

# SYNET: A Human Resources Management System

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*Abstract:* - Social problems demand opportunistic and viable solutions; we have the responsibility of attacking the roots of these problems by applying numerous disciplines to create effective results. SYNET is a system that integrates knowledge of computer science, psychology, and management aiming to aid in the process of personnel selection. The different modules of SYNET orientate a company to choose the most adequate people to fulfill specific jobs within its organization. It's compulsory to know "What a worker should do" and "The skills required by this task". The finality of SYNET is to improve the interrelation worker-work atmosphere.

*Key-Words:* - Knowledge-based system modeling psychometrics behaviorism

## 1 Introduction

Solving social problems represent an important challenge. The particular problem that SYNET pretends to solve is personnel selection [7]. This paper examines this tool that was created in an interdisciplinary atmosphere.

SYNET is inspired in three ideas:

It is possible to isolate and identify essential characteristics of a job, making it comprehensible and controllable.

It is possible to identify essential characteristics of a person, and then to be able to comprehend the roots and motivation of his acts (with limitations). This is achieved throughout a methodic process of observation, in the behavioral sense: an observation centered on precise definition of reinforcement, extinction and repertory-selection processes. It is also useful to apply psychometric test to support this task.

Workers control themselves using Positive Reinforcement (PR) and Negative Reinforcement (NR). It is necessary to organize the working environment in order to improve its quality.

### 1.1 The objective of SYNET

The purpose is to create a propitious environment (PE), where the individual can plenty interact within his surrounding and be productive.

The work environment can gradually be organized following scientific guidelines, avoiding a negative impact towards production. The idea is to develop the selection process around the concept PE. A PE presupposes a semi-deterministic influence of the environment on individual's behavior [1, 2]. It is

organized since it pretends to manipulate environmental variables according to a pre-established agenda, aiming to improve individual behavior within his environment.

The potential benefits are to create high-effective team works, to catch high quality personnel, aid on the strategic planning of the HR, to reduce the time invested on recruitment, to know the individual and organizational psychology of the company.

The various disciplines involved are described in next sections. Behaviorism is introduced first due its importance.

### 1.2 Behaviorism

Behaviorism [3] is centered on the analysis of visible and measurable behavior. Two concepts are especially important, Conditioning and Operational Behavior. Conditioning is the scientific term to conduct-learning and Operational refers to the idea that any organism operates with its environment, it executes actions that changes its surroundings for good or worse. Operational psychology is based on the next ideas:

- It is accustomed that an action done by a person or an animal has natural consequences within the environment.

-Reinforcement increments the probability of repeat certain conducts.

In this context the objective is to create a tool capable of modeling the impact of the environment on the individual. The specific problem was the personnel selection, aiming to modify and develop certain conducts to improve the quality of work. And the environmental analysis was centered on two aspects: team work and job specification.

Psychometrics was used to determine the history of the individual.

## 2 KAMET

At the stage of knowledge acquisition the methodology many lineaments of KAMET [4, 5] were used, such as the classification of the Knowledge Sources, the development of the initial model, model validation and system evaluation.

KAMET is a model-based methodology designed to manage the Knowledge Acquisition (KA) from multiple Knowledge Sources (KS). The method provides a solid mechanism to accomplish the KA in an incremental manner, by stages, within a cooperative environment.

KAMET was used mainly to model the knowledge involved in the development of the Knowledge Based Modules (KBM). Section 6 shows some of the generated models.

## 3 Psychometric Tests

A test is a set of standardized experimental situations that stimulates certain behavior.

A psychological variable is defined as a property or characteristic present with measurable variations within different individuals. Two tests were used in the development of SYNET.

### 3.1 TERMAN

TERMAN test offers a multiple vision of Intellectual Coefficient. It supplies a general intellectual level of individual and an image of the principal functions of intelligence.

The different aspects of the intelligence measured are: information, vocabulary, judgment, synthesis, concentration, analysis, abstraction, planning, organization and attention. These 10 results are inputs for the Knowledge Based Modules.

### 3.2 Sixteen Personality Factors

The 16 Personality Factors (16 PF) test measures personality tendencies of an individual determining sixteen fundamental factors and four second order factors. Second order factors are integrated by combinations of first order ones.

A factor is a trend. Units called “sten” (standardized tens) are used. These 16 results are inputs for the Knowledge Based Modules.

Secondary Factors are: introversion, independency, tenacity and tension. The complete application is integrated by almost 170 questions with multiple choices of answers.

Descriptors of Low Range	Primary Factor	Descriptors of High Range
Reserved	(A) Warmth	Warm
Concrete-thinking	(B) Reasoning	Abstract-thinking
Reactive	(C) Emotional Stability	Emotionally stable
Deferential	(E) Dominance	Dominant
Serious	(F) Liveliness	Lively
Expedient	(G) Rule-Consciousness	Rule-conscious
Shy	(H) Social Boldness	Socially bold
Utilitarian	(I) Sensitivity	Sensitive
Trusting	(L) Vigilance	Vigilant
Grounded	(M) Abstractedness	Abstracted
Forthright	(N) Privatness	Private
Self-assured	(O) Apprehension	Apprehensive
Traditional	(Q1) Openness to Change	Open to change
Group-oriented	(Q2) Self-Reliance	Self-reliant
Tolerates disorder	(Q3) Perfectionism	Perfectionist
Relaxed	(Q4) Tension	Tense

Fig 1 Primary Factors of 16 PF

## 4 Job Specification

A job specification (JS) [6] is integrated by tree groups: intellectual features (Intellectual performance, Attention, abstraction, creativity, etc.) Personality features (Motivation, leadership, self-control, Emotional stability, etc.) and work-specific features (Conflict management, level of commitment, constancy, etc.) The person in charge of defining the job will ponder each one of these characteristics and will assign them a numerical value (From superior to inferior).

## 5 Problem Solution

Aiming to generate the necessary models it was decided to divide the study of labor in to sections: the subjective analysis (SA, high participation of individual pre-conceived ideas) and the objective analysis (OA, low participation of individual pre-conceived ideas).

A major objective of the system is to methodically recollect essential data with integrity and precision and to separate subjective work elements from objective ones and ordering both groups. Different knowledge domains are used to fulfill this endeavor. For the SA psychometrics and job specification are applied; for OA, behaviorism.

### 5.1 Implementation

The programming language used was Visual Basic .NET, database is supported by Access 2000 and communication is established by ADO.NET. Knowledge based modules are implementing using CLIPS and PROLOG.

## 6 Knowledge-based modules

The core of SYNET is integrated by four modules. Each one applies knowledge to provide useful information about the candidates. The output of these modules is considered as the principal criteria for the selection of a candidate.

Fig 2 shows the outputs of the four Knowledge Based Modules (KBM). The last column indicates whether the module is part of the Subjective or the Objective Analysis.

KBM	Output	Section
I	Textual description of a candidate's personality	SA
II	Fitting Quotient	SA
III	Compatibility Quotient	SA
IV	Programs for developing adequate conducts	OA

Fig 2 Outputs of the modules

### 6.1 KBM-I: Interpretation of 16 PF

The candidate had responded each one of the questions of the 16 PF test and the Recruiter decides to evaluate him. The KBM-I process these results and apply the rules to generate a textual description of the personality of the individual.

The interfaces of registry, application, evaluation and interpretation are provided by SYNET. SYNET

database stores each answer of the psychometric test and its standardized results.

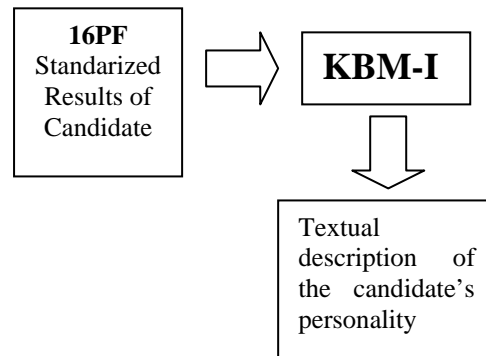


Fig 3 Block diagram of the KBM-I

An example of a KBM-I rule is showed. In this case the Jung's concept of Introversion was applied and the 16 PF results were combined to integrate a definition.

Model in Fig. 4 was generated following the principles of The KAMET Conceptual Modeling Language. Rule's code in Prolog is showed.

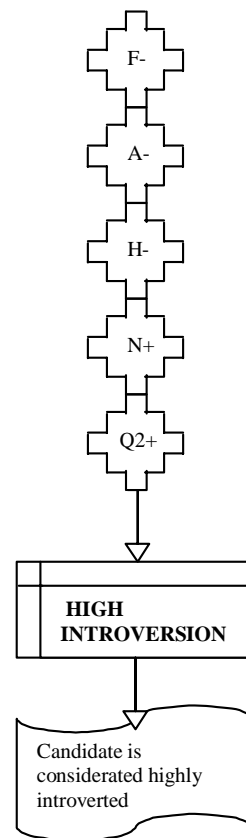


Fig 4 KAMET Model of the rule "High Introversion"

Prolog code:

```
factor_sec_QS1(CANDIDATE,OUT_FILE,RESP):-
reserved(CANDIDATE),
serious(CANDIDATE),
shy(CANDIDATE),
discrete(CANDIDATE),
selfreliant(CANDIDATE),
assert_in(qs1(CANDIDATE,high_introvesion))
```

### 6.2 KBM-II: job-candidate level of fitting

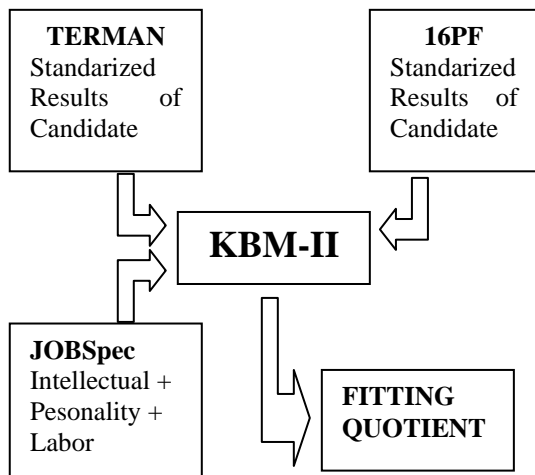


Fig 5 Block diagram of the KBM-II

Next module is dedicated to find the level of fitting between a job specification and a candidate.

The candidate completes both psychometric tests and the recruiter, using the system, evaluates them. On the other hand, a certain person (someone able to describe the job) generates the job specification, focusing in determining its requirements, distributed in three groups: intellectual, personality and labor.

The KBM-II receives the data, applies the rules and determines the Fitting Quotient (FQ).

An example of a KMB-II rule is showed. In this case the aim is to determine if the candidate has capacity towards leadership (like Pericles, in the sense described by Ordway Tead).

Other concept applied is the Freudian “Subconscious Identification” it this case based on the intellectual dominance of the leader.

CLIPS code corresponding to the rule is shown.

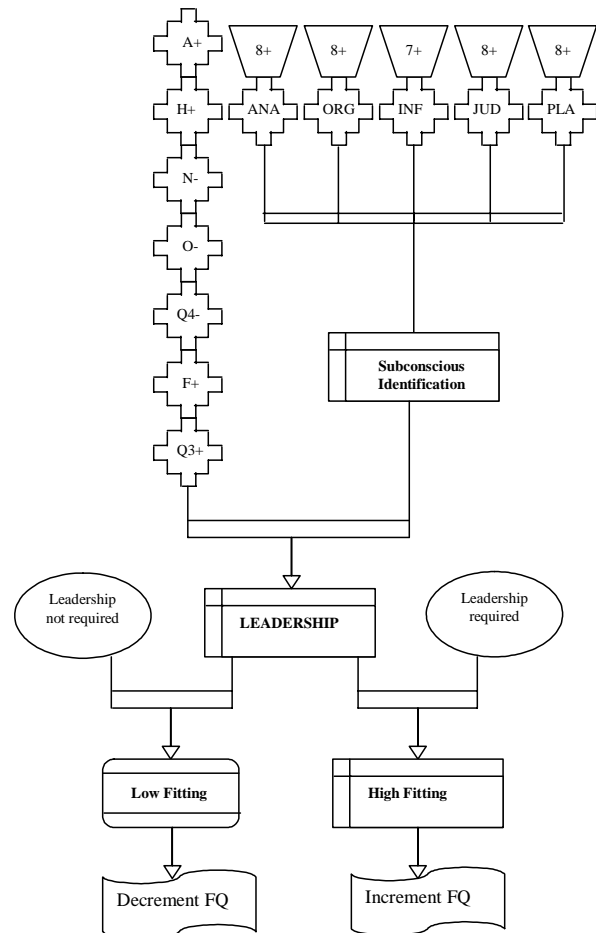


Fig 6 KAMET Model of the rule “Leadership”

CLIPS Rule:

```
(defrule lids "superior leadership"
(A ?val2&8|9|10) // perfectionist
(H ?val4&8|9|10) // dominant
(N ?val3&1|2|3) // Self assured
(O?val6&1|2|3) // forthright
(Q4 ?val3&1|2|3) // Self assured
(F ?val5&8|9|10) // emotionally stable
(Q3 ?val2&8|9|10) // perfectionist
(Candidate Subconscious_Identification)
=>
(printout t "superior in leadership")
(assert (candidate_leadership_superior))
)
```

### 6.3 KBM-III: Individual-Individual Compatibility

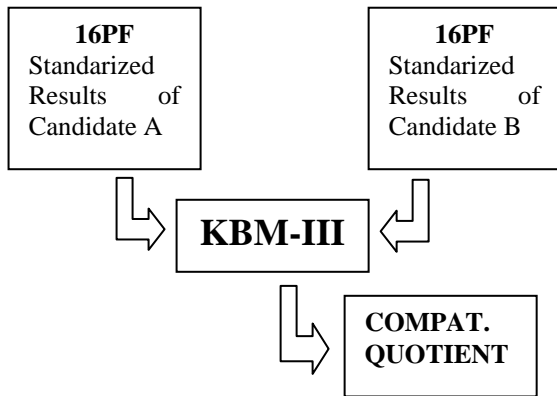


Fig 7 Block diagram of the KBM-III

This module establishes the compatibility existing between two individuals as a Compatibility Quotient (CQ). Input Data are standardized results of 16 PF test of each of the candidates.

An example of a KMB-II rule is showed. In this case two candidates with E+ (both of them are dominants) present a Compatibility Problems, generating a decrement in the CQ. The code is presented first.

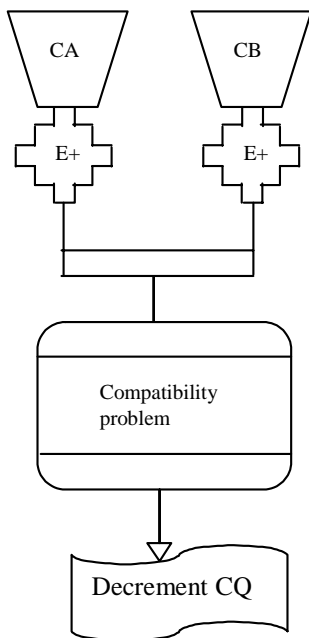


Fig 8 KAMET Model of the rule “Both Dominants”

CLIPS code:

```
(defrule c0 "both dominants"
?com<-(compatibility ?comp)
(E1 ?val1&1|2|3)
```

```
(E2 ?val2&1|2|3)
=>
(assert (compatibility(- ?comp 3)))
(retract ?com ?re)
)
```

### 6.4 KBM-IV Objective Analysis

The last module of the system is the result of the application of some of the principles described above. The final task of the recruiter will be to define a repertory of adequate conducts. For each of these conducts three components will be added: a Main Reinforcer (MR), the Reinforcement Program (RP) and a Chain Diagram (CD).

The process of SA should be enough to pre-select certain candidates. Then we can continue with the OA of work. In this period the results given in the SA should be verified, but the main goal is to analyze the operational repertories of the candidates. The first step will be to specify two kinds of conducts: adequate and non-adequate. Then a series of reinforcements programs will be designed to increment the frequency of the first set and to extinguish the second.

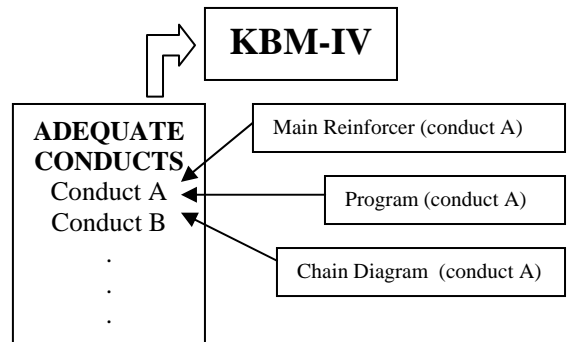


Fig 9 Block diagram of the KBM-IV

#### 6.4.1 Considerations

It is compulsory to assign a Behaviorist Engineer among the members of the enterprise, and to provide de necessary training. Excessive caution is recommended; the aim of this effort shouldn't be to transform the workers into automates, but to apply tested knowledge trying to improve productivity. It is recommendable to center the effort trying to determine in which way a worker adds new executions to his repertory? And, when a new conduct has been added to a worker repertory, how it can be reinforced or weakened?

To permanently modify conduct is indispensable to apply reinforcement or extinction procedures, never

punishment. Orders and commands, mostly, tend to be conditional aversive stimuli that specify an aversive consequence if certain conduct won't be emitted.

A list of available Reinforcers should be generated such as: rest, coffee, vacation, wages, bonus, authority, responsibility, acknowledge, social approbation, praise, etc. Which is the best Reinforcer for a certain Individual? KBM-IV tries to answer this question. To know this will permit to implement more efficient RP.

An Operant Conduct (OC) is any conduct emitted by an organism that changes its environment. When a certain conduct doesn't operate anymore and stop to critically changing the environment, it will occur with less frequency and will tend to disappear (extinction). Through OC organisms modify its environment in very different ways, achieve its survival goals and develop a normal physiologic activity.

	PRESENTATION	RETIREMENT
POSITIVE REINFORCER	Positive Reinforcement	Punishment
NEGATIVE REINFORCER	Punishment	Negative Reinforcement

Fig 10 Positive and Negative Reinforcement

Two main kinds of RP exist: Continuous Reinforcement Program (CRP) and Intermittent Reinforcement Program (IRP). Among the IRP are the Fix Rate Program (FRP), the Variable Rate Program (VRP), the Fix Interval Program (FIP) and the Variable Interval Program (VIP). On IRP and VRP reinforcement depends on rate of conduct and on VRP and VIP reinforcement depends on time elapse. To generate persistent and stable conducts, continuous reinforcement is changed by an IRP that gradually increments its rate and interval.

The result should be a set of Operation Conditioning Programs (OCP) to be carried out by the company, to enforce, reorder and supplement workers conduct.

To understand the kind of control that is pretended is recommended consulting the book Walden Two [10] and visit the web site [www.loshorcones.org.mx](http://www.loshorcones.org.mx), "Los Horcones" are members of a modern community that lives under the principles of behaviorism.

### 6.4.2 Chain Diagram

On a chain of conduct the same stimulus works as a Discriminative Stimulus (DS) and a Reinforcer

Stimulus (RS). When a response produces a DS for another one, these two conducts integrates a chain. A DS is the opportunity for an operant conduct for being reinforced. In a Chain Diagram (CD) a DS must be preceding a conduct and a reinforcer must (occasionally) follow this behavior.

## 7 Practical Case

The next case is based on an actual situation: a software development company needs a system specialist. Five candidates, their names are changed following ethical principles of psychometrics, are competing for the job (Anne, Peter, Mathias, Reuben and Ramiro). There already are two members in the Software Development Group, Charles and Maria. John will act as the recruiter of the company and Anthony will take action as a Directive.

### 7.1 Prerequisites

- Both Charles and Maria had completed their psychometric tests.
- The "Area Specific Knowledge exams" are designed. In this case there are two exams: a general programming exam and a Visual Basic.NET exam.
- Anthony had specified the job "Software Developer". Some of the key issues that he defined as important are: intellectual performance, concentration, logic, planning, competitiveness, effectiveness, constancy and high level of performance under pressure.
- Anthony had defined a set of Adequate Conducts regarding the job System Specialist.
- All the participants were registered in the system. Anne, Peter, Mathias, Reuben and Ramiro as Candidates; Anthony as Directive and John as Recruiter. The system receives a login and a password and automatically sends the user to his respective set of functionality.

### 7.2 Using SYNET

#### STEP 1

- All five candidates complete psychometric tests 16 PF and TERMAN.
- All five candidates complete two exams: General Programming and Visual Basic.NET

#### STEP 2

- John evaluates five 16 PF tests and five TERMAN tests.
- John evaluates five General Programming test and five Visual Basic.NET test.
- John can review and print a textual description of the personality of each candidate.

- John obtains FQ for each Candidate with the job specification "System Analyst".

- John obtains two CQ for each Candidate with Charles and Maria for a total of 10 Quotients.

#### STEP 3

- All the above data is considered and the system presents its verdict: Anne should be pre-selected.

#### STEP 4

- A period of observance is carried out. The set of adequate conducts are analyzed.

## 8. Results and Conclusions

We consider that the system is useful in the solution of the kind of problems that it addresses. We believe that the system provides very relevant information with low inversion of money and time. As an example of this, the company where the exposed case took place didn't plan to carry on this kind of analysis when looking for a System Specialist. When the set of advantages were discussed they immediately agree. The only resource they provided was some hours of their time.

The process of specifying a job will necessarily make the people involve a lot more conscious about the real needs of the business. The possibility of obtain a textual description of the personality of a person is a very useful tool, when the module of evaluation of the 16 PF test was developed approximately 240 psychometric test were carried out among students in the ITAM (Mexican university) In this period we received a lot of interesting feedbacks.

The modules of fitness and compatibility, we must say, need more development. This development should be carried in two ways. First, is recommended to add more psychometric test to increment the amount of data. Second, new rules should be added and existing ones should be reviewed.

The module of behavior analysis is nowadays subject of an improvement. Work is devoted first to further develop the KBM capable of determine which Reinforcer is most suitable for a certain person.

Nowadays a more complete Reinforcement Catalogue is been integrated. The other improvement is the creation of a designer of Control Panels, a software interface that orders the Adequate Conducts and keeps track of the frequency of its executions [8]. Theory of Conduct is giving birth to new ideas and concepts, and it's being review by its theorists [9]. SYNETH must take advantage of this process.

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