From information to decision: information management methodology in decisional process

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***Abstract* — A company uses several watch types for different needs. The main idea is to offer a generic watch system that meets various needs and can be adapted to many structures of watch process. We present, in this paper, these various watch process from information management to added-value information. Also, we describe the divergences in the watcher organizations with the knowledge presentations. Finally, we propose the architecture for our generic watch system.**

***Index Terms* — Information retrieval system, generic watch system, collaborative platform, information processing, added-value information, knowledge presentation.**

I. Introduction

Information has become a major interest in the economic, social and cultural development process of any nation. With the event of the computers and their integration into the company life, actors are in search of the effective manner to manage, store, disseminate and seek information. Several treatments and methods of information management were developed. Today, we can estimate that we are with a high level of computerization thanks to the development and the control of technologies. In addition, it has to be reminded that the knowledge and the information management are capital in the definition of the strategic development.

The passage of information to decision making requires different complex processes. Several tools have been implemented to meet specific needs. We can mention as example: - Tools for information extraction: Text, data and Web Mining; - Tools for information storage: Data Warehouse, Datamart, Bibliographic databases; - Technics of information presentation, like: cartography, abstract generation, Bibliometric processing…; - Shairing Tools: forum, mailing… - Tools for decision making assistance: process of Business intelligence...

In this jungle of tools, several integrated systems were proposed but they often have the same problem: they do not adapt to a specific decision problem or to informational need.
In this paper, at first we identify the place of the watch systems in this jungle which begins from information needs to decision making problem and from the information retrieval system to the Business intelligence system. At second, we present the information retrieval system linked to the various watch process and the possibility to integrate it in the same system. At last, we distinguish the importance by taking into account the actors in the system and we propose a generic methodology the watch system.

II. From Information to Decision

"Business users don't want to wait for information. Information needs to be always on and never out of date. This is the way we live our lives today. Why should Business Intelligence be any different?" [1].

The need to manage a large number of sources as strategic information in internal and external for business system can be problematic: how to treat, store, filter and protect information? Some examples quantify the risk like: the infiltration and lost information; the problem of business units disconnection, etc.

The watch system is seen as a means of understanding and monitoring changes in various business environments while business intelligence can act on these environments to cause specific changes. We can deduce that the watch system is a component of the business intelligence system. In fact, it incorporates in its approach the different watch technologies.

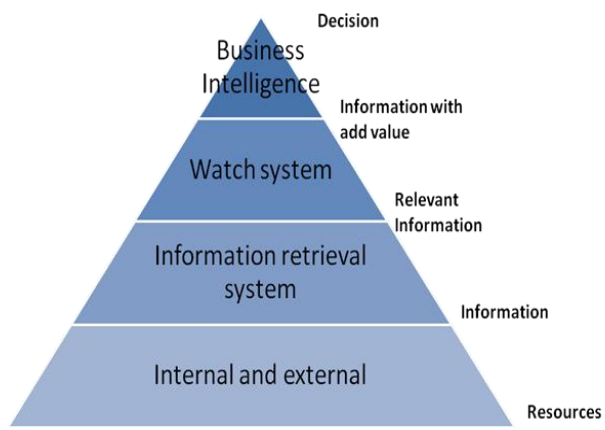
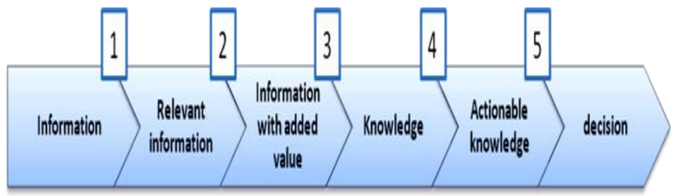


Figure 1: The pyramid of information

The information hierarchy in company is presented according to its importance and its quantity (cf. Figure 1). In bottom of the pyramid, we have the whole of the internal and external resources of the company. We can mention for example the web sites, flows RSS, the newsletters, the databases internal (CRM, DW) or external (Bibliographic bases, Brevet Bases). From this large panoply of information we will extract, using an information retrieval system, the relevant information that will meet our needs. The watch process will have a task of scanner, to treat and to present this selected information in order to give to the decision maker the added-value information. The business intelligence system will assist the decision maker in the interpretation of the relevant information and in the decision making process.

To summarize the decision making process, the information undergo five projections to reach the decision (cf. Figure 2).



(1) Collect and validation of information
(2) Treatment and presentation of the information
(3) Analysis and interpretation
(4) Evaluation
(5) Action

Figure 2: Information to decision

Information is the starting point of our process of transformation. It is the output of an actor understanding data, events or signal in the company context. It implies an interpretation according to a context of its use. Information retrieval system makes possible to collect information which given by specific queries. After, the watchers have to select and validate **relevant information**. These last will undergo specific treatments in order to obtain more concise information. After, it will be presented to the decision level as **information with added-values**. The decision level will be able to make decision thanks to the three transformations: information to relevant information; added-values to **knowledge**; **actionable** (or productive) **knowledge** to **decision**. The first transformation is interpretation through personal or collective models, theories, experiment in order to give a sense to information. The second transformation is the evaluation of this knowledge in order to obtain productive knowledge which makes it possible to lead to the action (or decision making) which is the last transformation.

In the following paragraphs, we are interested only in the transformation from the state of information to relevant information: this first part is called "***Information retrieval system***"; and the transformation from the state of relevant information to added-value information: this second part called "***Watch Process***".

A. *Information retrieval system*

Information retrieval system is defined as a system composed on one hand by a module in charge of the treatment, indexing and storage of information: the "indexing module". This module built a structure of data organized from the data processing to give rapid access to information. On the other hand, it is composed by a module equipped with the mechanisms of information selection directed by the queries of the user; it is called the "interrogation module". Lastly, a module of correspondence (ie. correspondence function) which establishes association between the user query and the indexed documents [2].

In company, there are two kind of systems for the information management:

• The data flow management system: in the one hand, it allows extracting knowledge from flows of information without being memorized. In the other hand, knowledge will be stored in a database and will reduce in size as we go in time to being summarized.

• The database management system: it stores all the documents and information in data warehouses. The extraction of knowledge will be done on these structured data and then stored in knowledge database.

Whatever the data management system used, we always need to extract knowledge starting from the documents. We present in follows the levels of indexing as well as the approaches related to the literature.

1) *Indexing levels*

The indexing is the process which consists in describing to characterize a document using representations by concepts in its contents. The process of analysis can use intellectual competences of the field: from the human indexer to the robustness of the tools (i.e. complex algorithms and software which automates the human task of indexing and approaches). Or to mix competences between automatic indexing and human competences to implement a new indexing approach.

The process of indexing constitutes the big step in the valorization of a of information retrieval system [3].

The listed steps of indexing are the following ones [4, 5]:

- Document index Extraction:
  - Labels Extraction in documents: title, author, date, abstract…
  - Occurrence Extraction: we use a segmentation tool of text.
  - Use of the punctuation and separators lists and treat the special cases: compounded words, e.g.: 127.0.0.1, Mrs. Durand, 14/07/1789
- Linguistic standardization:
  - Removal of the capital letters
  - Removal of the accents
  - Standardization of the dates
  - Suppression of the points in acronyms (U.S.A →USA)
  - Use of blank lists of words (stop words), which are eliminated during the indexing and of the queries: The most frequent words are not very interesting in

grammatical form (conjunction, prepositions, pronouns, determinants): they are eliminated. In the same way, we carry out the automatic of the suffixes related to the inflection (plural, female suppression, and with the various grammatical cases like the genitive, the ablative…

  - Lemmatization of the words thanks to definite automats [6].

- Occurrence document Memorizing
  - Sorting of the index
  - Regrouping of the index
  - Indication of how many occurrences by document
  - Only one entry per couple (index, document)
- Index Separation from the direct file to the reverse file:
  - Counting of the full number for each index in the complete collection,
  - Obtaining a dictionary enumerating the index and their number of occurrences in the corpus,
  - Obtaining a list of Postings, associating a number of occurrences in each document for an index of the direct file.
  - The use of the extraction Knowledge approach is done on this level to give weight to the occurrences related to their frequencies of appearance in the document and the collection. In this level it is necessary to choose an approach or to evaluate several methods on the corpus and compare their results [7, 8].

In the following paragraph, we talk about a various approaches of knowledge extraction as well as the method adopted for our system.

2) Knowledge extraction approaches

Knowledge extraction closely depends on the types of documents handled: structured, semi structured or not structured. In the literature, we find several models to release this process, that we can classify according to three approaches:

• **Statistical Approach:** it is based on the extraction of the co-occurrences of the terms in a particular context. The statistical tools are based on the detection of the contextual recurrences. For this need, we use various measurements of similarity. The statistical approach is based on the assumption that the use of two terms in co-occurrence is the expression of a semantic relation between these terms. This relation is expressed by word combinations which often occur in a corpus with linguistic status: for example, grammatical categories of the words can vary. This approach gathers the Boolean [9, 10], Vectorial[11] and Probabilistic[12-15] models.

• **Linguistic approach:** the linguistic approach is based on the study of linguistic phenomenon with the expression of the relations between terms. In most time, it exploits the syntactic relations in flexible way. The linguistic markers (morpho-syntactic tags) are used to extract the relations between terms [2, 16-19].

• **Hybrid approach:** the hybrid approach associates statistical approaches with methods of linguistic approaches. It exploits the advantages of the statistical and the linguistic approaches and tries to reveal the relations between terms by locating the candidates terms starting from syntactic diagrams and filter them using statistical methods [20-22].
After this state of the art on knowledge extraction, we choose to make experience on a probabilistic approach: OKAPI (also called BM25), which gave better results on several corpora and which is frequently used by many participants of TREC.

OKAPI makes possible to compute the weight of the words in order to define their relevance. These weights are defined by the probability of relevance of the words in the corpus. OKAPI is defined as follows [15]:

$$\mathbf{Wij = ((k1+1)*tf_{ij}) / (k+tf_{ij})}$$

Where: $K=k1*(1-b)+b*(Li/avdl)$
Tf_{ij} is the frequency of the T_i term in the document D_i. L_i is the number of index term included in the representation of the D_i document. "b" and "k1" constants fixed empirically on collection of tests. "avdl" a constant defined by the average length of term number of the papers in the collection.

The score OKAPI for a request is then defined as follows:

$$\mathbf{Score\ (Q,Di) = \sum_{ti \in Q} tf_{qi}*idf_i*w_{ij}}$$

Where Idfj is the inverse frequency of the term J. It is defined by: $Idfj= log ((n-dfj)/dfj)$

3) Our results: IR system

We built our Information retrieval (IR) system starting from "INAthèque" corpus (http://inatheque.ina.fr). This corpus was built as documentary collection with added content analysis. The collaboration of the INA experts (INA: National institute of Audiovisual in France) to develop the content analysis about French broadcasting scene [16]. Precisely, content analyses are various notes from audiovisual contents (Primary documents from TV and radio programs). These notes contain 45 fields ans more of various records (textual, numerical, thesaurus INA…) cf. Figure 3.

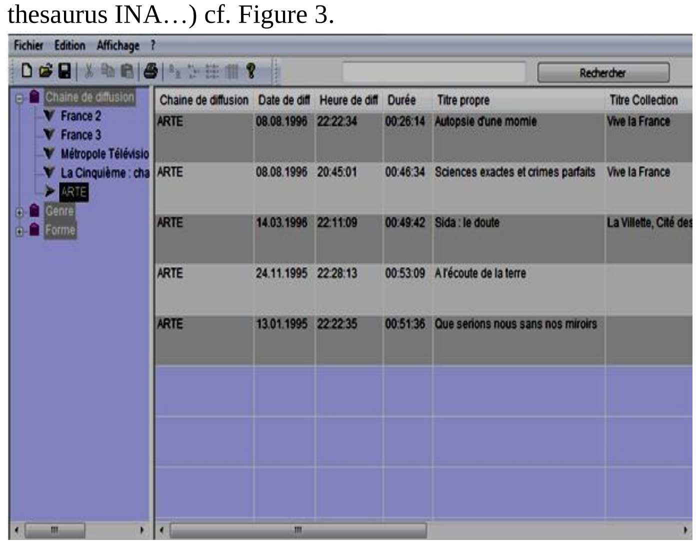


Figure 3: Interface of our IR system.

B. Watch process

The watch process, in its definition, can be presented in two different ways: in its construction phases or in its statements “at the time of its starting”.
At first, the watch process construction according to Jacobiak [23] begins with these five crucial steps:
1) Identification of a decisional problem.
2) Translation of the decisional problem in a problem of information search.
3) Identification of the relevant sources which meets needs.
4) Collect and evaluate information.
5) Construction of watch corpus.
The result of these steps can be represented by our research information system set starting from the corpus of INAthèque. At once, this watch process is built, it does not remain still it updates information flow periodically and build added value information which will be diffused.

At second, the definition of the watch process, that we prefer it, i.e. “at the time of its starting”, which appears rather more representative: the watch system is then defined in two main senses that either complement or contradict each other: it is both a systematized intelligence activity and/or a research targeted by the development of indicators of trends [24].
In general, we can detect three watch types:

1) Project process:

To meet a specific decision need, the process must translate this decision need into information needs. The expected answer would be a set of accurate and targeted information. In this case the project ensures a predefined lifetime. The proposed architecture is obtained by oriented objective (or goals) modeling.

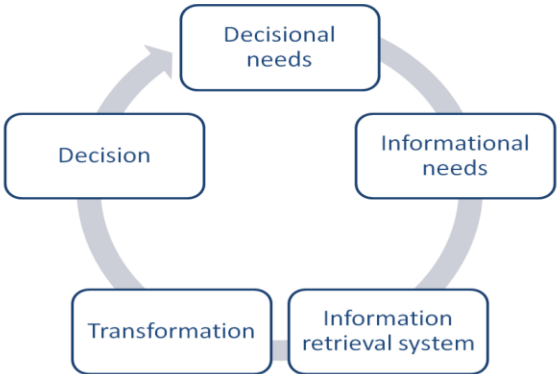


Figure 4: Project process.

In this objective context, the decision maker should not communicate his decisional needs to the community of watchers, in order to not make influence in watch results. Watchers must translate the decision needs into informational needs objectively without the sphere influence of the decision maker.

2) Alarm process:

Scan the environment and detect any changes, these information is communicated to the decision-making level. In this case, oriented actor architecture with the introduction of a collaborative system should meet the hierarchy needs (cf. Figure 5).

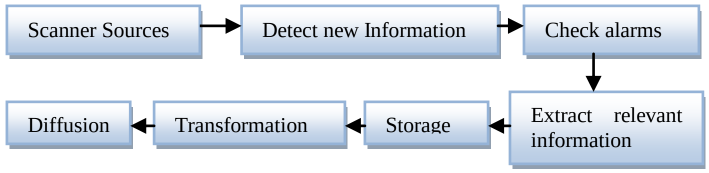


Figure 5: Alarm Process

We can scan the sources over a given period and/or upon the user request. The addition of a new source implies a first scan for storage and the definition of the alarms.

3) Report process

In general, the results of a report process are presented by an active file. For example monthly, a report can make active new data collected. These supervision data is related to permanent databases in the company.

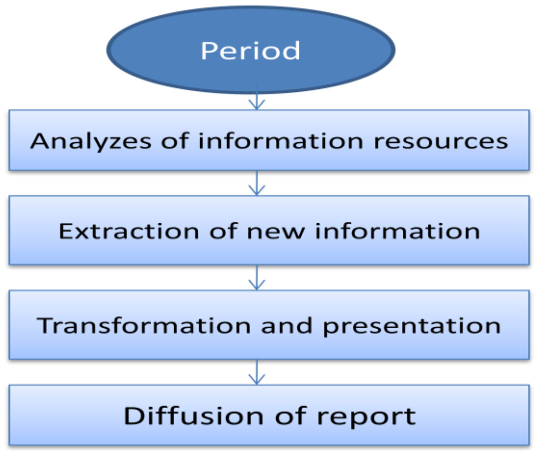


Figure 6.Report process

This process is not iterative but periodic. In this case, reported information is communicated to the decision maker. It can involve another need so it will activate the first process.

4) Processes' Integration

In order to guarantee the effectiveness of a watch system, the three processes described (Project, Alarm and Report) must coexist within the same design. The integration of these three processes in the same system is possible to supervise one or more information sources. Consequently, the main process is the information retrieval (IR) system. IR process make possible to collect, sort and to select relevant information according to defined queries by an actor: a set of keywords for alarms as queries expressed in natural language according to many criteria for the project.

Figure 7: Integration process

The representation and diffusion of relevant information are done in an automatic way for the alert and reports processes. While for the project process, the watcher has to define the representation among a list of possibilities and the target community. In the following paragraph, we present the generic methodology about the watch system integration.

III. Generic Methodology for the Watch System Integration

To face all these problems and alternatives of the watch systems, we have defined the concept of generic watch process. It indicates at the same time the association of the several of watch tools and takes in to consideration the divergences between the types and the models of watch. Our objective is then to make it possible to the end-user to adapt and personalize the system to his needs. The generic watch system makes possible to solve almost problems mentioned previously by proposing a list of functionalities to the end-user. The list of functionalities gives the possibility of choosing the configuration which adapts the end-user needs.

On another side, the generic watch system should take into account the multi-actor aspect by offering methods that makes possible to adapt various flow charts and to optimize the system use. According to criteria and needs, the end-user can generate one or more watch profile in the system to adapt watch specifications.

A. *Watch actor organization*

In a watch activity, we distinguish three possible cases:

Coordination: Each actor works in order to achieve a common goal, i.e. the organizational evaluation of employee performance. In this case, only a minimum of confidence is necessary (in the system) to achieve a common work [25].

Cooperation: It implies a division of the job between the actor participants. Each one is being responsible for a part of the problem. The main task is divided into independent sub-tasks: the coordination is done at the end. The cooperation between actors requires an average level of confidence, ie. confidence in the competences. The value does not allocated directly to the process [26].

Collaboration: It is the context of collaboration between actors, through shared interest, to explore in a constructive way new possibilities and to create "something" which they could not achieve by themselves. A mutual confidence is present in an implicit way and each one shares its good ideas in order to build the best possible result [27].

These three models can coexist together: one can then observe the need for imposing coordination; or cooperation between actors from the same department; or to allow collaboration between two teams for which the center of interest is different.

The groupware implies: to divide, to communicate, to coordinate, to cooperate, to organize and to produce. The general outline is represented by the following figure:

Three spaces (in general)		
Communication	Coordination	Production

Tools of access to knowledge

Figure 8: Collaboration structure

The main problems in a watch system are shared between the need to build in team information and to diffuse it to various actors keeping the access to information secure.

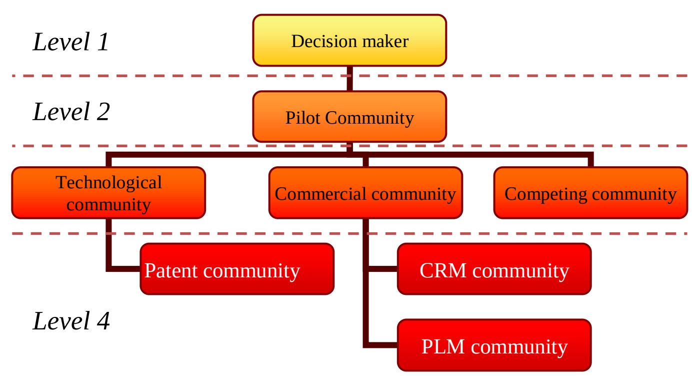


Figure 9: Example of a watch project hierarchy.

The organization with watch actors can change from a project to another according to the actor roles and the hierarchies. The line manager in a community of the project has the task to define the roles of actors in the system and allows the defined hierarchy level. In hierarchy level, it is quite important to define the collaboration between processes, the coordination in process tasks and the cooperation between actors; and also, the security about the knowledge chain.

In the example (cf. Figure 8.), we present a possible organization for a watch system which has the objective of buying a new technology for a company. Several points must be respected:

• The decision maker have not to communicate his decision **intentions**, as to intend to do something in the company environment. Only the request for information needs is related to the technologies offered on market. It is the transformation of the decisional problem into information search problem.

• The line manager in community have the responsibility to share this requirement in sub-requirements: the research technologies used by competitors, new research of technologies and existing patent on the market, define the customer requirements and the impact planned for this change….

• The actors' community has to work in collaborative way to answer the needs and then turning over the results to the direct hierarchical level. If a need is expressed between two ore more different communities, it is allocated to the pilot community to grant or refuse the authorization of this request.

• Finally, the decision maker will receive all synthetic information about his decision problem as added-value information to knowledge capitalized in objective way.

We propose to offer a first possible organization according to the resemblance of the watch project. It is a generic model of assistance to the actors of watch project. As model, it is proved in the field of e-training [28]. We took, as starting point, the reasoning containing case which consists in entering the various combinations then to seek the most similar case in order to offer a solution. This case, once adapted to the needs, will be capitalized for its further development. A case database must be then stored for processing.

B. *Knowledge Organization in watch process*

The actor task in the watcher process can be recapitulated in four points [29, 30] (cf. EQuA^{2}te Architecture):

• To explore through the information retrieval system. We propose for applications a set of functionalities, as to explore by information attributes or values. For example, clicking on an attribute will give all the set values. Starting from these values, the IR system user is able to query and have the associated documents and information.

• To query the IR system, user requests by generic to specific topics He can represent his queries in Boolean forms. In documentary systems, most search engines employ the Boolean approach to search documents. The major disadvantage is that the degree of information relevance depends on the level of knowledge of the user. He seeks on the specification of values in attributes.

• To analyze the whole data of the IR system and to select the relevant information attributes. The analysis quality depends of course on the degree of the decisional problem comprehension as well as fidelity to translate the decisional problem into IR indicators.

• To annotate the solutions proposed in context according to personal criteria. This functionality makes possible to adapt the IR system from the informational contents to the personal characteristics of the actor.

The first two levels being built on the level of our information retrieval system. For the data analysis we gave to the watcher actors the possibility of selecting and sorting the most relevant data among the results obtained after the query.

The last level will to present the information retained in a specific form which highlights the most relevant knowledge. This representation can be in the form of graphs, curves, multidimensional tables, abstracts… These actions vary according to the type of treated data (numerical, textual, date and hour, multimedia…).

In this level, we noted that:

• The choice of the aggregation action is closely depend on the data to incorporate.

• The regrouping of the data in the same diagram of aggregation depends on their types (date and hour, text, numerical…) and of their uses later (technique, diffusion, production, audience…).

• The actions can be gathered under categories while being based on the similarity of their treatments.

This took us along to the simultaneous use of the meta-data and the meta-actions.

The meta-data are the representation of "the data which describe the data"[31]. It is necessary to represent, describe and store the interactions between the various collected data. The process of description of the meta-data makes it possible to register the collection methods and data processing supports. In our context, the meta-data aim is to facilitate the creative process of the aggregate data starting from the detailed data.

The meta-actions are the descriptions of the actions which can undergo the data [32]. In the one hand, they will make it possible to define, on the one hand, the data which can be grouped in the same graph, table, curve…

In Figure 10, we present the diagram that illustrates our solution about Knowledge organization in the watch system.

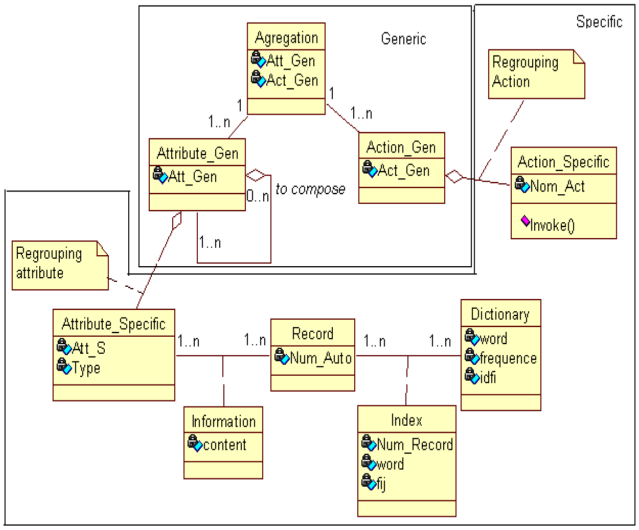


Figure 10: Diagram of knowledge organization.

C. *Our approach*

We propose in this part our approach of various project constructions in watch process. Interactions are defined, on one hand, with the information retrieval system and, on the other side, with our generic watch system (cf. Figure 11).

The stages 1 to 3 are about the information source indexing linked to the IR System.

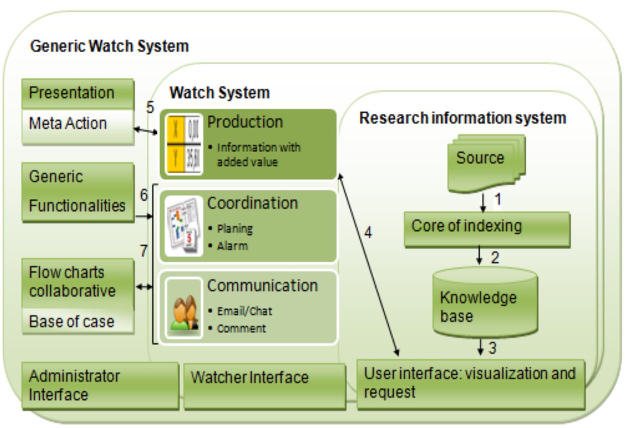


Figure 11: Approach for construction of watch system

Result is illustrated by our IR system that presents its H-M interface to communicate with user who searches while going through queries.

The stage 4 explains the interaction between the watch system and the IR system: in the first direction to ***Filter***, ***Sort*** and ***Select*** relevant information and in the second direction to ***Present*** information in a personalized form (curve, table, graph, summarized…).

In stage 5, the administrator grants the specific functionalities to the watcher in order to avoid overloading the system while controlling the interactions. The watcher will be able to reach through the stage 6 the presentation possibilities for the retained attributes at stage 4. Also, if the administrator has a task, in stage 7, he will give a hierarchical level to the watcher and to put him in communication with actors to cooperate on common tasks.

The proposed architecture makes possible to define a specific structure for watch needs and can varies from a project to another by controlling the possible interactions in the system in safety way.

IV. Conclusion

In this paper, we present, in a first part, our information retrieval system based on a probabilistic approach OKAPI. In the second part, we define a watch system and her different process and propose her integration. In the last part, we propose our approach to design a watch system and answer requirements about a specific architecture.

Our idea in front of variable needs from a project to another was to set up a generic watch system that makes possible to take into account all the divergences between projects in a functional architecture. Our prospects are to set up this architecture and to carry out diagnostic for each stage of the system while comparing the past situation, the processed situation and the concerned situation.

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