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# Intellectual Property (IP) Creation Model for Corporate Bodies using the Dynamic Expert System (DES) Approach

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**Abstract**
In this Intellectual Property (IP) Creation Model using Dynamic Expert System (DES) Approach, experienced staff among the workforce constitute the domain experts, the researcher functions as knowledge engineer, who elicits knowledge from the domain experts. The elicited knowledge is further validated by the workforce peers namely the principal engineer and the director. The validated knowledge is then codified and stored in the DES knowledge repository by the knowledge engineer. By repeating this process every quarter of the year, the elicited knowledge is modified as appropriate and made to be continuously up to date. The IP Creation Model using DES was subjected to Monte Carlos simulation to see how it would fare for the next five years (20 quarters). When a new IP is elicited and validated, it is rated by the workforce peers as either grade 1 or grade 2 or grade 3 according to its quality. A remuneration package for new IP creation was crafted by the researcher such that the remuneration paid to the workforce is always less than the contribution of the new IP to the company's bottom line. This enables the company to acquire new IP at a reduced cost than its market worth. The model of IP growth over the years (X) was found to be new IP = 90.40x + 8.20 with coefficient of determination of 98.94%, meaning that the model can be used for forecasting new IP. Over the 5years of simulation, a total of 218 new IPs were discovered causing the company a remuneration package of ₦1, 010,364.5. However, the expert valuation of those new IP gave their market worth to be ₦ 4,440,929. This means that the company produce the new IPs cheaper than their market price by as much as N 3,430,564.5 within the 5years of simulation. The software used for the Dynamic Expert System (DES) inference Engine is written in Java Programming Language.
**Keywords:Intellectual Property, Creation Model, Corporate Bodies, Dynamic Expert System**

## 1. Introduction

Intellectual property (IP) is an original thought of a person, which may be new creative work which is protected by law. It is the knowledge in the brain of a company's workforce. Improved IP makes the organization to move faster, smoother and better and on the bottom line, have higher income and better integrity. It helps improve the IP content of the workforce so that they work with greater efficiency. These will enable the workforce appreciate in value. These creative works (IPs) could come in form of new inventions, artistic works, literary works, images, symbols etc. Intellectual property creation model for corporate bodies using DES Approach is a means of creating IP. Initially, there is a static Expert system creation process that grows dynamically when successive knowledge elicitation is done quarterly from the workforce (Nwobodo et al.2017).The successful elicited IP are verified by higher associates of the workforce. The effective validated IP are stored in the knowledge base. An expert system is a branch of artificial intelligence that mimics the thinking process of an expert, it remains static if its knowledge base is not enhanced from time to time but dynamic otherwise.

IP creation model is a cost effective way of growing intellectual property (IP) content of the workforce in a corporate body. The proposed model will help capture the best practices for every shade of work done in a company which represents the company on paper, so that the know-how (IP) of the company will not be lost when a worker leaves. The efficiency and effectiveness of the company's workforce will be kept at the highest level.

### 2. Review of Related Literature

Smith and Hansen (2014) split the strategic management of IP in the activities of IP generation, protection and valuation and argue that firms must ensure that these activities are aligned with business strategy. They mentioned that firms must ensure that patent protection should be given out free but there was no means of growing the IP. Schindler. K et al. (2016) developed an

internal IP database storing ideas, invention disclosure and patent data. In the database, patents are classified according to their market success and patent sustainability potentials. The keywords of the classifications are renewed every two years. Technical aspects are assessed too. The challenge for Schindler regarding the database is to provide firm-wide communication and to ensure confidentiality of information. Data communication between the database users is therefore implemented via a secured intranet, he established different levels of access authorization. Wyatt (2017) wrote on Intellectual Property Management for Technology Professionals to make it easy to understand how to manage intellectual property while keeping it as a strategic asset. It is a primer that first explains what intellectual property is and why it exists. The three fundamental models of its use are mentioned as pricing power, defensive bargaining and direct revenue generation model. He familiarize IP as the core driver of the decision making process, more so for the businesses of the digital age. He did not mention the dynamic aspect of it and a means of remunerating the inventors is missing. William (2013) developed an IP management framework where R&D strategy and legal functions are integrated. It allowed engineers, lawyers and business executives to manage IP assets, it is also used to exercise market power by employing IP right protection to increase incentives so as to invent around the inventors. There was no means of evaluating the IP mentioned.

**3. Model Design**

The key components of the model design are:

1. The initial (Static) Expert System Creation Process.
2. The transformation of the static expert system to dynamic expert system. This involves the use of knowledge elicitation every quarter of the year from the workforce to discover new IPs (best practices) that could replace some of the existing ones, previously in the knowledge base, this means the expert system is growing in terms of newly created IPs and continuously made relevant and up to date. It is therefore said to be dynamic.
3. The simulation of the Model for 5years using the Monte Carlo Approach.
4. The analysis of the simulation result and the summary of the new IP creation over 5years.
5. The development of a new IP creation model through Linear Regression Analysis of the simulation results.

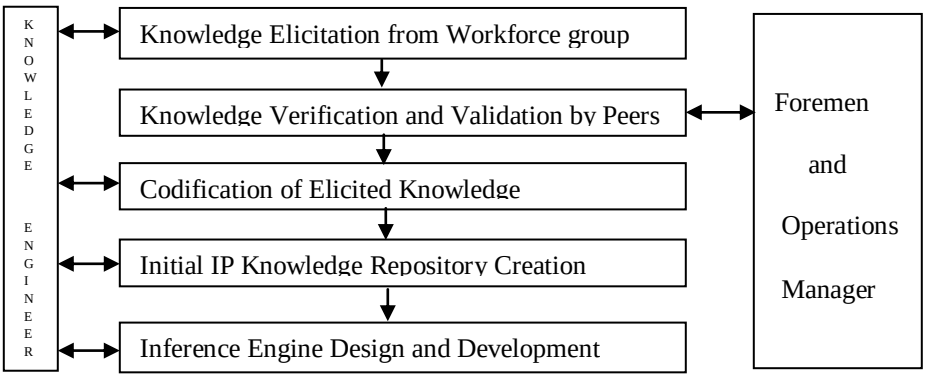


**Fig 1: Initial (Static) Expert System Creation Process**

Fig 1 indicates the initial (static) expert system creation process. The knowledge elicited from the workforce group forms the initial static expert system. The effect of the knowledge elicitation is to capture the best practices for all shades of work done in any corporate body. It is verified and graded by peers, the successful ones are codified by the knowledge engineer, and stored in the initial IP knowledge repository. These best practices form the initial intellectual property repository, if the knowledge base of this expert system is never updated, the expert system remains static over time. However in this research, this expert system knowledge base grows as knowledge elicitation is done quarterly, leading to the term dynamic expert system by which it is known.

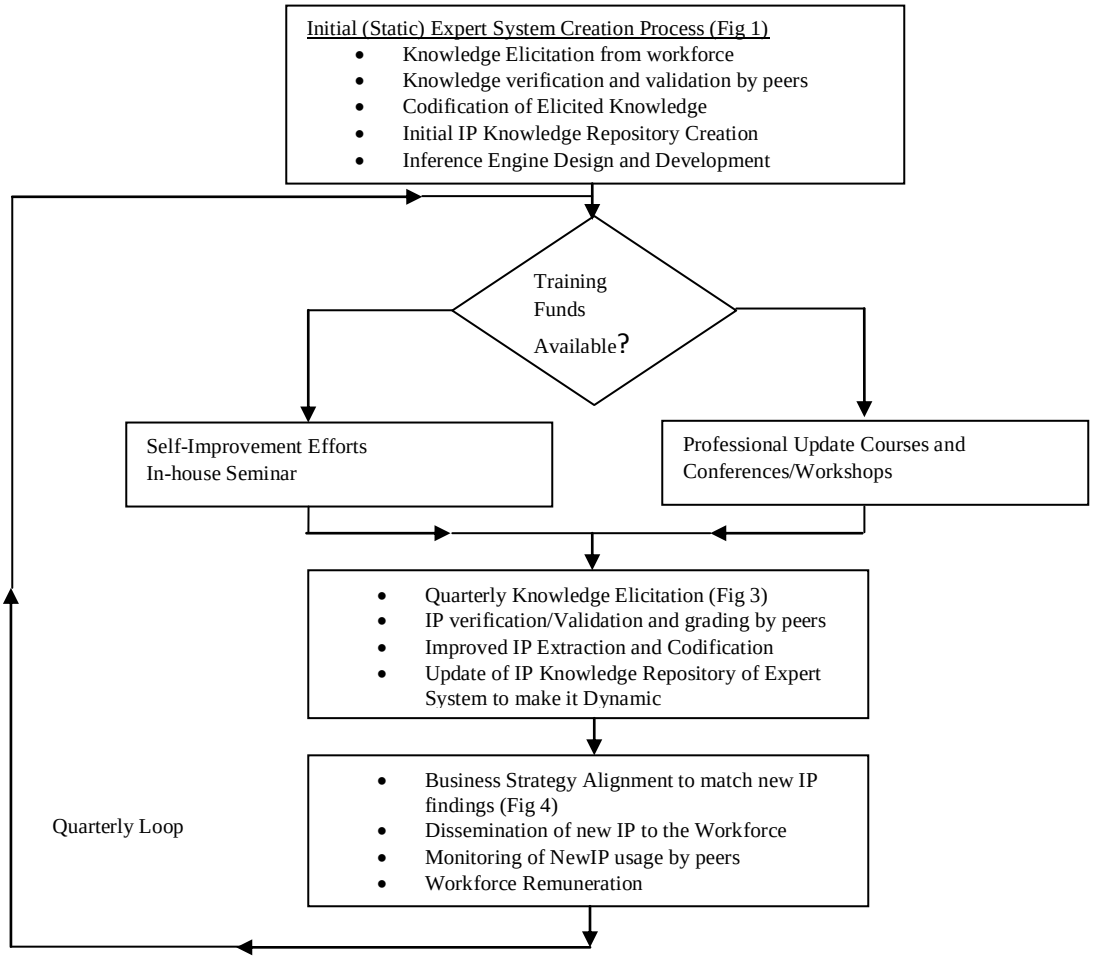


**Fig 2:Intellectual Property Creation Model for Corporate Bodies using the Dynamic Expert System Approach**

Fig 2 denotes the Intellectual Property Creation Model for Corporate Bodies using the Dynamic Expert System Approach. There is an initial expert system creation process (Fig 1) which is enhanced through professional update courses, conferences, workshops or even through self-improvement efforts, in-house seminars etc. There is a quarterly knowledge elicitation, the elicited knowledge is verified, validated and graded by the peers. The successful ones are used to update the knowledge repository. The workforces are monitored on the use of new IP, they are also remunerated for creation and the use of new IP. The quarterly loop shown in the diagram ensures that this IP improvement process is continuous. Fig 3 illustrates this process further and highlights the parts played by knowledge engineer and the peer review panel.

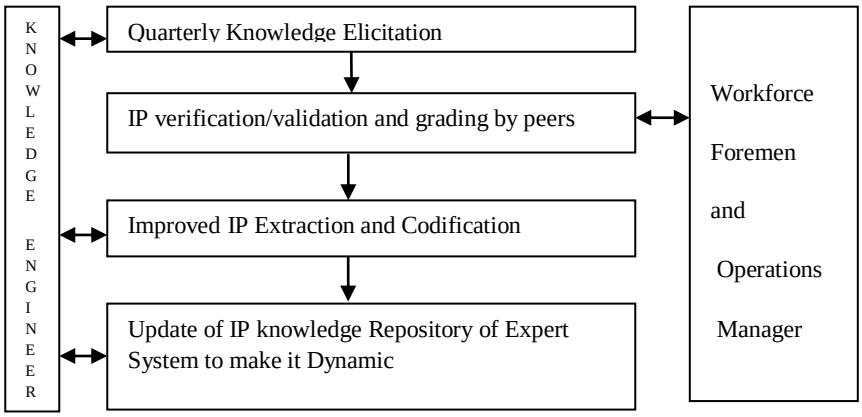

**Fig 3: Quarterly Knowledge Elicitation and update of IP knowledge Repository**

Fig 3 shows that after the professional improvement exercises from the workforce, there is an elicitation of knowledge every quarter. This is verified by the workforce peer, codified by the knowledge engineer and use to update the knowledge repository.

Example, if Knowledge Repository (KR) was of the size $X_{records}$
$KR_{size} = X_{records}$
If a knowledge is removed for enhancement, it becomes:
$KR_{del} = X_{records} - 1$
Here, an old knowledge is removed, a new IP is updated to become,
$KR_{add} = (X_{records} - 1) + 1 = X_{records} = KR_{size}$
This means that the improvement of the knowledge repository does not change the size (number of records) of the knowledge repository, but when an entirely new IP is found, it increases the size of the knowledge repository.
Example, New process IP size = $Y_{new}$
$KR_{size} = X_{records} + Y_{new}$

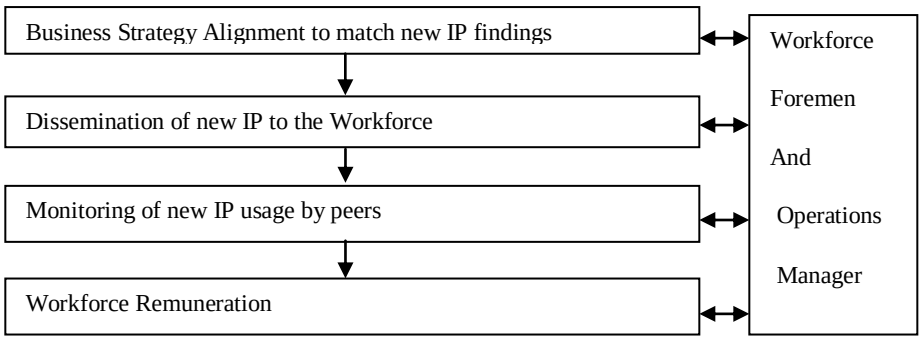


**Fig 4: Business Strategy Alignment and Workforce Remuneration**

Fig 4 portrays Business Strategy Alignment and Workforce Remuneration. The business strategies are adjusted to match the new IP found in Fig 3 and made available to the entire workforce. The workforce are monitored on the use of new IP. The inventors of the new IP are remunerated (Fig 4).

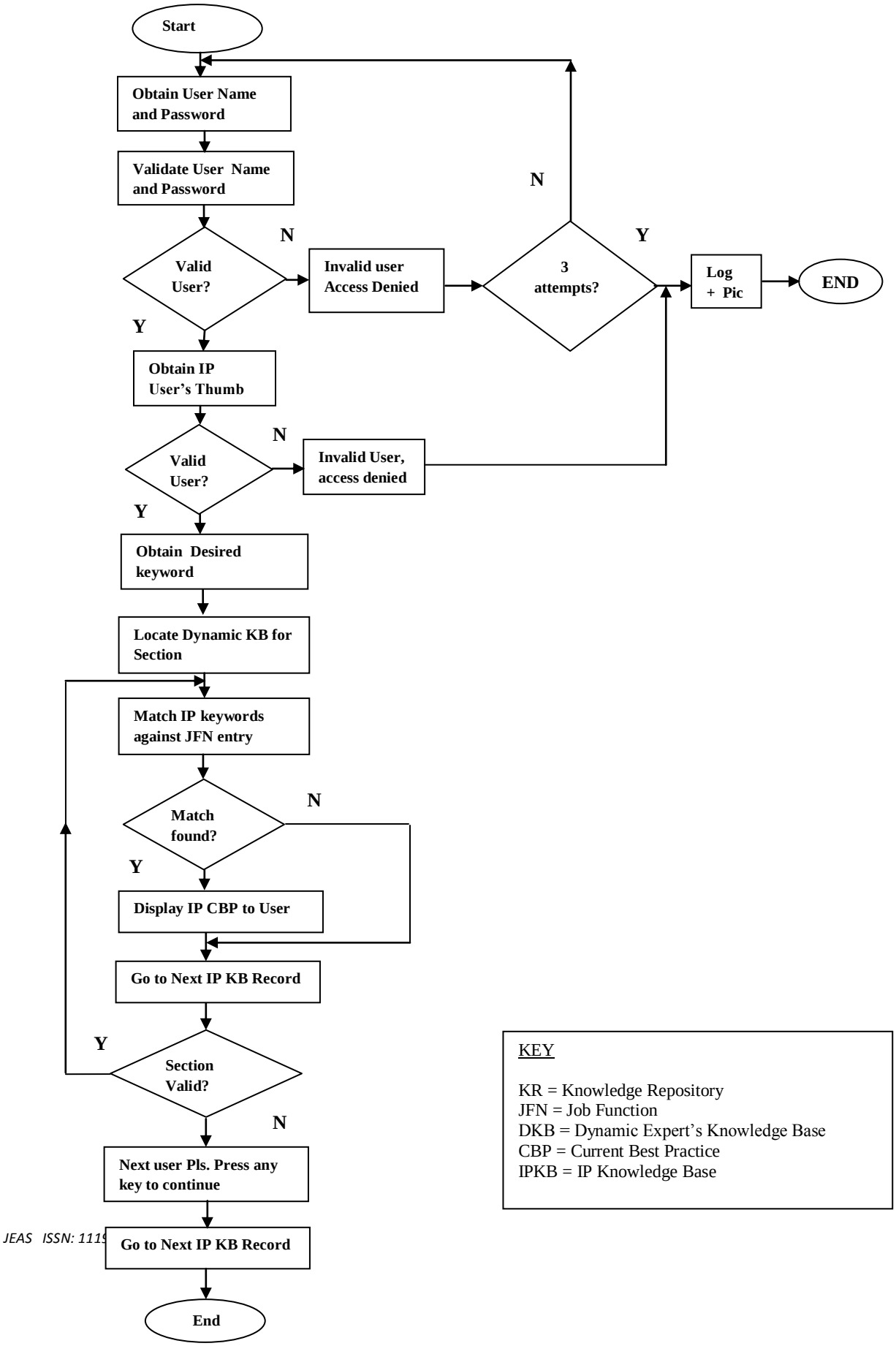
Start
Obtain User Name and Password
Validate User Name and Password
Valid User?
N
Invalid user Access Denied
3 attempts?
N
Y
Log + Pic
END
Y
Obtain IP User's Thumb
Valid User?
N
Invalid User, access denied
Y
Obtain Desired keyword
Locate Dynamic KB for Section
Match IP keywords against JFN entry
Match found?
N
Y
Display IP CBP to User
Go to Next IP KB Record
Section Valid?
Y
N
Next user Pls. Press any key to continue
Go to Next IP KB Record
End
KEY
KR = Knowledge Repository
JFN = Job Function
DKB = Dynamic Expert's Knowledge Base
CBP = Current Best Practice
IPKB = IP Knowledge Base

**Fig 5: Inference Engine Flowchart**

Fig. 5 is an Inference Engine flowchart showing how user obtains IP from Knowledge base. A user who must be a staff of the company concerned, logs in with his user name and password. The user name is the section name to which the user belongs while the password is the staff ID. The system validates user name and the section he/she belongs, if not a valid user, it denies him access, if he attempts logging in up to 3 times, the system automatically takes his picture and logs his information for future reference. If the user is valid, the system obtains the user's thumbprint and compares it with the staff thumbprint, user name and password. If they did not match, it will deny access to the user, takes picture and logs his information. That concludes the logging in process. To access IP information from the dynamic knowledge base, the user enters an appropriate keyword. The system then searches through the knowledge base and throws up matches for the keywords.

## 4. Simulation of the new IP creation Model

A simulation of the New IP Creation Model of Fig 2 was done to serve as a look ahead facility to see what the outcome of New IP Creation Model would be in the next 5 years. The Electronic Development Institute (ELDI) Awka was used as a case study for simulation. New IP discovery is captured every quarter, which is 4 times per year. The 5 years simulation therefore covered 20 quarters. On the average, each section of ELDI can add between 1 and 6 new IPs per quarter. Using Monte Carlo simulation (Bremaud 2013), made it possible to work out numbers of new IPs per section per quarter via random number generation. In this, a random number N is generated for a section per quarter. (N modulo 6) + 1 gives a remainder which has between 1 and 6 and serves as the number of new IPs for the section for that quarter. This is indicated in the 3rd column of Table 1. Also each new IP is rated as either grade 1 or grade 2 or grade 3. Again a random number M is generated and (M modulo 6) + 1 (i.e. a number which lies between 1 and 6 inclusive) is found. If the (M modulo 6) + 1 is 1 or 2, grade 1 new IP is assumed. If (M modulo 6) + 1 is 3 or 4, grade 2 new IP is assumed and if (M modulo 6) + 1 is 5 or 6 grade 3 new IP is assumed. This is the treatment given in the simulation to each new IP found and is informed by the current happenings in the company. It is envisaged by the expert valuers that each new IP could add as much as 9 times the step size in salary of the staff that discovered it if it is rated grade 1. Grade 2 new IPs are deemed to be worth 6 times the step size in salary of the staff that discovered it while grade 3 new IPs add 3 times the step size in salary of the staff that found it. However, staff remuneration for each grade 1 new IP is only 1 step size in salary of the staff involved; grade 2 new IP attracts 0.5 step size in salary to the discoverer while grade 3 new IP attracts 0.25 step size in salary to the discoverer. This ensures that the worth of the IP to the Company is far ahead of the cost of remuneration demanded from the Company.

**Table 1: Simulation results of the new IP Creation Model**

| | | | | | | | Quality of IP (Grade) | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| **s/n** | **Qtr** | **NewIP** | **Section ID** | **GL** | **STEP** | **INC** | **1(1&2)** | **2(3&4)** | **3(5&6)** | **Remuneration(₦)** | **Worth (₦)** |
| 1 | | | Mkg-004 | 06 | 9 | 930 | | 0.5 | | 465 | 5,580 |
| 2 | | | Mkg-004 | 12 | 5 | 700 | | 0.5 | | 350 | 4,200 |
| 3 | 1 | 6 | Res-002 | 15 | 2 | 8100 | 1 | | | 8,100 | 72,900 |
| 4 | | | Prd-001 | 09 | 2 | 2300 | 1 | | | 2,300 | 20,700 |
| 5 | | | Agc-005 | 05 | 1 | 870 | 1 | | | 870 | 7,830 |
| 6 | | | Prd-001 | 03 | 8 | 644 | | 0.5 | | 322 | 3,864 |
| 7 | 2 | 1 | Prd-001 | 01 | 11 | 360 | 1 | | | 360 | 3,240 |
| 8 | 3 | 2 | Agc-005 | 16 | 5 | 12900 | | | 0.25 | 3,225 | 38,700 |
| 9 | | | Agc-005 | 11 | 3 | 2700 | | 0.5 | | 1,350 | 16,200 |
| 10 | | | QC-003 | 11 | 4 | 2700 | | | 0.25 | 675 | 8,100 |
| 11 | 4 | 3 | Agc-005 | 06 | 9 | 930 | | 0.5 | | 465 | 5,580 |
| 12 | | | Agc-005 | 04 | 10 | 718 | | | 0.25 | 179.5 | 2,154 |
| 13 | 5 | 1 | Res-002 | 01 | 15 | 360 | 1 | | | 360 | 3,240 |
| 14 | | | Res-002 | 08 | 3 | 1900 | 1 | | | 1,900 | 17,100 |
| 15 | 6 | 3 | Prd-001 | 10 | 1 | 2600 | 1 | | | 2,600 | 23,400 |
| 16 | | | Mkg-004 | 17 | 8 | 14502 | 1 | | | 14,502 | 130,518 |
| 17 | 7 | 1 | Mkg-005 | 05 | 5 | 870 | 1 | | | 870 | 7,830 |
| 18 | 8 | 2 | Prd-001 | 05 | 4 | 870 | | 0.5 | | 435 | 5,220 |
| 19 | | | Res-002 | 09 | 2 | 2300 | 1 | | | 2,300 | 20,700 |
| 20 | 9 | 1 | QC-003 | 13 | 7 | 7690 | | 0.5 | | 3,845 | 46,140 |

| | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 21 | 10 | 3 | QC-003 | 11 | 4 | 2700 | | | 0.25 | 675 | 8,100 |
| 22 | | | Prd-001 | 06 | 9 | 930 | 1 | | | 930 | 8,370 |
| 23 | | | QC-003 | 07 | 1 | 1600 | | | 0.25 | 400 | 4,800 |
| 24 | 11 | 4 | Mkg-004 | 11 | 6 | 360 | | | 0.25 | 90 | 1,080 |
| 25 | | | Prd-001 | 06 | 9 | 718 | | 0.5 | | 359 | 4,100 |
| 26 | | | Mkg-004 | 07 | 8 | 8100 | | | 0.25 | 2,025 | 24,300 |
| 27 | | | QC-003 | 17 | 3 | 14502 | 1 | | | 14,502 | 24,300 |
| 28 | 12 | 3 | Mkg-004 | 07 | 2 | 1600 | | 0.5 | | 800 | 9,600 |
| 29 | | | QC-003 | 11 | 6 | 2700 | 1 | | | 2,700 | 24,300 |
| 30 | | | Prd-001 | 15 | 2 | 8100 | | | 0.25 | 2,025 | 24,300 |
| 31 | 13 | 2 | Prd-001 | 03 | 5 | 644 | 1 | | | 644 | 5,796 |
| 32 | | | Mkg-004 | 05 | 9 | 870 | | 0.5 | | 435 | 5,220 |
| 33 | 14 | 1 | Prd-001 | 09 | 11 | 2300 | | | 0.25 | 575 | 6,900 |
| 34 | 15 | 3 | Mkg-004 | 12 | 8 | 7000 | 1 | | | 7,000 | 63,000 |
| 35 | | | Res-002 | 14 | 4 | 7990 | | 0.5 | | 3995 | 47,940 |
| 36 | | | Res-002 | 17 | 6 | 14502 | | | 0.25 | 3,625.5 | 43,506 |
| 37 | 16 | 2 | Agc-005 | 01 | 15 | 360 | 1 | | | 360 | 3,240 |
| 38 | | | Prd-001 | 05 | 4 | 870 | 1 | | | 870 | 7,830 |
| 39 | 17 | 1 | Mkg-004 | 08 | 8 | 1900 | | 0.5 | | 950 | 11,400 |
| 40 | 18 | 1 | Res-002 | 11 | 4 | 2700 | 1 | | | 2,700 | 24,300 |
| 41 | 19 | 2 | Prd-001 | 17 | 6 | 14500 | | | 0.25 | 3,625 | 43,500 |
| 42 | | | Mkg-004 | 01 | 11 | 360 | | 0.5 | | 180 | 2,160 |
| 43 | 20 | 2 | Res-002 | 17 | 3 | 644 | 1 | | | 644 | 5,796 |
| 44 | | | QC-003 | 03 | 7 | 500 | | 0.5 | | 250 | 3,000 |

Table1 is Remuneration and Worth Table (RWT), generated using Monte-Carlos Simulation for the different sections (Production, Research, Quality Control, Marketing and Agricultural) of ELDI company. Intellectual Property growth was simulated for (5) years. New IP's, grade level and step size were generated through random number generation from their probability function. From the first quarter, six (6) new IP's were generated and four (1) in the second quarter of the Production section etc. From table 2, the actual grade and step size values of the inventors are retrieved. INC represents the actual step increment value.

Remuneration is calculated as:

Quality of IP * Step value = Cost of IP

Grade 1* step value = 1 * step value = cost of IP

Grade 2 * step value = 0.5 * step value = cost of IP

Grade 3 * step value = 0.25 * step value = cost of IP

Worth of IP is the value the IP is expected to earn for the company (Table 1).

Grade 1 new IP is worth at least 9 times the inventor's step increment = 9 * Step increment value

Grade 2 new IP is worth at least 6 times the inventor's step increment = 6 * Step increment value

Grade 3 new IP is worth at least 3 times the inventor's step increment = 3 * Step increment value

We had access to the salary grade levels and the step increment that were prevalent at ELDI at the time of this research (Table 2).

**Table 2: The Grade and Step Increment of ELDI Staff**

| s/n | Grade Level | Step Increment (₦) |
|---|---|---|
| 1 | 01 | 360 |
| 2 | 02 | 500 |
| 3 | 03 | 644 |
| 4 | 04 | 718 |
| 5 | 05 | 870 |
| 6 | 06 | 930 |
| 7 | 07 | 1,600 |
| 8 | 08 | 1,900 |
| 9 | 09 | 2,300 |
| 10 | 10 | 2,600 |
| 11 | 11 | 2,700 |
| 12 | 12 | 7,000 |

| | | |
|---|---|---|
| 13 | 13 | 7,690 |
| 14 | 14 | 7,990 |
| 15 | 15 | 8,100 |
| 16 | 16 | 12,900 |
| 17 | 17 | 14,502 |

Table 2 is the Grade and Step Size of ELDI Staff. Each Staff has different grade level and step increment attached to them. Grade Level 12-14 terminates at Step 11. Grade level 15-17 terminates at Step 9. Grade level 01-11 terminates at step 15. The new IP gained by all sections of ELDI workforce during the period covered by simulation (20 quarters or 5years) is summarized in Table 3.

**Table 3: New IP Gain for 5years (20 Quarters)**

| s/n | Section code | Section name | Total no of IP | Cost of IP (₦) | Worth of IP (₦) | Gain (₦) |
|---|---|---|---|---|---|---|
| **1** | **Prd-001** | **Production** | **44** | **98,700** | **750,842** | **652,142** |
| **2** | **Res-002** | **Research** | **54** | **153,521.50** | **1,267,804** | **1,114,282.5** |
| **3** | **QC-003** | **Quality Control** | **32** | **256,162** | **1,076,952** | **820,790** |
| **4** | **Mkg-004** | **Marketing** | **58** | **369,412** | **1,476,802** | **1,107,390** |
| **5** | **Agc-005** | **Agriculture** | **30** | **132,569** | **1,008,529** | **875,960** |
| | | **Total: 218** | | **1,010,364.5** | **4,440,929** | **3,430,564.5** |

Table 3 shows the Gain the company gets after remunerating its staff that contributed the IP. The total number of IP for 20 quarters is 218. The company uses less than the Worth of IP to Remunerate Staff and also make their own gain. It is calculated as:

Gain = Worth of IP – Cost of IP (Remuneration)

i.e. Worth of IP in a section per 20 quarters – Cost of IP in a section per 20 quarters.

## 5. Evaluations of New IP Creation Model

Table 3 is a simulation summary of the New IP Creation Model. It shows that the total number of new IPs over the period of simulation is 218, while the cost to the company in terms of the remuneration paid to staff for the new IP contributed is ₦ 1,010,364.5. But the worth to the company of the new IPs introduced is ₦ 4,440,929. That means that New IP Creation Model provides a cheap means of achieving a vital growth in IP at minimum cost. The gain to ELDI in this simulation is ₦4,440,929 –

| Year | New Grade 1 IP (NGD1) | New Grade 2 IP (NGD2) | New Grade 3 IP (NGD3) | Total New IP for the Year (TNIP) |
|---|---|---|---|---|
| **Year 1 Qtr 1 – Qtr 4** | NGD1 = 15 | NGD2 = 12 | NGD3 = 15 | TN IP YR 1 =42 |
| **Year 2** | NGD1 = 16 | NGD2 = 16 | NGD3 = 23 | TN IP YR 2 = 55 |

₦ 1,010,364.5 = ₦ 3,430,564.5. This is important to the company's bottom line. Also New IP Creation Model ensures that the company is operated along best practices only and should therefore be very efficient and effective.

## 6. Evaluation of New IP Gained

Again New IP Creation Model can be evaluated in terms of the new IP gained during the five (5) years simulation period (Table 4).

**Table 4: Details of Yearly, Categorized IP.**

| | | | | |
|---|---|---|---|---|
| **Qtr 5 – Qtr 8** | | | | |
| **Year 3 Qtr 9 – Qtr 12** | NGD1 = 12 | NGD2 = 15 | NGD3 = 11 | TN IP YR 3 = 38 |
| **Year 4 Qtr 13 – Qtr 16** | NGD1 = 17 | NGD2 = 20 | NGD3 = 14 | TN IP YR 4 = 51 |
| **Year 5 Qtr 17 – Qtr 20** | NGD1 = 10 | NGD2 =8 | NGD3 = 14 | TN IP YR 5 = 32 |
| **Totals** | TGD1 = 70 | TGD2 = 71 | TGD3 = 77 | Sum of IP for 5Yrs = 218 |

Table 4 shows the details of the new IP gained each year for the five (5) years simulation period, categorized according to grade of IP.

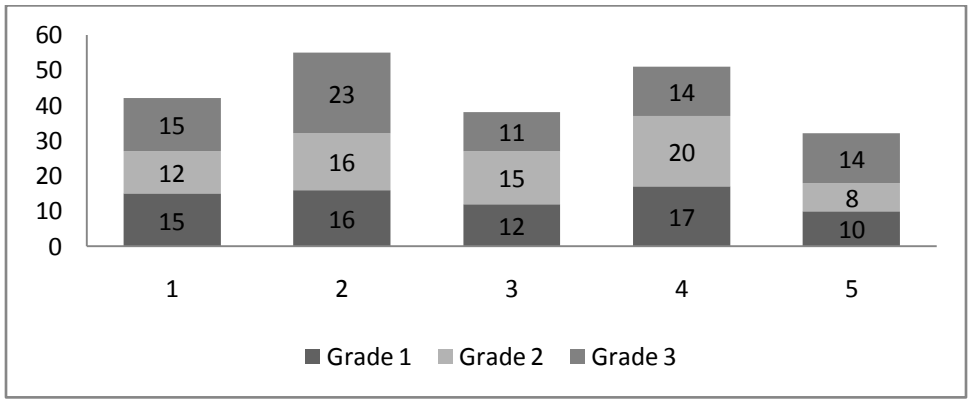


**Fig 6: Stacked Column chart for yearly new IP findings**

The bar chart of Fig 6 shows the yearly new IP findings, with each year segmented according to the quality of the IP namely, grade 1, grade 2 and grade 3. The bar chart shows a low in the first year, gradual rise in the number of new IP acquisition from year 2 then low in year 3,the new IP began to rise again in year 4 and was lower in year 5. In real life, this phenomenon can be explained as follows: When a new process is started, it is often easier to improve on the process initial, hence the high value of 55 in year 2. As time goes on, it becomes harder to find areas of improvement in IP and new IP findings will fall as in year 3. As innovation continuous, there may be a quantum leap in technology leading to higher IP findings (year 4). The number of new IP found will fall as in year 5, as the new technology is mastered more and more.

## Table 5: Details of Yearly, Categorized IP with Quality Factor

| **Year** | **New Grade 1 IP Quality factor = 3** | **New Grade 2 IP Quality factor = 2** | **New Grade 3 IP Quality factor = 1** | **Total New IP for the Year** |
|---|---|---|---|---|
| **Year 1 Qtr 1 – Qtr 4** | NGD1 * QF = 45 | NGD2 * QF = 24 | NGD3 * QF =15 | TN IP *QF =84 |
| **Year 2 Qtr 5 – Qtr 8** | NGD1 * QF = 48 | NGD2 * QF = 48 | NGD3 * QF =23 | TN IP *QF = 119 |
| **Year 3 Qtr 9 – Qtr 12** | NGD1 * QF = 36 | NGD2 * QF = 30 | NGD3 * QF =11 | TN IP *QF = 77 |
| **Year 4 Qtr 13 – Qtr 16** | NGD1 * QF = 51 | NGD2 * QF = 40 | NGD3 * QF =14 | TN IP *QF = 105 |
| **Year 5 Qtr 17 – Qtr 20** | NGD1 * QF = 30 | NGD2 * QF = 16 | NGD3 * QF =14 | TN IP *QF = 60 |
| **Totals * Quality Factor** | TGD1 *QF = 210 | TGD2 *QF = 158 | TGD3 *QF = 77 | Sum of QF = 445 |

| Year (X) | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| New IP | 42 | 55 | 38 | 51 | 32 |
| Cumulative New IP (V) | 42 | 97 | 135 | 186 | 218 |

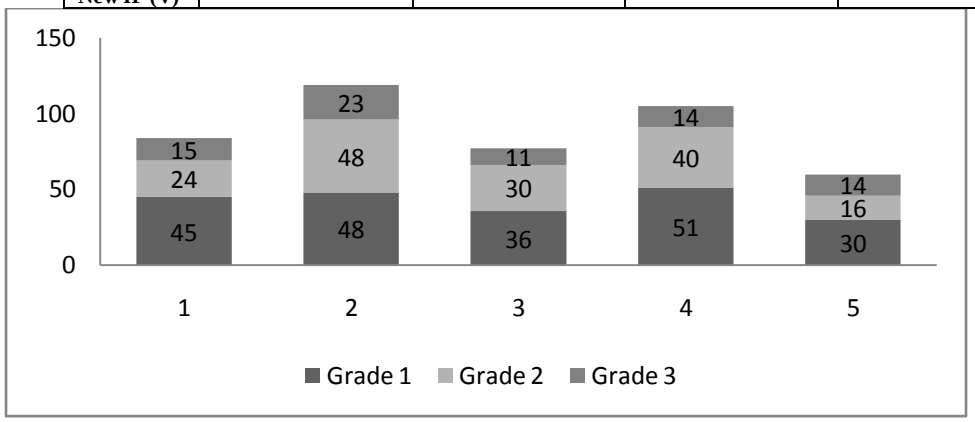


**Fig 7: Stacked column chart for Yearly IP with Quality Factor**

To take the quality factor into account properly, each grade 1 new IP is rated 3 units, a grade 2 new IP is rated 2 units and a grade 3 new IP is rated 1 unit. This is shown in Table 5 and leads to the stacked column chart of Fig 7.

**Table 6: Cumulative New IP Gained in 5 Years**

**Table 7: Cumulative New IP with Quality Factor**

| Year (X) | 1 | 2 | 3 | 4 | 5 |
|---|---|---|---|---|---|
| New IP | 84 | 119 | 77 | 105 | 60 |
| Cumulative New IP (V) | 84 | 203 | 280 | 385 | 445 |

Table 6 shows the cumulative new IP gained over the years of simulation.
Table 7 shows the cumulative new IP with Quality Factor taken into account. Utilizing the quality factor allows one to have a true measure of the real growth attained, because the new IP grows incrementally from year to year. What is really important in terms of growth is the yearly cumulative of the new IP multiplied with the quality factor (Table 7). The same cumulative for the number of new IPs without the quality factor was also shown in Table 6.

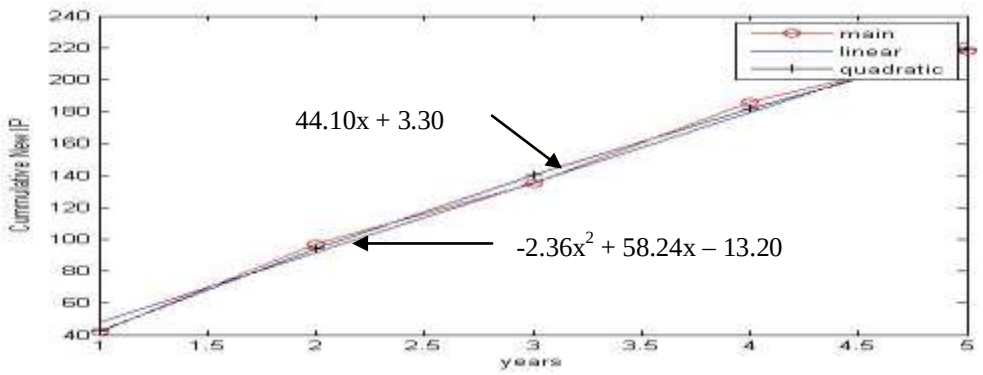


**Fig 8: Cumulative new IP gained over the years of simulation**

Fig 8 shows the values of cumulative new IP without the quality factor fitted to a straight line of best fit (Darlington 2017) and then to a quadratic curve to show which fits better. The idea is to find out whether the outliers of the straight line graph suggest a quadratic fit (Maindonald et al, 2010).

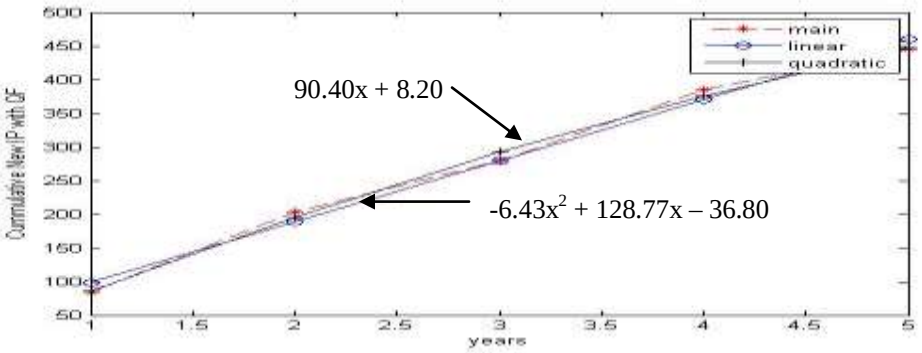


**Fig 9: Cumulative new IP gained over the years of simulation multiplied with the quality factor**

Fig 9 shows the values of cumulative new IP qualified with quality factor as in Table 7 fitted to a straight line and at the same time to a curve of quadratic nature. The straight line seems to be a better fit for the values in table 7. A Matlab software was used to generate the graphs of Fig 8 and Fig 9. This was further buttressed by the coefficient of determination for both the linear and the quadratic fit (Raiborn 2010), where the linear fit has a higher percentage (98.94%) compared to the quadratic fit which has a score of 85.50%, using the formulae:

$$R^2 = \frac{\text{Explained Variation}}{\text{Total Variation}} = \frac{\Sigma (Y_1 - \bar{Y})^2}{\Sigma (Y_2 - \bar{Y})^2} \quad (1)$$

Where, $R^2$ = coefficient of determination

$R^2$ = The square of the correlation coefficient (R)

For linear fit,

Substituting in equation (1), it becomes;

$$R^2 = \frac{\text{Explained Variation}}{\text{Total Variation}} = \frac{\Sigma (Y_1 - \overline{Y})^2}{\Sigma (Y_2 - \overline{Y})^2} = \frac{81,721.6}{82,593.2} * 100\%$$

Coefficient of Determination for the linear fit, $R^2$ becomes, $R^2 =$ 98.94%

For the quadratic fit;

$$R^2 = \frac{\text{Explained Variation}}{\text{Total Variation}} = \frac{\Sigma (Y_1 - \overline{Y})^2}{\Sigma (Y_2 - \overline{Y})^2} = \frac{82,593.2}{98,604.02} * 100\%$$

Coefficient of Determination for quadratic fit, $R^2$ becomes, $R^2 =$ 85.50%

**7. Acknowledgement**

It must be emphasized at this point that the in-depth knowledge of the operational factors mentioned in the foregoing would not have been possible without the profound cooperation which the researcher and her supervisor received from immediate past director of ELDI. The immediate past director was on seat at the inception of this project but now he serves as a professor of communication and computer engineering in a federal university in Nigeria. Also, the project supervisor, Prof. Inyiama has worked at University of Manchester, Institute of Science & Technology (UMIST) as a special research assistant for years and is familiar with patentability issues, he also did his PhD in the same institution and his research was sponsored by the British Science Research Council (BSRC) because of its novel nature. He has been a professor of computer engineering for more than 20 years and was a professional colleague of the said ELDI director, he has also served as post graduate (PG) coordinator for four (4) continuous years. Thus we had all the cooperation needed for the in-depth information presented above. When this model is applied to a company order than ELDI, a similar in-depth cooperation is required from the company's leaders if reliable model simulation result is to be realized (Table 1).

**8. Conclusion**

Intellectual Property (IP) Creation Model for Corporate Bodies using the Dynamic Expert System (DES) Approach has been designed in a manner that traps IPs or new IPs used for production within the corporate body. In the approach used in this research, the intellectual property of the workforce is used to develop best practices and these best practices were evaluated by the foremen or the production manager or their equivalents. Initially, a static intellectual property creation model was developed and then dynamically updated every quarter through knowledge elicitation technique, knowledge base editing and inclusion in the knowledge repository of newly discovered best practices. An inference engine was developed to facilitate decision making. A scheme of remuneration to inventors for evolving new IP that keeps the inventors happy, even though the new IP is worth several times the remuneration paid out to them was worked out in this research. A simulation of the New IP Creation Model was done to cover a period of 5years to provide a look ahead way of evaluating the performance of the New IP Creation Model.

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