveals the methods employed in the research, Sect. 4 presents the results obtained in performance evaluation of spyware classification and Sect. 5 shows the conclusion and recommendation.

2 Related Literature

[3] in an experiment to classify spyware affected files through the implementation of data mining technique, more than eight thousand malware samples with hundreds of benign sample were used in spyware classification, which was based on Application Programming Interface (API) call dataset, J48 Decision Tree classification algorithm was used, an accuracy, true positive rate and false positive rate of 86.93%, 86.9% and 3.3% respectively was achieved, however, there exist an imbalance dataset sample based on malware to benign ratio, while focus was majorly based on API system call.

[14] proposed a SpyAware framework that encompasses of a profiler, a feature extraction and a classifier, which were to aid in automatic profiling of app execution as it relates to binder calls and system, calls, obtaining feature vectors from execution traces and predicting and training of spyware execution in terms of feature vectors; support vector machine (SVM) and Naïve Bayes classifiers was incorporated at the classification stage. Furthermore, performance level of 67.4% and 64.2% accuracy was achieved in detecting spyware execution respectively, however, the research focuses majorly on smartphone privacy leakage issues, and also based on a define version of Android OS platform, accuracy rate is low and a high undisclosed FPR is said to be achieved.

In order, to counteract the challenges faced by existing anti-spyware tools such as detecting of spyware that have capacity to modify self against detection, [15] proposed a Stateful Threat Aware Removal System (STARS) that has the potent to track critical activities of running process, monitoring spyware removal task effectiveness over a period, and establishing a trade-off between system dependability and system performance as it relates to severity threat of spyware system. To this end, it was establish that STARS has the capacity to detect and remove self-healing spyware a challenge faced by existing commercial anti-spyware tools based on an experiment performed in this study, however, there is a shortfall in overall performance in removing self-healing spyware likewise the proposed method lack the capacity to detect hidden registry entries.

[16] opine a prevention mechanism against key logger spyware attacks, the proposed methodology include the following phase, key logger spyware attack, honeypot based detection and prevention of key logger spyware, generation of spyware attack in order to help track attack behavior, detection of keylogger spyware, monitoring of malicious system activities and permanently disabling the key logger spyware by a prevention server is achieve respectively by the aforementioned phases, it was stated that proposed mechanism if employ can tackle key logger spyware attack, however, focus was designated on key logger spyware attack alone.

Cloud theory model was used to develop an interest model to enable spyware detection, the research, [17] present a novel spyware detection technique that employs an abstract characterization of popular classes of spyware programs through the use of data mining approach as a result of its capacity to discover program of interest in large amount of behaviors, thereby leading to overcoming the drawback associated with unknown signature based detection as the proposed model can detect unknown spyware as well as variant of known spyware theoretically, it was further reveal that the define model was able to detect spyware programs optimally, though, this research was theoretically based and not implemented in real system scenario.

Extraction and selection of optimal features to detect spyware was proposed by [18] in the research that leads to optimal features selection is based on the frequency and appearance of the feature in the dataset as opine in this study. Accuracy performance metrics was employed in this study as well as the following classification algorithms; ZeroR, Naïve Bayes, C4.5 decision Tree (J48), Support Vector Machine (SVM), JRip and Random Forest attaining an accuracy of 91.50%, 99.49%, 99.86%, 99.80%, 99.24% and 99.86% respectively with n-gram equal to 5 out of 100 selected features, J48 classifier outperforming all competing approaches, however, more performance metrics will enhance result interpretation and gauging,

In order to attain an optimal and accurate detection of Adware, data mining algorithms such as Naïve Bayes, Support Vector Machine algorithm SMO, IBk, J48, and JRip were employed in the proposed approach for accurate detection of Adware using Opcode sequence extraction to identify unseen and novel instances of adware along n-gram size, detection rate, false alarm rate, and accuracy were used as performance evaluation metric including area under receiver operation characteristics curve (AUC). ZeroR serve as the baseline classifier, IBk achieve AUC, FNR, FAR of 0.949, 0.022 and 0.115 respectively with $n = 4$ and a 70% split. IBk was said to have outperform

other classification algorithms used, however, focus was based on adware, with a little collection of dataset used in experimental evaluation [19].

The research performed by [19] basically based on evaluation of Windows platform executable achieve through the implementation of machine learning algorithms such as ZeroR, Naïve Bayes, Support Vector Machine (SMO), J48, Random Forest, and JRip classification algorithms, also, a 10 fold cross validation was employ to classify unseen binaries. Accuracy and Area Under Receiver Operation Characteristics (ROC) curve was used as metrics in terms of performance evaluation. J48 classification algorithms achieve 90.5% accuracy using n as 6, denoting the highest accuracy compared to other classification algorithms used in this study, while ZeroR, Naïve Bayes, SVM, Random Forest and JRip achieved 86.92%, 89.80%, 89.65%, 89.48%, 89.45% accuracy respectively, Random Forest algorithm give an AUC score of 0.83 using n as 6,ZeroR, Naïve Bayes, SVM, J48, Random Forest and JRip achieved AUC of 0.50, 0.62, 0.71, 0.65 and 0.66 respectively furthermore, common feature based extraction and frequency feature extraction was employ in order to obtain Reduced Feature Set (RTS) which was further used in generation of arff files, nevertheless, attention dwell mostly on Windows executable and dataset used in experiment is of small size.

[20] in their research opined a framework with the capability of detection and classification of spyware, the following classification algorithms Decision Tree, ZeroR, JRip, J48 and Naïve Bayes was applied in classifying existing spyware, Decision Tree attained the best accuracy of 97.7854, Kappa Statistic of 0.723 and ROC area of 0.9356, which serve as a robust rule based algorithm to enhance the proposed framework.

Data mining based detector optimized by Breadth-First Search algorithms was employed to achieve an accuracy of 90.5% and 0.731 FPR in the research by [21] in order to detect spyware, feature set generate form Common Feature-based Extraction (CFBE) feature selection technique with $n = 4$ achieve the accuracy of 89.49%, 88.21% and 88.02% respectively for Random Forest, Naïve Bayes, and Support Vector Machine, the following FPR was also recorded against each of aforementioned classifier respectively 0.731, 0.665 and 0.665 was used as a comparative factor, however, the research experiment was majorly based on executable files in evaluating the performance of employed method that was developed and experience a high FPR and low accuracy. [1] proposed a kernel level system routine interception in detecting and eliminating spyware and ransom ware, Linear Regression, JRip and J48 decision tree classifiers was employed in the research in order to achieve the spyware and ransom ware detection as well as elimination, experiment performed based on the designed methodology give an accuracy of 93% with a FPR of 7%, however, the resulting performance evaluation indicates a low accuracy couple with high FPR.

[22] opined a surveillance spyware detection system that encompasses both static and dynamic analysis, in order to classify spyware SVM classification algorithm optimal features generated from information gain ranking was trained, an accuracy of 97.91% for known spyware and 96.4% for the unknown spyware was achieved and a false positive rate of 0.68% and TPR of 95.33% based on the static and dynamic analysis performed, however, the research based the experiment basically on executable and a resulting high FPR. [23] proposed a hypothesis of the possibility of classifying software that have spyware functionality embedded based on the software End User License Agreement

(EULA), the experiment performed by the study using data information obtained from 100 software application through the means of anti-spyware application in order to aid in determining software applications that have spyware features embedded therein based on the application EULA, 15 different classification algorithms was employed and multi-nominal Naïve Bayes, SVM and Voter Perception algorithms was assert to have outperformed other classification algorithms while achieving optimal AUC and accuracy rate and low false positive rate, the obtained result indicates that the proposed hypothesis about EULAs can serve as an evaluating mechanism for classification of software with embedded spyware functionality, however the result indicates a very high FPR and Low accuracy.

[24] developed a novel malware detection technique known as Memory management with API Call mining (MACA-I) to detect malware that transit in memory management API, monitored and tracked based on dynamic analysis, the evaluation of the developed technique was based on accuracy and sensitivity performance metrics, using the following machine learning algorithms; Logistics Regression, Support Vector Machine (SVM), and Decision Tree, which achieved the following accuracy 78.78%, 77.27% and 89.89% respectively, while the sensitivity of 91.17%, 85.28% and 97.05% was attained respectively, however, the research majored on API calls only. Other works exist in which SVM was applied. Such works include [28] in which SVM for applied for the predict6ion of path loss while the work of [29] applied a variant of SVM called support vector regression (SVR) for the forecasting of stream flow.

3 Methodology

In this research, publicly available dataset of Advance Persistent Threat (APT) dataset accessible for research and development found in Microsoft subsidiary repository known as Github, the dataset is comprised of 189 attributes and 291 instances, the following form part of the attributes; techniques, tactics and procedure (TTP), spyware, backdoor, Trojan and rootkit.

Symbiotic Organism Search algorithm and Grid Search algorithm was employed for optimal feature selection and optimal parameter respectively in order to achieve optimization in classification based on SVM. A 5 fold and 10 fold cross validation was employed in this study, a total of 186 optimal features was selected out of 189 feature based on SOS algorithms through the iterative process of 50 and a population size of 50.

In order to optimize learning the dataset was preprocessed, Synthetic Minority Oversampling Technique (SMOTE) was employed to addressing biasness associated with imbalanced dataset, likewise the following metrics was used to remarkably evaluate the performance optimization of SVM for classification of spyware; accuracy, true positive rate and false positive rate.

4 Results

The Tables 1 and 2 below indicates the optimized parameters of both gamma (γ) and cost (c) based on defined range as well as the values of cross validation and the default SVM parameter (γ) and (c) respectively.