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Highlights

The Strategy of Digital Twin Implementation at the Cyber-Physical

Discovering Thoughts, Inventing Future

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The Strategy of Digital twin Implementation at the Cyber-Physical Enterprises

By Nataliya Pankratova & Kostiantyn Grishyn

National Technical University of Ukraine

Abstract- The strategy of digital twin (DT) implementation at the cyber-physical enterprises is proposed, which is due to the need for high-quality and effective reconstruction of Ukraine. The TISM and MICMAC methods are used to study the factors that influence the strategy of DT implementation to support the guaranteed functioning of a cyber-physical system. 13 main factors, that determine strategy success, were identified, and a model of strategy realization was built in the form of a six-level interaction diagram (digraph). The factors are classified by influence and dependence. The substantiated conclusion is that the state support of DT implementation strategy, the availability of design standards, data protection methods, legislative regulation and implementation experience by other enterprises are key factors to the success of strategy for DT implementation at the enterprise.

Keywords: digital twin, strategy, TISM, MICMAC, Industry 4.0, cyber-physical system, technology adoption.

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The Strategy of Digital twin Implementation at the Cyber-Phisical Enterprises

Nataliya Pankratova [α] & Kostiantyn Grishyn [σ]

Abstract- **The strategy of digital twin (DT) implementation at the cyber-physical enterprises is proposed, which is due to the need for high-quality and effective reconstruction of Ukraine. The TISM and MICMAC methods are used to study the factors that influence the strategy of DT implementation to support the guaranteed functioning of a cyber-physical system. 13 main factors, that determine strategy success, were identified, and a model of strategy realization was built in the form of a six-level interaction diagram (digraph). The factors are classified by influence and dependence. The substantiated conclusion is that the state support of DT implementation strategy, the availability of design standards, data protection methods, legislative regulation and implementation experience by other enterprises are key factors to the success of strategy for DT implementation at the enterprise.**

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I. Introduction

Ukraine's economy and infrastructure are being increasingly damaged since the full-scale russian invasion. The World Bank's estimate of full reconstruction price as of February 24, 2023 was $411 billion. The estimate covered social, production and infrastructure sectors as well as environmental damage [1]. A 10-year Recovery Plan for Ukraine has been developed, which includes 850 projects with a total cost of over $750 billion. One of 5 plan's core guiding principles is "Build back better" [2]. One of prerequisites for ensuring implementation sustainability is digital transformation. In order for infrastructure to meet modern standards, during the country reconstruction Industry 4.0 technologies should be involved, one of which is digital twin (DT).

The basic DT concept is a physical object, a virtual object with information exchange between them. DT could be designed as a computer model of physical object, with a set of forecasting algorithms, which include an information-analytical system, as well as corresponding hardware-software system. DT development may be based on simulation modeling methods that provide the most realistic representation of physical environment or virtual world object. Mathematical description of DT could be obtained by statistical and analytical modeling, machine learning [3–4].

Object's virtual nature allows to experiment with model, build scenarios instead of doing real tests, thus bypassing resource loss and risks. A detailed history of development, classification, areas of use and prospects of this technology are given in authors work [5]. DT is used both for new technical systems design and maintenance of existing ones. For instance, General Electric uses DT to optimize aircraft engines performance and predict its components failure time [6]. According to Research and Markets report, the global DT market is estimated at $10.1 billion in 2023, and is expected to grow to $110.1 billion by 2028. [7].

DT is applied, in particular, in manufacturing sector, automobile, aerospace and aviation industries, energy sector, and smart cities [6]. The versatility of the strategy allows it to be used at almost any enterprise. Among other things, digital twins of organizations are implemented, the main purpose of which is scenario analysis and support for business strategies [8].

The purpose of this paper is to develop a strategy of DT implementation to support the guaranteed functioning of a cyber-physical system in the form of enterprise during Ukraine reconstruction. The TISM (Total Interpretive Structural Modeling) and MICMAC (Cross-Impact Matrix Multiplication Applied To Classification) methods were applied to investigate the factors that influence DT implementation at the enterprise [9–10]. Based on TISM results, a 6-level digraph of factors interaction was built, which elucidates key factors that the company's top management should pay attention to when implementing DT. The work is relevant, because in post-war Ukraine, infrastructure reconstruction must be done according to modern standards.

II. Literature Analysis

The idea of creating a digital copy during the design of system and its subsequent support was implemented as early as 1960 by NASA during the Apollo mission. However, DT concept emergence is associated with Michael Greaves' work which was a part of presentation at the University of Michigan for industry representatives in 2002 year. In 2014, he laid out a detailed description in a White Paper, later writing a book «The Origin of Digital Twins». 3 stages of concept development, areas of use, prospects of DT are given in author's work [5]. The emergence of cloud computing, IoT, Big Data, and rapid development of artificial intelligence have given a powerful rise to DT

Author α σ: National Technical University of Ukraine "Igor Sikorsky Kyiv Polytechnic Institute" (Ukraine).e-mail: natalidmp@gmail.com

technology, spreading it among developed countries along with other Industry 4.0 innovations [11].

In order to identify factors that influence DT implementation at the enterprise, a comprehensive literature analysis was conducted in Scopus, Researchgate, and IEEE Xplore databases. Scientific articles, conference materials, analytical reports and technological blogs of leading companies were examined. The analysis showed that market economy is not sufficient for innovative activity at enterprises [12].

The main barriers to DT implementation are high financial costs and lack of qualified employees, especially for small and medium-sized businesses [13–14]. A noticeable problem is the lack of DT design standards [15]. Existing ISO, IEEE, ITU, IEC standards are not yet able to satisfy the needs [16]. Cybersecurity is also important. DT accumulates data about a physical object from sensors network, installed on it, generating several gigabytes of information per day. Data must be collected, processed through cloud solutions and protected from unauthorized influence [17]. For example, in 2015, the BlackEnergy malware attack on cyberphysical systems of Ukrainian energy suppliers affected 225,000 consumers [18].

The strategy of DT implementation creates uncertainty in issues of intellectual property and copyright, liability for errors and data privacy [19]. A possible version of state regulatory measures is given in [20]. Also, lack of top management commitment is a serious barrier for Industry 4.0 [21]. For example, according to a survey among Norwegian enterprise managers, 85% of oil and gas companies and 49% of mixed industry, consider uncertainty about consequences and risks as a factor that inhibits Industry 4.0 development [22]. Cooperation with scientific centers and institutes is important when planning digitalization, an example is given in [23].

DT development is a sequential process. First, a Proof of Concept is being designed – DT prototype to confirm adequacy of object model. Next, Subsystem Digital Twins are created, which are combined into a Full Digital Twin [24]. At the development stage, 5G mobile and broadband coverage is critical to a successful project. Otherwise, it would be necessary to use inconvenient cable connections [17]. The launch of 5G pilot version in Ukraine was planned for 2024 [25].

For effective DT application at the enterprise, an important factor is a corporate digital culture that defines common values and ways of doing business, encourages lifelong learning among employees, teamwork and innovation. Studies show there was no "cultural" preparation at companies where digitalization failed [26].

III. Methods of Research

Within the proposed strategy framework, the TISM and MICMAC methods are used to investigate factors that influence DT implementation at the cyber physical enterprise to support guaranteed functioning of physical model. The TISM is a modification of ISM (Interpretive Structural Modeling) method, the latter was proposed by researcher John Warfield for complex socioeconomic systems analysis [27]. TISM algorithm repeats ISM, but additionally requires interpretation of connections in the system [9]. Now it is used to analyze any system, in particular, various aspects of Industry 4.0 [10], [28–30]. Usually, after TISM, the MICMAC method is used, which classifies system components into 4 types according to two properties: influence on system development and dependence on other system components. MICMAC discovers which factors are root causes and which are consequences of other factors.

a) *The TISM method. Algorithm construction of the hierarchical structure of the studied system*

The TISM method displays structure of the system under study. As output, it produces a hierarchical diagram of interconnections between system elements, which is then analyzed for decision-making. *Algorithm of method is as follows* [9]:

Step-1: Define set X – key elements of the system.

Step-2: Define relationship between elements of X, which could be interpreted as:

- causal relationship (A leads to B);
- elements priority (A is more important than B);
- mathematical relationship between elements, etc.

Step-3: Compare pairwise all X elements whether there is a relationship between each pair, which is done by experts or research group. Results are put inside Initial reachability matrix (IRM) according to the rule:

- if there is a relationship between (i, j) – into cell (i, j) of IRM 1 is written;
- if there is no relationship between (i, j) – into cell (i, j) of IRM 0 is written;
- cell (i, i) of IRM (diagonal elements of matrix) is always 1.

Total amount of comparisons for set of size n could be calculated by formula (1)

$$N = \text{n (n-1)} \qquad (1)$$

Here is an example of creating an IRM. Assume we have set $\{a_1, a_2, a_3\}$ with the relationship between (a_3, a_1), (a_1, a_2). The corresponding IRM is shown in table 1.

Table 1: Example of Creating an IRM

	a_1	a_2	a_3
a_1	1	1	0
a_2	0	1	0
a_3	1	0	1

Step-4: From now on, it is convenient to apply the mathematical theory of relations, in terms of which the relationship between elements is a binary reflexive relation R, which is defined by the Boolean matrix IRM. TISM methodology requires to check R for transitivity, that is, condition (2)

$$\forall a, b, c \in X: aRb \wedge bRc \Rightarrow aRc \quad (2)$$

If (2) is fulfilled, proceed to step 5 of the algorithm. Otherwise, replace the relation R with its transitive closure R^*. The Boolean matrix that defines R^* is called the Final reachability matrix (FRM) in TISM. Since R is defined on a finite set, it is possible to obtain transitive closure from IRM according to formula (3) [31].

$$FRM = \sup_{1 \le i \le n} IRM^k, \quad (3)$$

where matrix multiplication and supremum are defined by (4) and (5), respectively.

$$(A \cdot B)_{ij} = \max_k \left(\min \left(A_{ik}, B_{kj}\right)\right), \quad (4)$$

$$\sup (A, B)_{ij} = \max \left(A_{ij}, B_{ij}\right). \quad (5)$$

FRM defines new transitive relation R^*.

Step-5: Perform level partitioning the following way:

5.1. Define set of elements D and level $r = 1$.

5.2. If $D = \emptyset$ stop. Otherwise, for each $D_i \in D$ find Reachability set R_i, Antecedent set A_i and Intersection set I_i according to (5), (6), (7), respectively

$$R_i = \{D_j \in D \mid (D_i, D_j) \in R\}, \quad (6)$$

$$A_i = \{D_j \in D \mid (D_j, D_i) \in R\}, \quad (7)$$

$$I_i = R_i \cap A_i. \quad (8)$$

$$I_i = R \cap A_i.$$

R_i – set of elements $D_j \in D$, which could be reached from D_i in one step.

A_i – set of elements $D_j \in D$, which could reach D_i in one step.

If we work with causal relationship, then R_i – set of events directly caused by D_i and A_i – set of events, which directly cause D_i.

5.3. If $R_i = I_i$ then assign element D_i to level r. Then assume $D = D \backslash \{D_i\}$ and $r = r + 1$. Return to step 5.2.

Step-6: Display divided elements on digraph. The first levels are on top, the following levels are below them. Only direct connections and significant transitive links are displayed. Digraph is interpreted by experts, explanations are written into Interpretive matrix. Lower levels are independent elements that affect all others. Upper levels – elements that depend on the elements of the lower levels.

b) MICMAC method. Algorithm for evaluation of elements influence on the system

MICMAC is often applied after TISM, since it uses FRM as input to evaluate influence of each element on system. *The algorithm includes the following steps*:

Step-1: Calculate sum for each row in FRM – Driving power. It is a measure of D_i influence on other system components.

Step-2: Calculate sum for each column in FRM – Dependence, which measures how much components affect the element D_i.

Step-3: For each element display (Dependence, Driving power) in the Cartesian coordinate system.

Step-4: Set thresholds for Dependence and Driving power, above which they are considered "high", below – "low". For set of n elements the value of $\frac{n}{2}$ is taken as the threshold. The plane is divided into 4 quarters (an example is shown in Figure 1).

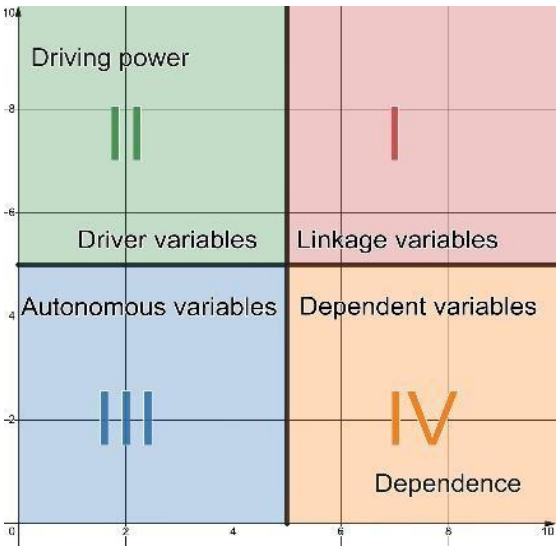

Fig. 1: Example how plane is divided in MICMAC-analysis

Step-5: Classify each element according to which quarter the corresponding point is in. MICMAC divides elements into four types:

- Linkage Variables – high influence and dependence (quarter 1);
- Driver Variables – high influence, low dependence (quarter 2); - Autonomous Variables – low influence and dependence (quarter 3);
- Dependent Variables – low influence, high dependence (quarter 4).

As a result, elements are classified into the most influential, which determine system development (Driver and Linkage) and ones without a significant impact (Autonomous and Dependent). Other variations of MICMAC exist, such as fuzzy version [21]. However, the essence remains unchanged – classification of system elements according to their level of influence and dependence on other components.

IV. Results

a) *Application of TISM method to build a hierarchical scheme of factors interaction*

DT implementation depends on both external and internal conditions. During literature analysis 13 key factors were identified. Their description is given below:

1. *State support for the implementation of the DT strategy.* The state's role in support of this innovative activity process includes various forms of stimulation: direct financing, technical support programs, loans (including preferential), earmarked grants, DT implementation support funds, legislative protection of intellectual property [14].
2. *DT design standards, data protection methods.* The Lack of standards for DT creation is a serious barrier to its implementation [15]. In particular, these standards should take into account cybersecurity issues [18].
3. *Regulation of DT implementation at legislative level.* For DT to take root in the market, the state needs to create an administrative and legal framework in accordance with European standards [19].
4. *Experience of DT implementation by other enterprises.* It will be easier for top management to implement DT, focusing on successful experience of other companies, cooperating with them and using approaches proven by practice. This, together with a competition factor, can convince top management of DT expediency.
5. *Top management commitment and project planning*. DT implementation is a serious step in enterprise development, which requires significant financial costs and changes in production processes. The complexity of the project and uncertainty, risks, need for a clear plan and lack of transparency are serious obstacles to digitization [22]. DT adoption success also significantly depends on top management commitment [21].
6. *Cooperation with scientific centers.* To obtain a systematic view of the problems related to the implementation project, reduce financial costs and find qualified specialists, it is advisable to cooperate with research centers and universities [23]. *7. Proof of Concept quality*. Success of the project depends on the DT prototype – Proof of Concept (PoC). Not only does it confirm that the model is correct, but also helps developers to choose software and tools necessary for real-time simulations [24].
7. *Adjustment of data collection and processing.* To implement effective DT, it is necessary to solve the problems of data collection, processing and storage [17].

8. *Building a communication network at the facility.* If broadband Internet and 5G communication technologies are available, establishing data exchange between physical and digital object becomes simpler. Otherwise, it will be necessary to build a network of optical fiber cable networks at the facility [17, 25].
9. *Corporate culture.* Human capital is the most important resource for business transformation in Industry 4.0 and directly affects the success of this transformation. Specialists aspire to work in a business dominated by digital culture [26].
10. *Personnel retraining.* The implementation strategy significantly changes duties and functions of employees, so they must be highly qualified [13]. Successful DT operation will require lifelong learning, teamwork skills, as well as acceptance of innovations, changes and ideas [26].
11. *Changes in the organization, management.* There will be a need to adjust the organizational process at the enterprise, which requires time and effort [32]. It is also necessary to eliminate Data silos – a phenomenon when different information systems are separated and cannot effectively work together. The reason is that different departments independently created databases long before DT implementation project, also some employees may be against sharing information with other departments [33].
12. *Predictive maintenance level at the enterprise*. One of the main purposes of DT is predictive maintenance. After DT implementation and adoption, time will be needed for its adjustment and its effective use during mundane work [34].

The calculation process is given in Tables 29. Table 2 is the IRM of identified factors. Table 3 shows the corresponding FRM, which is obtained by formula (3). Tables 4-9 display calculations of level partitioning, according to step 5 of the TISM algorithm (paragraph 3.1). To perform these calculations, a Python program was created, computations then were checked manually.

Table 2: IRM of identified factors

	1	2	3	4	5	6	7	8	9	10	11	12	13
1	1	1	1	1	1	1	0	0	0	0	0	0	0
2	0	1	1	1	1	0	1	1	1	0	0	1	0
3	0	0	1	1	1	1	0	0	0	0	0	0	0
4	0	1	1	1	0	1	1	1	1	0	0	1	1
5	0	0	0	0	1	1	1	0	0	0	1	1	0
6	0	0	0	0	1	1	1	0	1	0	0	0	1
7	0	0	0	0	0	0	1	1	1	1	1	0	0
8	0	0	0	0	0	0	1	1	0	0	1	0	1
9	0	0	0	0	0	0	1	1	1	0	0	0	1
10	0	0	0	0	0	0	0	0	0	1	1	1	0
11	0	0	0	0	0	0	0	0	0	1	1	1	1
12	0	0	0	0	0	0	0	0	0	0	0	1	1
13	0	0	0	0	0	0	0	0	0	0	0	1	1

Table 3: FRM of identified factors

	1	2	3	4	5	6	7	8	9	10	11	12	13	Driving power
1	1	1	1	1	1	1	1	1	1	1	1	1	1	13
2	0	1	1	1	1	1	1	1	1	1	1	1	1	12
3	0	1	1	1	1	1	1	1	1	1	1	1	1	12
4	0	1	1	1	1	1	1	1	1	1	1	1	1	12
5	0	0	0	0	1	1	1	1	1	1	1	1	1	9
6	0	0	0	0	1	1	1	1	1	1	1	1	1	9
7	0	0	0	0	0	0	1	1	1	1	1	1	1	7
8	0	0	0	0	0	0	1	1	1	1	1	1	1	7
9	0	0	0	0	0	0	1	1	1	1	1	1	1	7
10	0	0	0	0	0	0	0	0	0	1	1	1	1	4
11	0	0	0	0	0	0	0	0	0	1	1	1	1	4

12	0	0	0	0	0	0	0	0	0	0	0	1	1	2
13	0	0	0	0	0	0	0	0	0	0	0	1	1	2
Dependence	1	4	4	4	6	6	9	9	9	11	11	13	13	

Then level partitioning is carried out to assign level to each element. Calculations are shown in tables 4-9.

Table 4: Iteration 1 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1	1	
2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4	2, 3, 4	
3	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4	2, 3, 4	
4	2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4	2, 3, 4	
5	5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6	5, 6	
6	5, 6, 7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6	5, 6	
7	7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
8	7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
9	7, 8, 9, 10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
10	10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	
11	10, 11, 12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	
12	12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	12, 13	1
13	12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	12, 13	1

At the first iteration, level 1 was assigned to factors 12 and 13. According to step 5.2 of the TISM algorithm, since set D is not null (it has factors from 1 to 11), level partitioning process is repeated, but without factors 12 and 13. Level partitioning continued until levels were assigned to each factor.

Table 5: Iteration 2 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1	1	
2	2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4	2, 3, 4	
3	2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4	2, 3, 4	
4	2, 3, 4, 5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4	2, 3, 4	
5	5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6	5, 6	
6	5, 6, 7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6	5, 6	
7	7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
8	7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
9	7, 8, 9, 10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	
10	10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	2
11	10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	2

Table 6: Iteration 3 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1, 2, 3, 4, 5, 6, 7, 8, 9	1	1	
2	2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4	2, 3, 4	
3	2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4	2, 3, 4	
4	2, 3, 4, 5, 6, 7, 8, 9	1, 2, 3, 4	2, 3, 4	
5	5, 6, 7, 8, 9	1, 2, 3, 4, 5, 6	5, 6	

6	5, 6, 7, 8, 9	1, 2, 3, 4, 5, 6	5, 6	
7	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3
8	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3
9	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3

Table 7: Iteration 4 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1, 2, 3, 4, 5, 6	1	1	
2	2, 3, 4, 5, 6	1, 2, 3, 4	2, 3, 4	
3	2, 3, 4, 5, 6	1, 2, 3, 4	2, 3, 4	
4	2, 3, 4, 5, 6	1, 2, 3, 4	2, 3, 4	
5	5, 6	1, 2, 3, 4, 5, 6	5, 6	4
6	5, 6	1, 2, 3, 4, 5, 6	5, 6	4

Table 8: Iteration 5 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1, 2, 3, 4	1	1	
2	2, 3, 4	1, 2, 3, 4	2, 3, 4	5
3	2, 3, 4	1, 2, 3, 4	2, 3, 4	5
4	2, 3, 4	1, 2, 3, 4	2, 3, 4	5

Table 9: Iteration 6 of level partitioning

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
1	1	1	1	6

Level partitioning results are displayed in table 10.

Table 10: Level partitioning results (levels are highlighted with green)

D_i	Reachability Set R_i	Antecedent Set A_i	$R_i \cap A_i$	Level
13	12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	12, 13	1
12	12, 13	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13	12, 13	1
10	10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	2
11	10, 11	1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11	10, 11	2
7	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3
8	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3
9	7, 8, 9	1, 2, 3, 4, 5, 6, 7, 8, 9	7, 8, 9	3
5	5, 6	1, 2, 3, 4, 5, 6	5, 6	4
6	5, 6	1, 2, 3, 4, 5, 6	5, 6	4
2	2, 3, 4	1, 2, 3, 4	2, 3, 4	5
3	2, 3, 4	1, 2, 3, 4	2, 3, 4	5
4	2, 3, 4	1, 2, 3, 4	2, 3, 4	5
1	1	1	1	6

Table 10 displays a digraph (Figure 2), in which we highlight 3 components.

- External factors (green color; 6-th and 5-th level);
- Factors, that describe the stage of DT implementation (orange; 4-th and 3-rd level); - factors, that describe the stage of DT integration into enterprise work (blue; 2-nd, 1-st level).

The enterprise cannot influence external factors, that why they are located at lower levels of the scheme. The following levels reflect the "chronology" of digitalization from DT development to fully-fledged implementation at the enterprise.

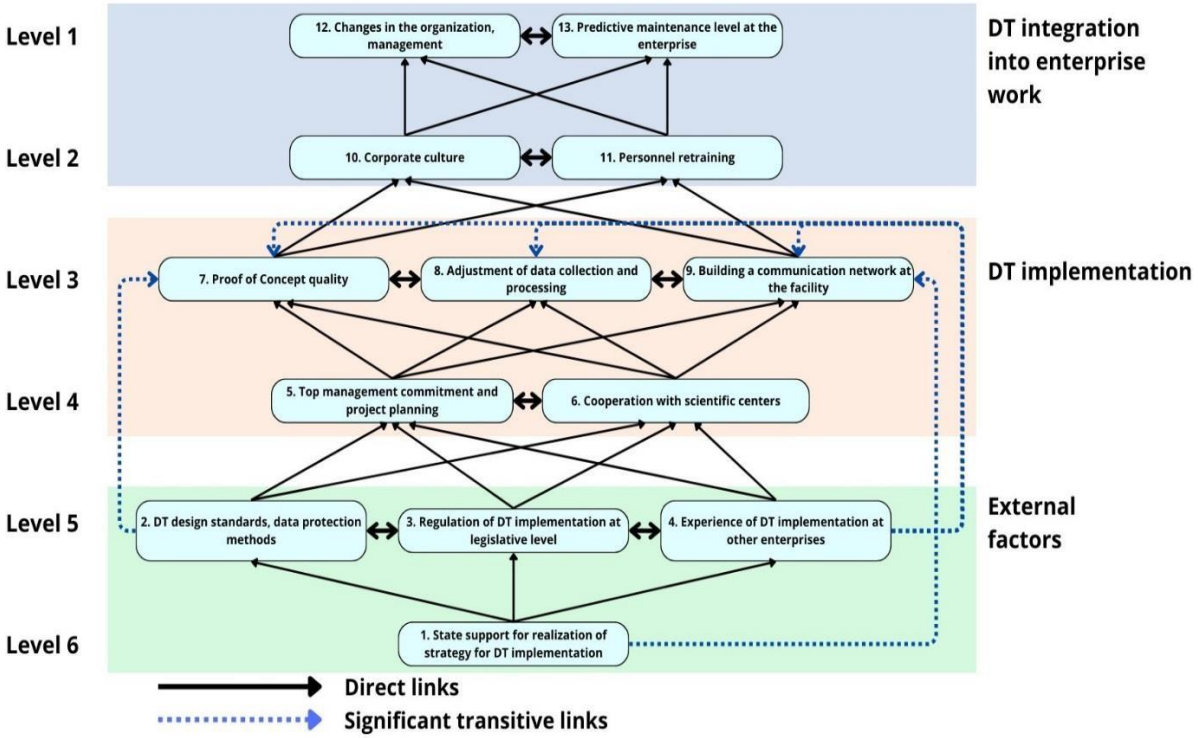

Fig. 2: Digraph, illustrating TISM model of factors that influence DT implementation Based on the digraph, an Interpretive matrix, which explains interconnections between factors, is built (Table 11).

Table 11: Interpretive matrix

№	Factors	Influence	Interpretation
1	State support for realization of strategy for DT implementation	2, 3, 4, 9	The state determines the following aspects: amount of financial support for enterprises that switch to DT, quality of legislative regulation of this technology and standards, as well as overcoming corruption. These factors accelerate DT adoption on the market so that it will be easier for our enterprise to implement it. In particular, the state could provide 5G coverage, which will significantly simplify the building of communication network at the facility.
2	DT design standards, data protection methods	3, 4, 5, 6, 7	The standards for DT design will contribute to data protection methods development and formation of relevant legislation, as well as give companies and scientific centers a "common language", opening opportunities for cooperation. This will help top management to form a better plan and develop a high-quality Proof of Concept.
3	Regulation of DT implementation at legislative level	2, 4, 5, 6	Legislation supports DT standards development and reduces uncertainty. Under these conditions, it will be easier for the enterprise to create a plan of DT implementation, as well as establish cooperation with colleagues and scientists.
4	Experience of DT implementation at other enterprises	2, 3, 5, 6, 7, 8, 9	Examples of successful digitalization and other enterprises experience, as well as competition factor, could convince the top management of DT implementation expedience. Experience exchange will allow the enterprise to develop high-quality Proof of Concept, data acquisition and processing system, communication network.
5	Top management commitment and project planning	6, 7, 8, 9	The entire further DT development process depends on the top management commitment and project plan. A sound plan would also include collaboration with academics.

6	Cooperation with scientific centers	5, 7, 8, 9	Cooperation with research centers allows us to plan the DT effective development, identify barriers to digital transformation at a specific enterprise and key factors. This would also motivate the management.
7	Proof of Concept quality	8, 9, 10, 11	Proof of Concept is a DT prototype, created to confirm the adequacy of physical system models, so that it determines further development success, and therefore staff training quality. In the process, it may be necessary to improve the communication network and data acquisition system.
8	Adjustment of data collection and processing	7, 9	Data acquisition, processing and storage systems provide the DT with all the information. Hence, it determines DT prototype quality and its further development.
9	Building a communi-cation network at the facility	7, 8, 10, 11	5G/Wired network coverage is critical for DT development, as it determines whether it will be convenient for employees to switch to a new system.
10	Corporate culture	11, 12, 13	Effective use of DT, business process change begins with a corporate culture that accepts new information technologies and adapts to them.
11	Personnel retraining	10, 12, 13	Only qualified employees will be able to work with the DT at the enterprise. This will create the necessary corporate "digital culture" and allow to adopt the innovation.
12	Changes in the organization, management	13	After DT development at the enterprise, reorganization of activities is inevitable: new duties, positions, requirements and change of corporate rules. Such measures will define the effectiveness of DT use.
13	Predictive maintenance level at the enterprise	12	The ability of DT models to conduct scenario analysis will accelerate the transition to a new organizational level at the enterprise.

b) Application of the MICMAC method for factor classification

Based on the TISM method results, MICMAC is used to classify the identified factors. Driving power and Dependence values from table 3 for each factor are displayed in the Cartesian coordinate system. Since we consider 13 elements, the threshold for classification was 6.5 (dashed lines). The results are shown in Figure 3.

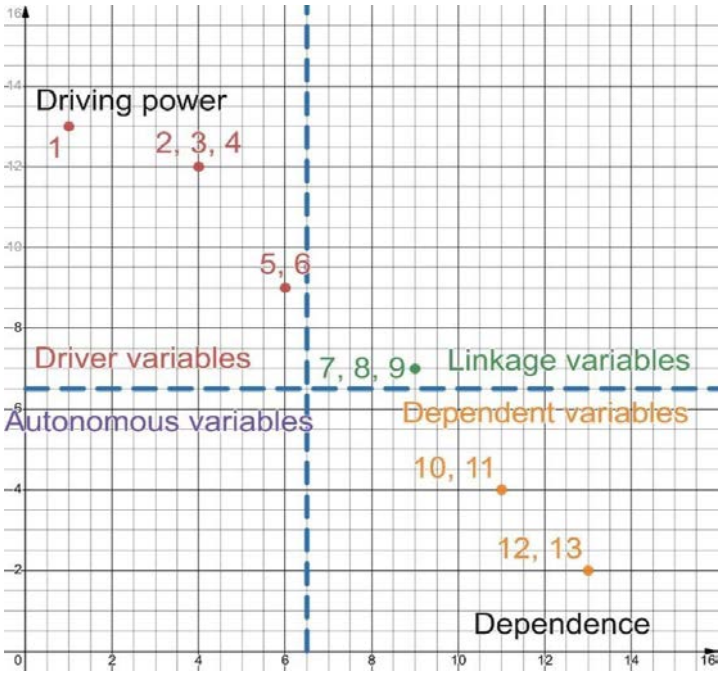

Fig. 3: Elements classification via MICMAC-method

From Figure 3 we have the following classification.

- Driver variables: factors 1, 2, 3, 4, 5, 6;
- Linkage variables: factors 7, 8, 9;
- Dependent variables: factors 10, 11, 12, 13;
- Autonomous variables are absent.

MICMAC results confirmed that all identified factors play an active role in system development and/or are significantly influenced by it.

All external factors were found to be driver variables (state support for realization of strategy for DT implementation, other companies' experience, DT design standards, legislative regulation), as well as top management commitment, project planning and cooperation with scientific centers. The algorithm attributed to linkage variables the factors of data collection and processing system adjustment, Proof of Concept and building a communication network. They have a great influence on system development; however, they are also greatly influenced by other factors. Corporate culture, personnel retraining, changes in the organization, management, and the level of predictive maintenance at the enterprise are considered to be dependent factors.

V. Conclusions

Industry 4.0 technologies, especially cyber-physical systems with a DT, open up unique opportunities for companies to increase efficiency, bring business processes management to a new level, and improve the quality of products and services. This paper aims to develop a DT implementation strategy to support the guaranteed functioning of a cyber-physical system in the form of enterprise in the reconstruction of post-war Ukraine. To solve this problem, it is essential to identify and prioritize the factors that affect the quality of the DT implementation at the enterprise.

The study identified 13 factors of that kind. Using the TISM method, they were organized into a scheme with 6-level digraph. External factors are located at two lower levels: state support for the realization of strategy for DT implementation, availability of design standards and data protection methods, legislative regulation of DT and other companies' experience of DT adoption. The factors at higher levels are the consequences of external factors. Two middle levels contain factors that determine the quality of DT implementation strategy process. Two upper levels contain factors that determine the success of transition to a new information system after DT development. Next, the factors were classified by the MICMAC method. All external factors, as well as top management commitment and project planning, cooperation with scientific centers are classified as driver variables.

Finally, the prospects for further domestic DT industry development depend on financial and legislative support of the state, the promotion of DT design standards formation and data protection methods, as well as improvement of legislation which will regulate their implementation. These factors should be the key goals of strategies to support the development of Industry 4.0 in Ukraine.

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Mathematical Playfulness: A Humorous Approach to Reforming English Orthography

By Rolf Windenberg Hamburg

Motivation and Basics of our "Mathematically Oriented Reform" of English Orthography- The desire to shorten texts to reduce the effort of writing has always been very popular. Among others, this has led to the invention and common use of stenography (e.g. by secretaries). However, use of stenography is demanding a non-negligible learning effort. Therefore, people were looking for alternatives requiring much less learning expenditure.

An example for a completely different approach to shorten texts is represented by the kind of writing which is popular, in particular, among our current young generation, e.g., when writing and sending SMS messages or eMails. Here, formulations such as "CU" or "C U" (for "see you"), "U R …" (for "you are …"), "coffee 2 go" (for "coffee to go"), "tea 4 U" (for "tea for you"), "2 4 1" (for "two for one"), etc are pretty common.

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Mathematical Playfulness: A Humorous Approach to Reforming English Orthography

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I. Motivation and Basics of our "Mathematically Oriented Reform" of English Orthography

The desire to shorten texts to reduce the effort of writing has always been very popular. Among others, this has led to the invention and common use of stenography (e.g. by secretaries). However, use of stenography is demanding a non-negligible learning effort. Therefore, people were looking for alternatives requiring much less learning expenditure.

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Some time ago, when I tried to find some means to achieve students' relaxation in the courses I was teaching at the University of Hamburg, the idea came to my mind to invent a mathematically oriented reform of the German language. In my approach, suggested as a new way of writing texts, I did not only use numbers and single letters pronounced as in the alphabet, as it is quite common nowadays. As a new idea, I decided to also use well-known mathematical symbols, such as +, –, •, /, $\sqrt{}$, etc. I applied my reform of orthography to the German language only and published the results in a first book entitled *"Um etliche Ecken ged8"* (Shaker Media publisher, first version in 2012; Version 2.0 in 2018 [1]). During public presentations of the book in reading events, somewhat regularly, there were suggestions to this author to try to apply the rules of his orthography reform to the English language, too. Finally, it became too difficult to resist this exciting new challenge. And the latest book in English is the result of the corresponding efforts also to cover English texts: It comprises the innovative proposal for a reform of English orthography.

The two most important goals underlying the reform of English orthography as invented by us, are the following ones:

1. We aim for compression factors which are as large as possible, namely we try to compress words or complete phrases to 1/3 or even 1/4 of the original size (in terms of symbols required originally to write the word/phrase), cf. our short investigation of compression factors achieved by us.
2. A second goal we had in mind (equally important – or even more important!) has been to discover very creative new ways of writing words/phrases which are non-evident at first and, moreover, as humorous as possible.

Let us shortly mention some examples satisfying one of the two or even both goals to some extent:

a) *he lost 40th* [abbreviating: *he lost four teeth*]
b) *I h8 2 B l8 @ the g8 + miss my fl 8* [abbreviating: *I hate to be late at the gate and miss my flight*] → being very close to a poem
c) *Y R U so Z 2dA ?* [abbreviating: *why are you so sad today ?*]

The most essential rules on which our reform of English orthography is based are.

1. Mathematical operations do not have to be used in a mathematically correct manner. Example: "*–tax*" for *"tax reduction"* or *"h+"* for *"hand"* are acceptable expressions though a mathematician would be much more happy seeing a difference or a sum always with two operands.
2. Typically, only lowercase letters are used. If letters are used as capital letters they will always be pronounced as in the ABC. It is also allowed to mix small and capital letters in single words to indicate "ABC pronunciation" – just the capital letters.

Author: e-mail: bernd.wolfinger@uni-hamburg.de

Examples: *B* will denote "be", "bee", etc; *C* will denote "see", "sea", etc; *X* will denote "ex" or "cross"; *Tn* will denote "teen"; *B4* will denote "before"; *NTT* will denote "entity"; *idNTT* will denote "identity"; etc.

3. Words can be written so that pronouncement is facilitated and not necessarily written in an orthographic correct manner.
   Example: *ar/me* or even *R/me* (for "*army division*") is not necessarily abbreviated by *ar/my* to facilitate the reading.
4. Blanks can always be omitted.
   Example: In *n•ew* or *n•U* which abbreviates "*new product*", the blank between both words is missing.
5. … and last but not least:
   Creativity in the invention of new kinds of writing is always given priority over a strict application of mathematical or orthographic rules!

The transition from German to English orthography is far from being trivial: Pronunciation of (capital) letters according to their ABC pronunciation is completely different which also holds for digits as well as for mathematical symbols. Moreover, we are looking at completely different languages with different syntax and semantics of words and phrases.

Fortunately, e.g., the following two properties of the English language facilitate our desired reform of English orthography:

1. Usage of capital letters being pronounced as in the alphabet is quite promising because a lot of different letters are rather well suited to compress the English language (as opposed to the German language, where in particular the vowels do not offer good support for compression). Examples: U for "you", R for "are", Y for "why", C for "see" or "sea", etc.
2. Moreover, quite a few digits can be used advantageously, e.g., 8 in "great", "late", "gate", "afraid", etc.
   4 in "for", "before", "forward", "forth", etc.
   in "one", "anyone", "no one", "once", etc.
   0 in "love", "lovely", "beloved", "loveless", etc. (if "0" is not pronounced as "zero" but as "love" – like in tennis).

Let us terminate our introduction with a short investigation of the potential compression factors achieved by our compression methods of English texts.

As a compression factor, C_f, let us define:

$$C_f = \frac{L0 - Lk}{L0}$$, where

- *L0* denotes the number of symbols, i.e., letters (without blanks) of the original text, and
- *Lk* denotes the number of symbols of the encoded text resulting of the application of our compression method; we assume that *Lk* is including all mathematical symbols and digits.

As the following examples demonstrate, compression factors of up to nearly 80 % are reached. Here are just some nice examples:

- *∅ is –Nd* abbreviating: *nothing is endless*, i.e., L0=16, Lk=6 $\Rightarrow C_f = \frac{10}{16}$, therefore C_f (in %) = 62,5 %
  [Remark: As it is common, the symbol ∅ represents the "empty set" (i.e., nothing)]
- *4 ∀ Ur 0* abbreviating: *for all your love*, i.e., L0=14, Lk=5 $\Rightarrow C_f = \frac{9}{14}$, therefore $C_f \approx 64{,}3$ %
  [Remark: As it is common, the symbol ∀ represents "for all"]
- *CU* abbreviating: *see you*, i.e., L0=6, Lk=2 $\Rightarrow C_f = \frac{4}{6}$, therefore $C_f = 66\frac{2}{3}$ %
- *U2* abbreviating: *you two*, i.e., L0=6, Lk=2 $\Rightarrow C_f = \frac{4}{6}$, therefore $C_f = 66\frac{2}{3}$ %
- *2 4 1* abbreviating: *two for one*, i.e., L0=9, Lk=3 $\Rightarrow C_f = \frac{6}{9}$, therefore $C_f = 66\frac{2}{3}$ %
- *T 4 U* abbreviating: *tea for you*, i.e., L0=9, Lk=3 $\Rightarrow C_f = \frac{6}{9}$, therefore $C_f = 66\frac{2}{3}$ %

- $\frac{R}{my}$ abbreviating: *army division*, i.e., L0=12, Lk=4 $\Rightarrow$ $C_f = \frac{8}{12}$, therefore $C_f = 66\frac{2}{3}\%$
- *+y 1 ∅* abbreviating: *Andy won nothing*, i.e., L0=14, Lk=4 $\Rightarrow$ $C_f = \frac{10}{14}$, therefore $C_f \approx 71{,}4\ \%$
- *∀ 4 ∅* abbreviating: *all for nothing*, i.e., L0=13, Lk=3 $\Rightarrow$ $C_f = \frac{10}{13}$, therefore $C_f \approx 77\ \%$
- *∅ 4 U* abbreviating: *nothing for you*, i.e., L0=13, Lk=3 $\Rightarrow$ $C_f = \frac{10}{13}$, therefore $C_f \approx 77\ \%$.

II. Brain Jogging Based on our "Mathematically Oriented Reform" Applied to English Texts

Let us now consider different degrees of difficulty based on which we are going to present puzzle tasks (riddles) to the reader. Here, we distinguish the following levels of difficulty:

a) Beginners
b) Playing with Capital Letters
c) Advanced Persons
d) Experts
e) Geniuses

- *Category a):* Solving the riddles of this category should be quite evident without demanding specific knowledge (besides very basic mathematical education).
- *Category b):* As the name of this category already indicates it comprises riddles which are just based on the intensive usage of capital letters.
- *Category c):* The riddles of this category should be solvable for an average reader after having gained
- some basic understanding of the possibilities resulting from the five fundamental rules underlying our proposed reform of English orthography.
- *Category d):* This category should still be rather evident to persons, who are sufficiently creative and/or have a good mathematical background.
- *Category e):* Solutions of the riddles of this category will typically be non-evident a priori and may require a non-negligible amount of think-time (even for persons, who are able to quickly solve the riddles of categories a) to d)).

The mapping of puzzle tasks to the five categories (as distinguished in the following) is somewhat subjective. Anyway, we want to cheer up the reader by adding humoristic illustrations into the text of the riddles, which also should allow us to considerably facilitate the process of finding solutions for each category of riddles. All illustrations have been produced by the creative illustrator *Rico W. Hasselfang* (aka: Sascha Wolfinger).

The solution for all of the puzzle tasks will be presented in Subsection 2.2, together with precise and detailed justification of all solutions.

Excerpt of Puzzle Tasks

Allocation of the puzzle tasks to the five degrees of difficulty:

a) *Beginners:*

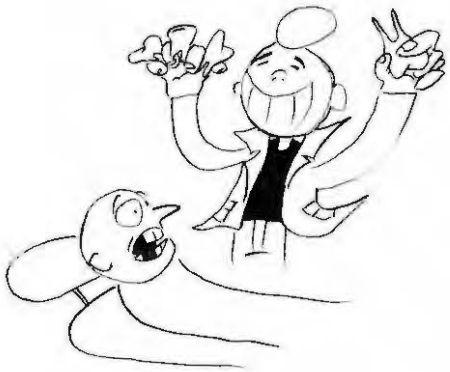
B1: $\sqrt{66}$

B2: the Q is > B4

B3: he lost 40th

B4: ∅ compares 2 U

B5: with U, I Njoy T 4 2



b) *Playing with Capital Letters:*

S1: XLNt

S2: 2 DYd

S3: RTQl8

S4: DcaPt8

S5: Br bR

c) *Advanced Persons:*

A1: I h8 2 B l8 @ the g8 + miss my fl8 *[Remark: @≡at]*

A2: Y R U so {up} ? *[Remark: {…}≡set]*

A3: (gr+pa) + (gr+ma) still 0 2 walk h+ in h+

[Remark: 0≡love (like in tennis); not zero]

A4: ∀c@s R grA by n8

A5: 1st, she asked 40 + then 4 coffE, 2

d) *Experts:*

E1: the strategy V chose 4 our (2• s) in 10is was "∀ or ∅"

E2: the c+id8 prSNTd by the nU pRT was knOn 2 nearly no 1

E3: V R fascin8ed by ∀ the 1 Rmed b+its in reno ⟹

E4: V 0 2 C th@ ∀ of our (nU• s) R ∀ most sold out

E5: Y do U Blieve th@ he is the $\sqrt{\forall evil}$ *?*

e) *Geniuses:*

G1: the Tcher was |ly| frustr8ed 2 C th@ ∀ most ∀ pupils knU ∅

G2: V (had + slEp) – n8s B4 V could B |ly| sure th@ V could cover ∀ costs

G3: l8ly, gr+ma (Bcame + what) 4getful ⟹

G4: R U sure th@ ∀ this ⇒ ∅ ?

G5: I C 1derful h@s + buy ¼ elma

Solutions of the Puzzle Tasks Accompanied with Detailed Justifications

Let us now give the solutions for all the riddles presented in Subsection 2.1. To simplify the interpretation of the solution's justification, we have decided to apply formatting decisions that should help the reader to understand the solutions better. In particular, we have put in italics all mathematical symbols, numbers and capital letters and, in addition, mathematical symbols are all underlined. Moreover, in the solutions, blanks are sometimes indicated by a point, if this potentially facilitates the readability.

Solutions accompanied with justifications:

B1: *Solution:* Route 66 [because: *Root-sixty-six*]

B2: the queue is larger than before [the-*Q-is-larger-than-B-four*]

B3: he lost four teeth [he-lost-*for.tieth*] → *Remark:* 40th is pronounced as "fortieth"

B4: nothing compares to you [*nothing*-compares-*two-U*] → *Remark:* ∅ denotes "nothing" B5: with you, I enjoy tea for two [with-*U-I-N*-joy-*T-four-two*]

P1: excellent [because: *X-L-N*-t]

P2: to divide [*two-D-Y*-d]

P3: articulate [*R-T-Q*-l-*eight*]

P4: decapitate [*D*-cap-*P*-t-*eight*]

P5: beer bar [*B*-r-b-*R*]

A1: I hate to be late at the gate and miss my flight [because: *I*-h-*eight-two-B*-l-*eight*-*@*-the-g-*eightand*-miss-my-fl-*eight*]

A2: why are you so upset? [*Y-R-U*-so-up-*set*?] → *Remark:* {…} denotes a "set"

A3: grandpa and grandma still love to walk hand in hand [gr-*and*-pa-*and*-gr-*and*-ma-still-*love-two*walk-h-*and*-in-h-*and*] → *Remark:* 0 is pronounced as "love" (like in tennis)

A4: all cats are grey by night [*all*-c-@-s-*R*-gr-*A*-by-n-*eight*] → *Remark:* @ is pronounced as "at"

A5: first, she asked for tea and then for coffee, too [*first*, she-asked-*for.ty-and*-then-*four*-coff-*E, two*] → *Remark:* 40 is pronounced as "forty"

E1: the strategy we chose for our doubles in tennis was "all or nothing" [because: the-strategy-*V*chose-*four*-our-(*double-s*)-in-*ten*-is-was-"*all*-or-*nothing*"] → *Remark:* "∀ or ∅" is pronounced as "(for) all or nothing"

E2: the candidate presented by the new party was known to nearly no one [the-c-*and*-id-*eight*-pr-*S-N-T*-ed-by-the-n-*U*-p-*R-T*-was-kn-*O*-n-*two*-nearly-no-*one*]

E3: we are fascinated by all the one-armed bandits in Reno [*V-R*-fascin-*eight*-ed-by-*all*-the-*one-R*med-b-*and*-its-in-reno]

E4: we love to see that all of our new products are almost sold out [*V-love-two-C*-th-@-*all*-of-our-n-*U-product*-s-*R-all*-most-sold-out] → *Remark:* (nU □ s) is pronounced as "nU Product s"

E5: why do you believe that he is the root of all evil ? [*Y*-do-*U-B*-lieve-th-@-he-is-the-*root-of-all*-evil] → *Remark:* " $\sqrt{\forall evil}$ " is pronounced as "root of 'all evil' "

G1: the teacher was absolutely frustrated to see that almost all pupils knew nothing [because: the-Tcher-was-absolute-ly-frustr-eight-ed-two-C-th-@-all-most-all-pupils-kn-U-nothing]

G2: we had some sleepless nights before we could be absolutely sure that we could cover all costs [Vhad-sum-sl-E-p-less-n-eight-s-B-four-V-could B-absolute-ly-sure-th-@-V-could-cover-all-costs]

G3: lately, grandma became somewhat forgetful [l-eight-ly, gr-and-ma-B-came-sum-what-four-getful]

G4: are you sure that all this implies nothing ? [R-U-sure-th-@-all-this-implies-nothing ?] → Remark: "∀ this ⇒ ∅" is pronounced as "(for) all this implies nothing"

G5: I see wonderful hats and buy one for Thelma [I-C-one-derful-h-@-s-and-buy-one four.th-elma] → Remark: " ¼ elma " is pronounced as "one for (th elma)"

The large variety of examples discussed up to now should allow most readers to accomplish the level of "Advanced Persons". To reach even the levels of "Experts" or even "Geniuses" let us refer such persons to the author's book entitled *"How 2 Shor10 English Texts",* which was published by Shaker Media. This book [2] contains numerous further riddles with various levels of difficulty accompanied by a large number of humoristic illustrations (again all designed by the illustrator R. W. Hasselfang).

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Green Computing:Techniques for Eco-Friendly IT Operations

By K. Sonawane & A. Padalkar

Abstract- Attention over the effects of computing on the environment has increased as a result of the increasing demands placed on information technology. This paper explores the field of environmentally friendly computing, highlighting creative approaches to energy saving and efficient e-waste disposal. The study looks at important technologies that are promoting a greener digital environment and investigates the importance of implementing eco-friendly practices in the IT industry. To achieve sustainable computing, energy-efficient algorithms, integration of renewable energy sources, and responsible disposal of electronic waste are highlighted as essential elements. This study tries to offer a significant understanding of the application of green computing practices and their advantageous environmental effects through case studies and real-world examples.

Keywords: sustainable development, green computing, data centre, energy efficiency, energy, computer and it.

GJCST-H Classification: LCC Code: QA76.9.C65

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Green Computing: Techniques for Eco-Friendly IT Operations

K. Sonawane [α] & A. Padalkar [σ]

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I. Introduction

In this section, a brief discussion is made on various issues related to green computing. This is followed by a section on a survey of recent research in the field of green computing.

The passage begins by highlighting the significant changes in temperature and weather patterns over the past few decades, attributing them to factors like increased greenhouse gases due to deforestation, fossil fuel burning, and rapid industrialization. It emphasizes the consequences of these changes on the Earth's environment, such as rising temperatures and sea levels.

Impact of Information Technology on the Environment:

The introduction connects these environmental changes with the rapid increase in computer usage over the same period. It underscores the combined environmental impact of the energy required to operate computers and the electricity needed for their cooling infrastructure. This sets the stage for the need to address these concerns through research in the field of Green Computing.

Green Information Technology:

The passage introduces the concept of Green Computing, emphasizing its role in addressing environmental sustainability. It defines Green I.T 1.0 as focusing on improving the energy efficiency of I.T products and processes, while Green I.T 2.0 extends the scope to include coordination, reengineering, and optimization of the entire supply chain, manufacturing process, and organizational workflow to minimize environmental impact.

Section Structure:

The passage outlines the structure of the paper, indicating that Section I contains the introduction, Section II presents a survey of recent literature, and Section III concludes the paper with a brief discussion on the direction of future research and its importance.

II. Survey

The following are the various areas where research in green computing is being carried out.

Usvuv et al. [1] proposed some techniques to make cloud computing more energy efficient. A resource-utilization- Reserved 468 aware energy-saving server consolidation algorithm (RUAEE) is proposed by Han et al. [5] which can be used to provide better utilization of resources while causing a reduction in the number of virtual machine live migrations. Experimental results show that can reduction in the energy consumption and service-level agreement (SLA) violation in cloud data centers can be achieved by RUAEE as per the experimental results.

Shaikh et al. [2] discussed about green Internet of Things by exploring ways of successful and efficient deployment of various enabling technologies like the Internet, smart objects, and sensors to name a few. They have also made a review of various IoT applications, projects, and standardization efforts going on at present along with identification of a few challenges that have to be addressed shortly to successfully enable a green IoT.

Kharchenko et al. [3] explained notions and classification of green IT engineering besides analyzing the main principles of development and implementation, indicators and values of green computing, and description of the European Union project GreenCo. More et al. [10] studied various techniques, models, and algorithms, for energy-competent green cloud computing. The technique used is virtualization. The study mainly involves the consolidation of virtual machines (VMs). Power consumption can be decreased by deactivating and reactivating physical machines as per the existing demand of workload. The approaches

Author α: Apulki Building, Cluster Pune 162, Mokarwadi, Pune, Maharashtra, India. e-mail: sonawanekeshav713@gmail.com
Author σ: Guruwar Peth, Shitala Devi Chowk, Swargate, Pune (Haveli), Maharashtra, India. e-mail: atharvapadalkar1@gmail.com

discussed are centered around saving power and making data centers energy efficient.

SAHA Biswajit [4] has analyzed various issues related to green computing the relation between environment and information technology, green information technology advantages, the adoption of green computing, eco-friendly practices, green computer design, green information technology standards and regulations, and about industry associations.

Sen Deepanjan [5] et al. in their study emphasized reducing the energy consumption and carbon footprint of various computing devices.

Lin et al. [6] proposed a new green video transmission (GVT) algorithm using video clustering and channel assignment that will help in video transmission. Design is also made of a video clustering model based on game theory for grouping the different video parts stored in mobile devices. The analysis and simulations demonstrate a superior video transmission performance by the proposed GTV algorithm.

Asad et al. [7] divided the big data enterprise into six planes which they considered vital in influencing the energy consumption of data centers. A survey is also made by them about the important strategies that will make these six vital planes greener. The challenges and directions in this area are also discussed.

Nanath et al. [8] discussed the impact of Green information systems (Green IS) practices on Green innovations and the various ways in which corporations get an advantage over competitors because of better performance of Green innovations.

Pahlevan et al. [9] presented an optimization framework for managing green data centers using multilevel energy reduction techniques jointly. The results obtained demonstrate satisfactory results as there is considerable, up to 96% savings in electricity bill. Taufiq et al. [18] in their study discussed about cloud computing and green I.T to discover the important factors that influences adoption of SaaS cloud computing as a means to adopt green I.T. Theory of planned behaviour (T. P. B) is used and their proposed model successfully explains the concept of cloud computing and green I.T jointly.

III. Conclusion

There will be a significant amount of research work in the field of green computing in the upcoming years.

The focus of the research could be on improving the energy efficiency of cloud computing and data centers. Corporate entities need to engage in more environmentally friendly activities. To create a greener world, all stakeholders must collaborate. If not, the human race will have serious issues in the years to come. This survey has no restrictions as of yet, but it is anticipated that there will be a lot more research on green computing in the future. That is the extent to which this work can be improved in the future.

Acknowledgement

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- Electronic material
- Any other original work

Authorship Policies

Global Journals follows the definition of authorship set up by the Open Association of Research Society, USA. According to its guidelines, authorship criteria must be based on:

1. Substantial contributions to the conception and acquisition of data, analysis, and interpretation of findings.
2. Drafting the paper and revising it critically regarding important academic content.
3. Final approval of the version of the paper to be published.

Changes in Authorship

The corresponding author should mention the name and complete details of all co-authors during submission and in manuscript. We support addition, rearrangement, manipulation, and deletions in authors list till the early view publication of the journal. We expect that corresponding author will notify all co-authors of submission. We follow COPE guidelines for changes in authorship.

Copyright

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Appealing Decisions

Unless specified in the notification, the Editorial Board's decision on publication of the paper is final and cannot be appealed before making the major change in the manuscript.

Acknowledgments

Contributors to the research other than authors credited should be mentioned in Acknowledgments. The source of funding for the research can be included. Suppliers of resources may be mentioned along with their addresses.

Declaration of funding sources

Global Journals is in partnership with various universities, laboratories, and other institutions worldwide in the research domain. Authors are requested to disclose their source of funding during every stage of their research, such as making analysis, performing laboratory operations, computing data, and using institutional resources, from writing an article to its submission. This will also help authors to get reimbursements by requesting an open access publication letter from Global Journals and submitting to the respective funding source.

Preparing your Manuscript

Authors can submit papers and articles in an acceptable file format: MS Word (doc, docx), LaTeX (.tex, .zip or .rar including all of your files), Adobe PDF (.pdf), rich text format (.rtf), simple text document (.txt), Open Document Text (.odt), and Apple Pages (.pages). Our professional layout editors will format the entire paper according to our official guidelines. This is one of the highlights of publishing with Global Journals—authors should not be concerned about the formatting of their paper. Global Journals accepts articles and manuscripts in every major language, be it Spanish, Chinese, Japanese, Portuguese, Russian, French, German, Dutch, Italian, Greek, or any other national language, but the title, subtitle, and abstract should be in English. This will facilitate indexing and the pre-peer review process.

The following is the official style and template developed for publication of a research paper. Authors are not required to follow this style during the submission of the paper. It is just for reference purposes.

Manuscript Style Instruction (Optional)

- Microsoft Word Document Setting Instructions.
- Font type of all text should be Swis721 Lt BT.
- Page size: 8.27" x 11'", left margin: 0.65, right margin: 0.65, bottom margin: 0.75.
- Paper title should be in one column of font size 24.
- Author name in font size of 11 in one column.
- Abstract: font size 9 with the word "Abstract" in bold italics.
- Main text: font size 10 with two justified columns.
- Two columns with equal column width of 3.38 and spacing of 0.2.
- First character must be three lines drop-capped.
- The paragraph before spacing of 1 pt and after of 0 pt.
- Line spacing of 1 pt.
- Large images must be in one column.
- The names of first main headings (Heading 1) must be in Roman font, capital letters, and font size of 10.
- The names of second main headings (Heading 2) must not include numbers and must be in italics with a font size of 10.

Structure and Format of Manuscript

The recommended size of an original research paper is under 15,000 words and review papers under 7,000 words. Research articles should be less than 10,000 words. Research papers are usually longer than review papers. Review papers are reports of significant research (typically less than 7,000 words, including tables, figures, and references)

A research paper must include:

a) A title which should be relevant to the theme of the paper.
b) A summary, known as an abstract (less than 150 words), containing the major results and conclusions.
c) Up to 10 keywords that precisely identify the paper's subject, purpose, and focus.
d) An introduction, giving fundamental background objectives.
e) Resources and techniques with sufficient complete experimental details (wherever possible by reference) to permit repetition, sources of information must be given, and numerical methods must be specified by reference.
f) Results which should be presented concisely by well-designed tables and figures.
g) Suitable statistical data should also be given.
h) All data must have been gathered with attention to numerical detail in the planning stage.

Design has been recognized to be essential to experiments for a considerable time, and the editor has decided that any paper that appears not to have adequate numerical treatments of the data will be returned unrefereed.

i) Discussion should cover implications and consequences and not just recapitulate the results; conclusions should also be summarized.
j) There should be brief acknowledgments.
k) There ought to be references in the conventional format. Global Journals recommends APA format.

Authors should carefully consider the preparation of papers to ensure that they communicate effectively. Papers are much more likely to be accepted if they are carefully designed and laid out, contain few or no errors, are summarizing, and follow instructions. They will also be published with much fewer delays than those that require much technical and editorial correction.

The Editorial Board reserves the right to make literary corrections and suggestions to improve brevity.

Format Structure

It is necessary that authors take care in submitting a manuscript that is written in simple language and adheres to published guidelines.

All manuscripts submitted to Global Journals should include:

Title

The title page must carry an informative title that reflects the content, a running title (less than 45 characters together with spaces), names of the authors and co-authors, and the place(s) where the work was carried out.

Author details

The full postal address of any related author(s) must be specified.

Abstract

The abstract is the foundation of the research paper. It should be clear and concise and must contain the objective of the paper and inferences drawn. It is advised to not include big mathematical equations or complicated jargon.

Many researchers searching for information online will use search engines such as Google, Yahoo or others. By optimizing your paper for search engines, you will amplify the chance of someone finding it. In turn, this will make it more likely to be viewed and cited in further works. Global Journals has compiled these guidelines to facilitate you to maximize the web-friendliness of the most public part of your paper.

Keywords

A major lynchpin of research work for the writing of research papers is the keyword search, which one will employ to find both library and internet resources. Up to eleven keywords or very brief phrases have to be given to help data retrieval, mining, and indexing.

One must be persistent and creative in using keywords. An effective keyword search requires a strategy: planning of a list of possible keywords and phrases to try.

Choice of the main keywords is the first tool of writing a research paper. Research paper writing is an art. Keyword search should be as strategic as possible.

One should start brainstorming lists of potential keywords before even beginning searching. Think about the most important concepts related to research work. Ask, “What words would a source have to include to be truly valuable in a research paper?” Then consider synonyms for the important words.

It may take the discovery of only one important paper to steer in the right keyword direction because, in most databases, the keywords under which a research paper is abstracted are listed with the paper.

Numerical Methods

Numerical methods used should be transparent and, where appropriate, supported by references.

Abbreviations

Authors must list all the abbreviations used in the paper at the end of the paper or in a separate table before using them.

Formulas and equations

Authors are advised to submit any mathematical equation using either MathJax, KaTeX, or LaTeX, or in a very high-quality image.

Tables, Figures, and Figure Legends

Tables: Tables should be cautiously designed, uncrowned, and include only essential data. Each must have an Arabic number, e.g., Table 4, a self-explanatory caption, and be on a separate sheet. Authors must submit tables in an editable format and not as images. References to these tables (if any) must be mentioned accurately.

Figures

Figures are supposed to be submitted as separate files. Always include a citation in the text for each figure using Arabic numbers, e.g., Fig. 4. Artwork must be submitted online in vector electronic form or by emailing it.

Preparation of Eletronic Figures for Publication

Although low-quality images are sufficient for review purposes, print publication requires high-quality images to prevent the final product being blurred or fuzzy. Submit (possibly by e-mail) EPS (line art) or TIFF (halftone/ photographs) files only. MS PowerPoint and Word Graphics are unsuitable for printed pictures. Avoid using pixel-oriented software. Scans (TIFF only) should have a resolution of at least 350 dpi (halftone) or 700 to 1100 dpi (line drawings). Please give the data for figures in black and white or submit a Color Work Agreement form. EPS files must be saved with fonts embedded (and with a TIFF preview, if possible).

For scanned images, the scanning resolution at final image size ought to be as follows to ensure good reproduction: line art: >650 dpi; halftones (including gel photographs): >350 dpi; figures containing both halftone and line images: >650 dpi.

Color charges: Authors are advised to pay the full cost for the reproduction of their color artwork. Hence, please note that if there is color artwork in your manuscript when it is accepted for publication, we would require you to complete and return a Color Work Agreement form before your paper can be published. Also, you can email your editor to remove the color fee after acceptance of the paper.

Tips for writing a good quality Computer Science Research Paper

Techniques for writing a good quality computer science research paper:

1. Choosing the topic: In most cases, the topic is selected by the interests of the author, but it can also be suggested by the guides. You can have several topics, and then judge which you are most comfortable with. This may be done by asking several questions of yourself, like "Will I be able to carry out a search in this area? Will I find all necessary resources to accomplish the search? Will I be able to find all information in this field area?" If the answer to this type of question is "yes," then you ought to choose that topic. In most cases, you may have to conduct surveys and visit several places. Also, you might have to do a lot of work to find all the rises and falls of the various data on that subject. Sometimes, detailed information plays a vital role, instead of short information. Evaluators are human: The first thing to remember is that evaluators are also human beings. They are not only meant for rejecting a paper. They are here to evaluate your paper. So present your best aspect.

2. Think like evaluators: If you are in confusion or getting demotivated because your paper may not be accepted by the evaluators, then think, and try to evaluate your paper like an evaluator. Try to understand what an evaluator wants in your research paper, and you will automatically have your answer. Make blueprints of paper: The outline is the plan or framework that will help you to arrange your thoughts. It will make your paper logical. But remember that all points of your outline must be related to the topic you have chosen.

3. Ask your guides: If you are having any difficulty with your research, then do not hesitate to share your difficulty with your guide (if you have one). They will surely help you out and resolve your doubts. If you can't clarify what exactly you require for your work, then ask your supervisor to help you with an alternative. He or she might also provide you with a list of essential readings.

4. Use of computer is recommended: As you are doing research in the field of computer science then this point is quite obvious. Use right software: Always use good quality software packages. If you are not capable of judging good software, then you can lose the quality of your paper unknowingly. There are various programs available to help you which you can get through the internet.

5. Use the internet for help: An excellent start for your paper is using Google. It is a wondrous search engine, where you can have your doubts resolved. You may also read some answers for the frequent question of how to write your research paper or find a model research paper. You can download books from the internet. If you have all the required books, place importance on reading, selecting, and analyzing the specified information. Then sketch out your research paper. Use big pictures: You may use encyclopedias like Wikipedia to get pictures with the best resolution. At Global Journals, you should strictly follow here.

6. Bookmarks are useful: When you read any book or magazine, you generally use bookmarks, right? It is a good habit which helps to not lose your continuity. You should always use bookmarks while searching on the internet also, which will make your search easier.

7. Revise what you wrote: When you write anything, always read it, summarize it, and then finalize it.

8. Make every effort: Make every effort to mention what you are going to write in your paper. That means always have a good start. Try to mention everything in the introduction—what is the need for a particular research paper. Polish your work with good writing skills and always give an evaluator what he wants. Make backups: When you are going to do any important thing like making a research paper, you should always have backup copies of it either on your computer or on paper. This protects you from losing any portion of your important data.

9. Produce good diagrams of your own: Always try to include good charts or diagrams in your paper to improve quality. Using several unnecessary diagrams will degrade the quality of your paper by creating a hodgepodge. So always try to include diagrams which were made by you to improve the readability of your paper. Use of direct quotes: When you do research relevant to literature, history, or current affairs, then use of quotes becomes essential, but if the study is relevant to science, use of quotes is not preferable.

10.Use proper verb tense: Use proper verb tenses in your paper. Use past tense to present those events that have happened. Use present tense to indicate events that are going on. Use future tense to indicate events that will happen in the future. Use of wrong tenses will confuse the evaluator. Avoid sentences that are incomplete.

11. Pick a good study spot: Always try to pick a spot for your research which is quiet. Not every spot is good for studying.

12. Know what you know: Always try to know what you know by making objectives, otherwise you will be confused and unable to achieve your target.

13. Use good grammar: Always use good grammar and words that will have a positive impact on the evaluator; use of good vocabulary does not mean using tough words which the evaluator has to find in a dictionary. Do not fragment sentences. Eliminate one-word sentences. Do not ever use a big word when a smaller one would suffice.

Verbs have to be in agreement with their subjects. In a research paper, do not start sentences with conjunctions or finish them with prepositions. When writing formally, it is advisable to never split an infinitive because someone will (wrongly) complain. Avoid clichés like a disease. Always shun irritating alliteration. Use language which is simple and straightforward. Put together a neat summary.

14. Arrangement of information: Each section of the main body should start with an opening sentence, and there should be a changeover at the end of the section. Give only valid and powerful arguments for your topic. You may also maintain your arguments with records.

15. Never start at the last minute: Always allow enough time for research work. Leaving everything to the last minute will degrade your paper and spoil your work.

16. Multitasking in research is not good: Doing several things at the same time is a bad habit in the case of research activity. Research is an area where everything has a particular time slot. Divide your research work into parts, and do a particular part in a particular time slot.

17. Never copy others' work: Never copy others' work and give it your name because if the evaluator has seen it anywhere, you will be in trouble. Take proper rest and food: No matter how many hours you spend on your research activity, if you are not taking care of your health, then all your efforts will have been in vain. For quality research, take proper rest and food.

18. Go to seminars: Attend seminars if the topic is relevant to your research area. Utilize all your resources.

19. Refresh your mind after intervals: Try to give your mind a rest by listening to soft music or sleeping in intervals. This will also improve your memory. Acquire colleagues: Always try to acquire colleagues. No matter how sharp you are, if you acquire colleagues, they can give you ideas which will be helpful to your research.

20. Think technically: Always think technically. If anything happens, search for its reasons, benefits, and demerits. Think and then print: When you go to print your paper, check that tables are not split, headings are not detached from their descriptions, and page sequence is maintained.

21. Adding unnecessary information: Do not add unnecessary information like "I have used MS Excel to draw graphs." Irrelevant and inappropriate material is superfluous. Foreign terminology and phrases are not apropos. One should never take a broad view. Analogy is like feathers on a snake. Use words properly, regardless of how others use them. Remove quotations. Puns are for kids, not grunt readers. Never oversimplify: When adding material to your research paper, never go for oversimplification; this will definitely irritate the evaluator. Be specific. Never use rhythmic redundancies. Contractions shouldn't be used in a research paper. Comparisons are as terrible as clichés. Give up ampersands, abbreviations, and so on. Remove commas that are not necessary. Parenthetical words should be between brackets or commas. Understatement is always the best way to put forward earth-shaking thoughts. Give a detailed literary review.

22. Report concluded results: Use concluded results. From raw data, filter the results, and then conclude your studies based on measurements and observations taken. An appropriate number of decimal places should be used. Parenthetical remarks are prohibited here. Proofread carefully at the final stage. At the end, give an outline to your arguments. Spot perspectives of further study of the subject. Justify your conclusion at the bottom sufficiently, which will probably include examples.

23. Upon conclusion: Once you have concluded your research, the next most important step is to present your findings. Presentation is extremely important as it is the definite medium though which your research is going to be in print for the rest of the crowd. Care should be taken to categorize your thoughts well and present them in a logical and neat manner. A good quality research paper format is essential because it serves to highlight your research paper and bring to light all necessary aspects of your research.

Informal Guidelines of Research Paper Writing

Key points to remember:

- Submit all work in its final form.
- Write your paper in the form which is presented in the guidelines using the template.
- Please note the criteria peer reviewers will use for grading the final paper.

Final points:

One purpose of organizing a research paper is to let people interpret your efforts selectively. The journal requires the following sections, submitted in the order listed, with each section starting on a new page:

The introduction: This will be compiled from reference matter and reflect the design processes or outline of basis that directed you to make a study. As you carry out the process of study, the method and process section will be constructed like that. The results segment will show related statistics in nearly sequential order and direct reviewers to similar intellectual paths throughout the data that you gathered to carry out your study.

The discussion section:

This will provide understanding of the data and projections as to the implications of the results. The use of good quality references throughout the paper will give the effort trustworthiness by representing an alertness to prior workings.

Writing a research paper is not an easy job, no matter how trouble-free the actual research or concept. Practice, excellent preparation, and controlled record-keeping are the only means to make straightforward progression.

General style:

Specific editorial column necessities for compliance of a manuscript will always take over from directions in these general guidelines.

To make a paper clear: Adhere to recommended page limits.

Mistakes to avoid:

- Insertion of a title at the foot of a page with subsequent text on the next page.
- Separating a table, chart, or figure—confine each to a single page.
- Submitting a manuscript with pages out of sequence.
- In every section of your document, use standard writing style, including articles ("a" and "the").
- Keep paying attention to the topic of the paper.
- Use paragraphs to split each significant point (excluding the abstract).
- Align the primary line of each section.
- Present your points in sound order.
- Use present tense to report well-accepted matters.
- Use past tense to describe specific results.
- Do not use familiar wording; don't address the reviewer directly. Don't use slang or superlatives.
- Avoid use of extra pictures—include only those figures essential to presenting results.

Title page:

Choose a revealing title. It should be short and include the name(s) and address(es) of all authors. It should not have acronyms or abbreviations or exceed two printed lines.

Abstract: This summary should be two hundred words or less. It should clearly and briefly explain the key findings reported in the manuscript and must have precise statistics. It should not have acronyms or abbreviations. It should be logical in itself. Do not cite references at this point.

An abstract is a brief, distinct paragraph summary of finished work or work in development. In a minute or less, a reviewer can be taught the foundation behind the study, common approaches to the problem, relevant results, and significant conclusions or new questions.

Write your summary when your paper is completed because how can you write the summary of anything which is not yet written? Wealth of terminology is very essential in abstract. Use comprehensive sentences, and do not sacrifice readability for brevity; you can maintain it succinctly by phrasing sentences so that they provide more than a lone rationale. The author can at this moment go straight to shortening the outcome. Sum up the study with the subsequent elements in any summary. Try to limit the initial two items to no more than one line each.

Reason for writing the article—theory, overall issue, purpose.

- Fundamental goal.
- To-the-point depiction of the research.
- Consequences, including definite statistics—if the consequences are quantitative in nature, account for this; results of any numerical analysis should be reported. Significant conclusions or questions that emerge from the research.

Approach:

- Single section and succinct.
- An outline of the job done is always written in past tense.
- Concentrate on shortening results—limit background information to a verdict or two.
- Exact spelling, clarity of sentences and phrases, and appropriate reporting of quantities (proper units, important statistics) are just as significant in an abstract as they are anywhere else.

Introduction:

The introduction should "introduce" the manuscript. The reviewer should be presented with sufficient background information to be capable of comprehending and calculating the purpose of your study without having to refer to other works. The basis for the study should be offered. Give the most important references, but avoid making a comprehensive appraisal of the topic. Describe the problem visibly. If the problem is not acknowledged in a logical, reasonable way, the reviewer will give no attention to your results. Speak in common terms about techniques used to explain the problem, if needed, but do not present any particulars about the protocols here.

The following approach can create a valuable beginning:

- Explain the value (significance) of the study.
- Defend the model—why did you employ this particular system or method? What is its compensation? Remark upon its appropriateness from an abstract point of view as well as pointing out sensible reasons for using it.
- Present a justification. State your particular theory(-ies) or aim(s), and describe the logic that led you to choose them.
- Briefly explain the study's tentative purpose and how it meets the declared objectives.

Approach:

Use past tense except for when referring to recognized facts. After all, the manuscript will be submitted after the entire job is done. Sort out your thoughts; manufacture one key point for every section. If you make the four points listed above, you will need at least four paragraphs. Present surrounding information only when it is necessary to support a situation. The reviewer does not desire to read everything you know about a topic. Shape the theory specifically—do not take a broad view.

As always, give awareness to spelling, simplicity, and correctness of sentences and phrases.

Procedures (methods and materials):

This part is supposed to be the easiest to carve if you have good skills. A soundly written procedures segment allows a capable scientist to replicate your results. Present precise information about your supplies. The suppliers and clarity of reagents can be helpful bits of information. Present methods in sequential order, but linked methodologies can be grouped as a segment. Be concise when relating the protocols. Attempt to give the least amount of information that would permit another capable scientist to replicate your outcome, but be cautious that vital information is integrated. The use of subheadings is suggested and ought to be synchronized with the results section.

When a technique is used that has been well-described in another section, mention the specific item describing the way, but draw the basic principle while stating the situation. The purpose is to show all particular resources and broad procedures so that another person may use some or all of the methods in one more study or referee the scientific value of your work. It is not to be a step-by-step report of the whole thing you did, nor is a methods section a set of orders.

Materials:

Materials may be reported in part of a section or else they may be recognized along with your measures.

Methods:

- Report the method and not the particulars of each process that engaged the same methodology.
- Describe the method entirely.
- To be succinct, present methods under headings dedicated to specific dealings or groups of measures.
- Simplify—detail how procedures were completed, not how they were performed on a particular day.
- If well-known procedures were used, account for the procedure by name, possibly with a reference, and that's all.

Approach:

It is embarrassing to use vigorous voice when documenting methods without using first person, which would focus the reviewer's interest on the researcher rather than the job. As a result, when writing up the methods, most authors use third person passive voice.

Use standard style in this and every other part of the paper—avoid familiar lists, and use full sentences.

What to keep away from:

- Resources and methods are not a set of information.
- Skip all descriptive information and surroundings—save it for the argument.
- Leave out information that is immaterial to a third party.

Results:

The principle of a results segment is to present and demonstrate your conclusion. Create this part as entirely objective details of the outcome, and save all understanding for the discussion.

The page length of this segment is set by the sum and types of data to be reported. Use statistics and tables, if suitable, to present consequences most efficiently.

You must clearly differentiate material which would usually be incorporated in a study editorial from any unprocessed data or additional appendix matter that would not be available. In fact, such matters should not be submitted at all except if requested by the instructor.

Content:

- Sum up your conclusions in text and demonstrate them, if suitable, with figures and tables.
- In the manuscript, explain each of your consequences, and point the reader to remarks that are most appropriate.
- Present a background, such as by describing the question that was addressed by creation of an exacting study.
- Explain results of control experiments and give remarks that are not accessible in a prescribed figure or table, if appropriate.
- Examine your data, then prepare the analyzed (transformed) data in the form of a figure (graph), table, or manuscript.

What to stay away from:

- Do not discuss or infer your outcome, report surrounding information, or try to explain anything.
- Do not include raw data or intermediate calculations in a research manuscript.
- Do not present similar data more than once.
- A manuscript should complement any figures or tables, not duplicate information.
- Never confuse figures with tables—there is a difference.

Approach:

As always, use past tense when you submit your results, and put the whole thing in a reasonable order.

Put figures and tables, appropriately numbered, in order at the end of the report.

If you desire, you may place your figures and tables properly within the text of your results section.

Figures and tables:

If you put figures and tables at the end of some details, make certain that they are visibly distinguished from any attached appendix materials, such as raw facts. Whatever the position, each table must be titled, numbered one after the other, and include a heading. All figures and tables must be divided from the text.

Discussion:

The discussion is expected to be the trickiest segment to write. A lot of papers submitted to the journal are discarded based on problems with the discussion. There is no rule for how long an argument should be.

Position your understanding of the outcome visibly to lead the reviewer through your conclusions, and then finish the paper with a summing up of the implications of the study. The purpose here is to offer an understanding of your results and support all of your conclusions, using facts from your research and generally accepted information, if suitable. The implication of results should be fully described.

Infer your data in the conversation in suitable depth. This means that when you clarify an observable fact, you must explain mechanisms that may account for the observation. If your results vary from your prospect, make clear why that may have happened. If your results agree, then explain the theory that the proof supported. It is never suitable to just state that the data approved the prospect, and let it drop at that. Make a decision as to whether each premise is supported or discarded or if you cannot make a conclusion with assurance. Do not just dismiss a study or part of a study as "uncertain."

Research papers are not acknowledged if the work is imperfect. Draw what conclusions you can based upon the results that you have, and take care of the study as a finished work.

- You may propose future guidelines, such as how an experiment might be personalized to accomplish a new idea.
- Give details of all of your remarks as much as possible, focusing on mechanisms.
- Make a decision as to whether the tentative design sufficiently addressed the theory and whether or not it was correctly restricted. Try to present substitute explanations if they are sensible alternatives.
- One piece of research will not counter an overall question, so maintain the large picture in mind. Where do you go next? The best studies unlock new avenues of study. What questions remain?
- Recommendations for detailed papers will offer supplementary suggestions.

Approach:

When you refer to information, differentiate data generated by your own studies from other available information. Present work done by specific persons (including you) in past tense.

Describe generally acknowledged facts and main beliefs in present tense.

The Administration Rules

Administration Rules to Be Strictly Followed before Submitting Your Research Paper to Global Journals Inc.

Please read the following rules and regulations carefully before submitting your research paper to Global Journals Inc. to avoid rejection.

Segment draft and final research paper: You have to strictly follow the template of a research paper, failing which your paper may get rejected. You are expected to write each part of the paper wholly on your own. The peer reviewers need to identify your own perspective of the concepts in your own terms. Please do not extract straight from any other source, and do not rephrase someone else's analysis. Do not allow anyone else to proofread your manuscript.

Written material: You may discuss this with your guides and key sources. Do not copy anyone else's paper, even if this is only imitation, otherwise it will be rejected on the grounds of plagiarism, which is illegal. Various methods to avoid plagiarism are strictly applied by us to every paper, and, if found guilty, you may be blacklisted, which could affect your career adversely. To guard yourself and others from possible illegal use, please do not permit anyone to use or even read your paper and file.

Criterion for Grading a Research Paper (Compilation) by Global Journals Inc. (US)

Please note that following table is only a Grading of "Paper Compilation" and not on "Performed/Stated Research" whose grading solely depends on Individual Assigned Peer Reviewer and Editorial Board Member. These can be available only on request and after decision of Paper. This report will be the property of Global Journals Inc. (US).

Topics	Grades		
	A-B	**C-D**	**E-F**
Abstract	Clear and concise with appropriate content, Correct format. 200 words or below	Unclear summary and no specific data, Incorrect form Above 200 words	No specific data with ambiguous information Above 250 words
Introduction	Containing all background details with clear goal and appropriate details, flow specification, no grammar and spelling mistake, well organized sentence and paragraph, reference cited	Unclear and confusing data, appropriate format, grammar and spelling errors with unorganized matter	Out of place depth and content, hazy format
Methods and Procedures	Clear and to the point with well arranged paragraph, precision and accuracy of facts and figures, well organized subheads	Difficult to comprehend with embarrassed text, too much explanation but completed	Incorrect and unorganized structure with hazy meaning
Result	Well organized, Clear and specific, Correct units with precision, correct data, well structuring of paragraph, no grammar and spelling mistake	Complete and embarrassed text, difficult to comprehend	Irregular format with wrong facts and figures
Discussion	Well organized, meaningful specification, sound conclusion, logical and concise explanation, highly structured paragraph reference cited	Wordy, unclear conclusion, spurious	Conclusion is not cited, unorganized, difficult to comprehend
References	Complete and correct format, well organized	Beside the point, Incomplete	Wrong format and structuring

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