

EVALUATION OF WORKFLOW-TYPE SOFTWARE PRODUCTS: A CASE STUDY

Pérez, M. ; Rojas, T.

Universidad Simón Bolívar

Departamento Procesos y Sistemas

Apartado Postal 89000

Sartenejas, Baruta

Caracas, Venezuela

movalles@usb.ve, trojas@usb.ve

Fax number: 58-2-9063301

Phone number: 58-2-9064017

Abstract

The main objective of this paper is to propose a set of indicators for the evaluation of Workflow Software-type products within the context of Information Systems. This paper is mainly based on a comprehensive bibliographical review of all topics referring to the *Workflow* Technology and Information Systems. Next, sets of indicators are presented for the selection of a Workflow Software based on the realities of the business world, including a method of examination so as to obtain an integral evaluation on the Workflow software. Finally, the evaluation method for two types of Workflow Software is applied: *Lotus Domino/Notes*® and Microsoft Exchange®, for the billing subsystems of a company called MANAPRO Consultants, Inc.®.

Keywords: Workflow Software, Information Systems, Workflow evaluation, Microsoft Exchange ®, Lotus Domino/Notes ®.

EVALUATION OF WORKFLOW-TYPE SOFTWARE PRODUCTS: A CASE STUDY

Introduction

The new way of thinking is geared towards the processes implicated in services which themselves support production processes, logically aimed at all times towards customer satisfaction. A new technology has arisen to provide backup to the automation of these processes, leading to timesaving. This technology is known as *Workflow*. Workflow is a technology whereby business process automation is successfully accomplished by means of an assembly of rules imposed by it. This process involves activities that can be performed in series or in parallel by one or more members of a work party for the purposes of accomplishing a common goal. Processes are monitored and co-ordinated through the automatic routing of documents to the user responsible for working with them [3]. Some of the features in this process include the routing of tasks in different ways and towards different locations within and outside the company, as well as the representation of the policies, techniques and procedures that aid in the integration of automated and human-performed work activities of the organization. Improved performance is thus achieved thanks to the permanent availability of information relating to the task being carried out and the integration of islands of information, which used to slow down the task.

The aim is to have neat, summarised, categorised, hierarchized information available, identified according to the process with which it is related, according to the person or entity responsible for it, for the purposes of following up the

execution of tasks so as to improve the efficiency of the processes being carried out in the organisation and attaining customer satisfaction.

This technology is an alternative to maintaining the co-ordination of each work team dedicated to a project in organisations in charge of creating Information Systems.

However, this technology is expensive, complex and has an unclear scope of action. For this reason it would be very useful for a series of indicators to be proposed that would aid in supporting the decision-making process for the selection of a Workflow Software-type product [4].

Literature Review

Towards the mid 70's, minicomputers started to provide support to work groups and to organisations in a more sophisticated, interactive manner. Thus arose the concept of **office automation** [9]. User applications, for instance word processors, increased their success in the support of groups and departments. Telecommunications technologies have enabled communication among various workstations, thus taking full advantage of the ample processing capabilities of PCs at a relatively low cost. Likewise, organisations can now be fully interlinked through a network. These Office Automation Systems sustain specific functions such as electronic mail, word processing, document and imaging filing and other functions within an organisation.

Nina Burns, of Collabra **Groupware** Central, states that **Groupware** is "software which manages workgroups involved in a common task at the same time as it provides an interface for a distributed environment" [5]. Another definition of **Groupware** is "software designed to be used in a network serving a group of users working on a common project"[8]. **Groupware** isn't just a multi-user software; it also provides a mechanism helping multiple users co-ordinate their activities and provide follow-up on a specific project. Both definitions point to one and the same Workgroup software concept, including the benefits offered by e-mail, group planning and videoconferencing discussions, etc.

Based on this "Workgroup software" approach, it is not correct to make a comparison between *Workflow* and **Groupware** but rather to the **Workflow Management System (WFMS)**. This latter refers to systems, which execute *Workflow* processes, whereas *Workflow* refers to a technology by means of which these processes are automated. Thus, **Groupware** and WFMS aid in supporting the collaboration effort in a shared-environment organisation. The most outstanding aspect, which marks the difference between these two applications, is based on the fact that **Groupware** is usually more flexible as regards its *group work paradigms* and regarding *co-operation aspect* [3].

The wide array of terms in the *Workflow* world can be confusing; thence, one must keep in mind that *Workflow* is simply the flow of work between two persons; therefore it is not necessarily part of an Information System (IS). Workflow Management Systems (WFMS) are the automation and co-ordination of business processes using computers - clearly not an IS. However, WFMS are systems that implement *Workflow* processes. Following is an explanation referring to the reason why these systems are considered to be information systems for the purposes of this research.

Within the scope of an Information System, Workflow Management System is the Information System, which manages the Workflow. Their main difference with Information Systems is that it performs the work co-ordination, projected at a superior level, by incorporating the dynamic aspect inherent in all business processes.

Knowing that WFMS are a formal set of processes (the processes of the business itself), operating on a collection of structured data and which contribute part of the information needed for business control and management activities, it can be stated that these are Information Systems. Furthermore, WFMS, like IS, partly support decision-making activities and share various features, as listed as follows:

1. They require a database with each instance of the processes to be managed.
2. In order to implement a *Workflow* solution, the same stages as for the development of a traditional system have to be performed: design, construction

and implementation, following the order established by the development methodology used.

3. The problems faced in the development stage are the same: software stability; user resistance to change; differences between the specifications and what can really be built.
4. It is an efficient technology; however, its effectiveness has not been proven. Considering it is a new technology, it can be a complete failure if steps against resistance to change are not foreseen.

The numerous advantages offered by the WFMS are reflected in the most important factor for any organisation: swifter time response, whether it be customer response time, an internal process, execution time and/or the time taken to finish a task. Consequently, costs are reduced and the company's global performance is significantly increased. The main feature of the WFMS is the Workflow solution offered to the IS, which works based on pre-existing processes within the organisation and which offers links with its database through a sophisticated easy-to-use interface. Additionally, by enabling the co-ordination of tasks, it facilitates the routing of data supplied by the IS, in turn backing decision-making processes.

Organisations can anticipate and respond to problems and opportunities by the innovative use of information technology [1]. Therefore, the next step is to improve the co-ordination of a task, for instance avoiding the pile-up of unattended paperwork on desks. Information must be used as an objective component of decision-making. However, in order to achieve its highest level of efficiency, it must be co-ordinated. This is a fundamental concept supporting the *Workflow* theory. This is the feature of the WFMS not shared by the **IS**. For this reason, despite being an **IS**, it is projected at a superior level insofar as the co-ordination of processes is the key element lacking therein, whereby organisations achieve full automation of their processes.

Likewise, the relationship existing between Business Processes and the type of Workflow Software needed for each case must be highlighted. As can be observed in Figure 1, an organisation must be able to locate the process to be automated or

supported through a type of Workflow Software, so as to choose the type of product to be purchased.

As can be observed, depending on the process that is being automated, there is a greater proportion between the Business Process and the People-centred Process. This all indicates that values have to be quantitatively determined to aid the decision-maker in purchasing the most appropriate type of Workflow Software.

A Proposal for Indicators

For this study, the indicators have been classified into two categories in order to group technical and organisational aspects separately. Technological Indicators cover all the features and functionalities inherent to a type of Workflow Software. All these indicators were obtained from a study of each variable and indicator used to evaluate a type of Workflow Software, as follows. They were presented at the AMCIS'98 [7]. Tables 1 and 2 show each indicator together with its conceptual definition.

Likewise, all technical requirements and documentation accompanying the product are included. Organisational indicators encompass company aspects (such as the users using the tool, implementation and acceptance) as well as the supplying company (technical support, sales personnel).

Organisational indicators:

A detailed explanation of the steps included in the method formulated for the evaluation of Workflow Software products is provided next.

Method used to evaluate Workflow Software with the proposed Indicators

Once the indicators have been defined, the next step is to determine their use. The applicability of the proposed scales constitutes the method used to evaluate Workflow software with the indicators:

- The first step consists of applying a qualitative scale to each variable. For instance, the "Routing based on roles" indicator of the *Routing capability*

variable shall be given a score of 1 if the tool evaluated does not possess said functionality. However, if it does, its quality shall be evaluated with a score from 2 to 5 and so on and so forth with the remaining indicators. The definition of the scale of values established to measure each indicator was based on the study carried out during this research. Selecting a scale however requires that the dimensions comprising the variable must be defined and that the various indicators reflecting it can be found. A scale of 1 to 5 is a general and complete mode of including the possible values for each indicator. This means to say that it is not very precise in the sense that, for instance, the term "regular" can lend itself to a subjective evaluation, although it is not as generic as a choice between good and bad would have been. With this scale, there is a small risk of subjective evaluation but this is inherent in any type of evaluation. Remember that each indicator is measured through its operational definition (variables involved).

- The second stage includes the application of weighted scales, which consists firstly of assigning a percentage to each category of (technological and organisational) indicators and then allocating a weight of between 1 and 10 to each indicator, depending on the needs of the decision-maker.
- The third step is the calculation of average values corresponding to each group of variables for each indicator. This average is multiplied by the weight assigned in step two. Thus the Weighted Average for each indicator is obtained.
- The fourth step is the calculation of the Weighted Average by Category, which is simply the sum of all Weighted Averages for the indicators corresponding to each category.
- In the fifth step, the Weighted Average by Category is multiplied by the weight assigned in step two and then all are added up. This result, the Final Total shall be compared to the values given in Table 3, and recommendations are suggested regarding the product that is being evaluated.

Case Study

The billing process in *Manapro Consultants Inc.* ® is managed by two software systems: the *Billing Control Software* and the *Manapro Consultants Inc.* ® *Administrative Software*. The first was developed for the purposes of automating the billing process (conceived as a WFMS). The second is in charge of the physical issuance of invoices and process-associated data handling with respect to its links with other administrative areas in the company.

Although the conceptual approach is adequate, the *Billing Control System* has not been adapted to transformations in the company and presents a series of characteristics that must be optimised, among which are the following:

- Parts of the billing process are not supported adequately and therefore continue to be manually performed, especially in the non-existent system integration with the company's administrative software.
- The application presents a substantial number of functional failures and is not sufficiently flexible, making it impossible to properly manage the temporary absence of personnel or delays in the execution of activities. Other desirable characteristics existing in a Workflow Software type solution are also absent.
- The basic scheme under which the application distributes the documents for approval to the corresponding sectors is done by mail. However, an increase in the company's sales volume has created difficulties for the personnel in properly handling their personal mail and the documents received for the billing process.
- Finally, the system's functionality is available solely within the infrastructure of the company. Inasmuch as on various occasions the personnel has to carry out projects in their clients physical premises, it would be desirable to be able to have remote access to the system.

Manapro Consultants Inc. ® in turn, as a software-developing company, wishes to broaden its expertise in the use of Workflow technology due to its preponderance in the current market situation, as reflected in customer demand. For this purpose, apart from establishing the theoretical bases, the intention is to determine the most ideal Workflow Software for this type of development. Given that the current

system was developed using the platform offered by *Lotus Domino/Notes*®, a comparison between this and *Microsoft Exchange*® (to which the company has easy access purchase-cost wise) is desired.

Characteristics of the Operational Prototype (Microsoft Exchange ®)

The basic functions that the prototype must comply with are given next:

- Approval cycle for billing documents, for the products as well as the services offered by the company. This entails the different approval instances from price quotes to the issuance of the invoice and the handling of annulments whenever required.
- Facility of visualisation of the billing documents by the users of the system, as per the following categories: pending for billing, billed, rejected all.
- For the users in charge of supervising the process, the documents classified by the executive generating said document is also a requirement.
- Maintenance of historical data for consultation and reporting purposes.
- Handling of the permisology and security within the functions executed.
- The possibility of placing parameters on users workflow: this aspect is limited to the possibility of creating auxiliary approval routes in case the person in charge is not available.
- Transfer of billing requisition data from the Administrative System implemented in the company.

Besides, it should comply with the following supplementary functions:

The possibility of entering billing documents via *Internet* that would permit remote access to the billing control work flow function and the determination of the proper mechanisms to build a statistics-generating and billing-projection environment.

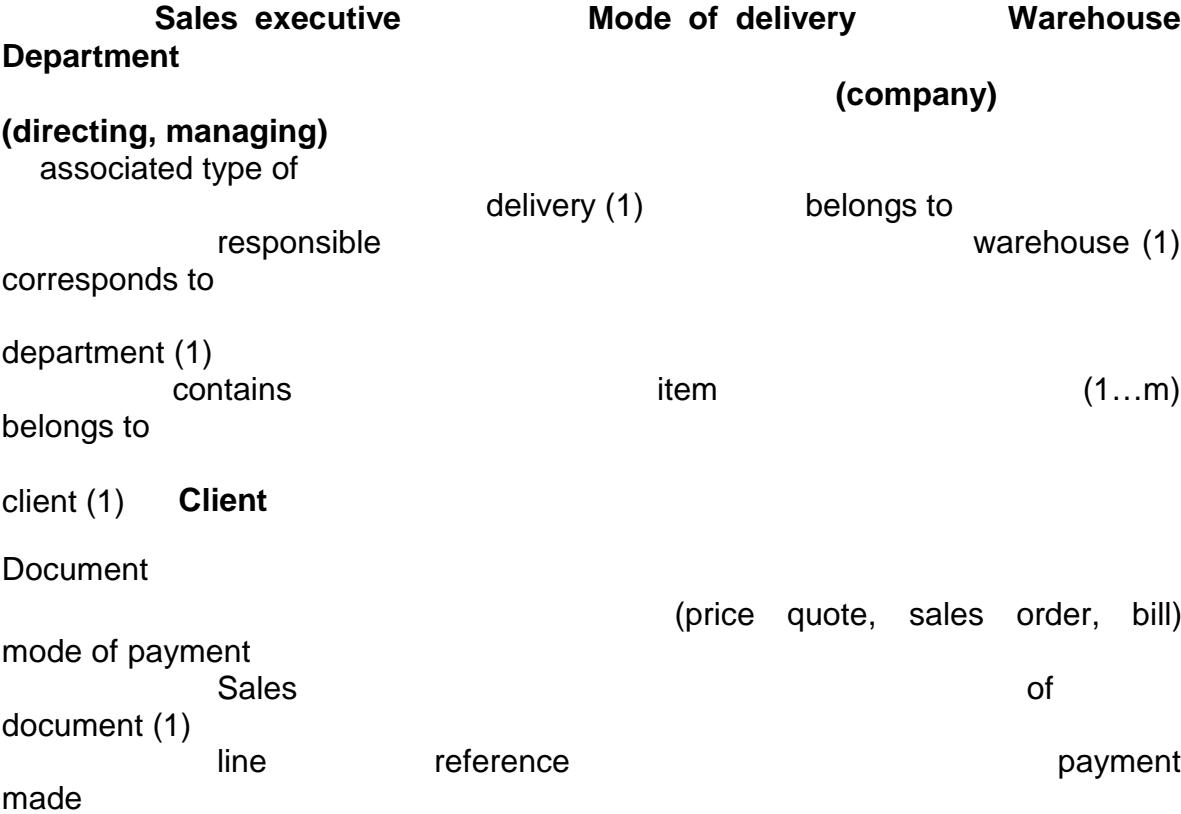
As a result of the object-oriented analysis of the situation, a conceptual approximation to the Billing Process is shown in Figure 2.

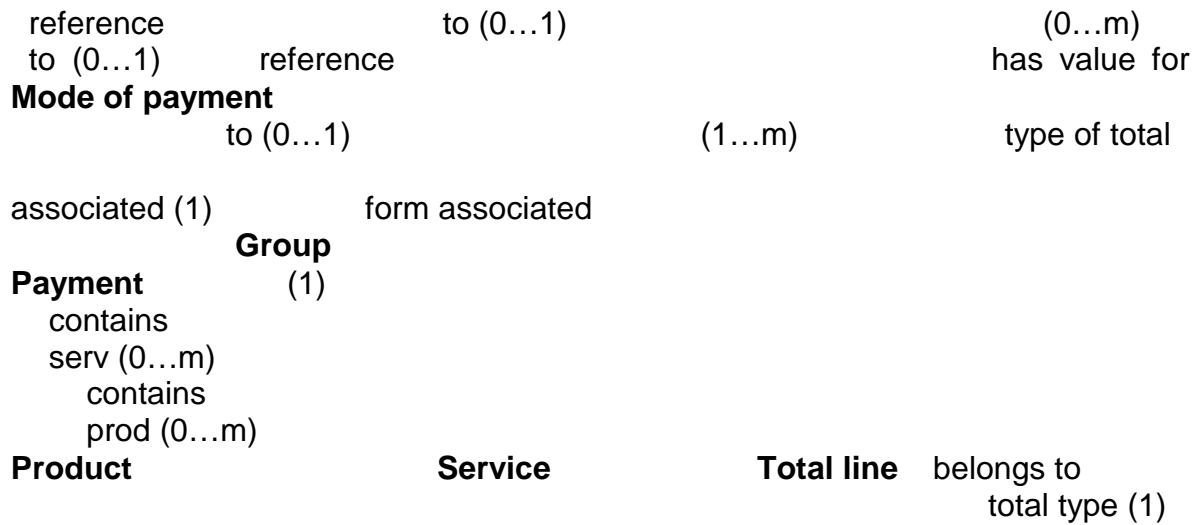
Where the *Client* represents an individual or company negotiating with Manapro Consultants Inc. ®, purchasing the products and/or services offered and finally

receiving the invoice corresponding to the items purchased; and the *Supplier* represents the individual or company by means of which Manapro Consultants Inc. ® acquires the products it puts on the market.

Based on Figure 3, the outstanding fact is that each subsystem presents its own sales supervisors, sale executives and billing documents. However, the Administration and Finance subsystem finally process the documents prepared in each subsystem. The importance of this scheme is that it helps in fully understanding the characteristics of the Business System. Through the identification of objects, the roles managed within the company that have to be included in the system to be developed are established.

The identification of the components in the data services could help in establishing a description of the traits in these systems. Inasmuch as the three modules are integrated and use one single data service, the composition of the database for the modules as a whole is described.





Total type

Figure 4 makes use of the same notation employed in describing the objects in the business system, but in this case an information system is being described. This is one of the advantages of using Jacobson notation [6].

Analysis and Findings

The results after applying the proposed method for evaluation of the two Workflow-type software are shown next. For space-saving purposes, first the results of step two shall be presented and then the results of the remaining steps are presented in tables.

- The second step is summarised in Table 4 for the Technological indicators and in Table 5 for the Organisational indicators, reflecting the importance considered for each indicator as per the particular characteristics of this case study. Notice how the valuation corresponding to the total index for each Workflow Software (100%) was assigned to the Technological category (70%) (aspects inherent to each product) and to the Organisational category (30%) (aspects supplementary to each product). A value between 1 and 10 was assigned according to the importance of each indicator. Therefore the weighting scale does not depend on the tool which is being evaluated but on the organisation and its needs, a fundamental aspect when purchasing any asset for the company.

In the case of the technological indicators, those deemed to be key indicators are those reflecting a greater weight (Routing capability, managing events, integration capability, managing formats and Webflow). The adaptation presented by the Workflow Software under study is in turn of vital importance with respect to the type of process to be automated (Billing); notice that the importance granted to the Process Management indicator (8 points) which measures this aspect, is outstanding.

With respect to the organisational indicators, a higher weight was assigned to the support offered by each Workflow Software. This turns out to be vital insofar as the company lacks much experience in the use of any of the products under evaluation; therefore security in the possible resolution of problems is required. Likewise, great importance was given to the degree of assimilation offered by the product with respect to the persons involved in its use. A higher weight was allocated to aspects related to Human Factors, Analysts and process Designers.

- The results of the first step (allocation of the qualitative scale) and the calculation of weighted averages by indicator is shown next:

Technological Indicators

1. Availability of Graphic Tools

The routing characteristics in both products require being programmed from a basic level. Microsoft Exchange ® presents certain advantages because it offers some basic components to develop this aspect. However, complexity in the use of these components does not allow for a higher qualitative valuation.

2. The Establishment of Groups

As in the previous case, the definition of work groups must be programmed. Although both products offer certain traits for the definition of groups, these do not comply with the needs under a Workflow solution whereby certain values have to be handled, inasmuch as, according to the order in which they are defined, the activities shall be carried out among the participants working each group, etc.

3. Routing Capability

Routing characteristics in both tools require programming at a basic level. Microsoft Exchange presents certain advantages as it offers some basic components for the development of this aspect, as previously indicated. However, complexity in the use of these components does not allow for a higher qualitative valuation.

4. Performance Metrics

Once again, the products offer no native mechanism to evaluate the performance in the execution of various instances in the process. If this characteristic is required, it must be programmed.

5. Queue Management

None of the products offers the possibility of defining queues. Programming this characteristic is highly complex.

6. Management of Events

The management of events for aspects in the Workflow technology also turns out to be insufficient. In the case of Microsoft Exchange® there are certain structures that enable the implementation of waiting conditions evaluated per each instance in the process. Thus, it is superior to *Lotus Domino/Notes*® in this aspect. This product in turn offers the possibility of sending messages to several participants, thus enabling them to vote on a specific topic. Finally, it is worthwhile mentioning that both products provide a robust and rather complete e-mail agent's structure. Microsoft Exchange® has the disadvantage that the agents cannot be directly invoked; the activation thereof is in periods of 60 s, as required by the case study.

8. Work Load

Once again this corresponds to a new aspect for which the products offer no native support; this characteristic will have to be programmed by means of vistas and elements.

9. Integration Capacity:

Microsoft Exchange ® presents a more robust option in the possibility of accessing relational database handlers given the feasibility that this could be carried out under a three-tier scheme; however, *Lotus Domino/Notes*® enables that the required functionality be performed through a more direct access to the application data service. On the other hand, both products can use Agents to automatically carry out certain Workflow activities. Finally, given the high popularity of Microsoft Office, it seems necessary to consider the integration offered by the Workflow Software in this case (Example: for handling the documents used in the company). In this sense, Microsoft Exchange ® presents a better integration as it even permits the definition of *fields* corresponding to elements defined in Office documents (example: Excel cells) that may be visible in the defined vistas. It also permits the documents to be automatically generated. *Lotus Domino/Notes*® only presents a similar functionality with respect to the ease of recognizing the global parameters in an Office document (example: the author of the document, etc.). This information can be visualised in vistas, etc., thus presenting a not-so-tight integration.

10. Monitoring

Monitoring is also a characteristic that must be programmed. In the case of Microsoft Exchange ® this can be done by using its Workflow structures (Routing Objects); however, its complexity of use does not allow a higher score to be granted to it.

11. Simulation

Simulation and testing of the designed process is, in turn, an aspect that must be completely programmed. The disadvantage of Microsoft Exchange ® is that it presents a diagram requiring certain adjustments in the server and others in the client, thus rendering the final testing of processes difficult. On the other hand, if the Workflow has to be tested, the user logged-into the *Operational System* has to be changed for each individual involved in the process, the result of which is rather tedious. *Lotus Domino/Notes* ® handles a more unified simulation scheme inasmuch as it provides a tool for the design of applications where the

corresponding tests can be carried out; nevertheless, it does not offer considerable facilities because multiuser simulations also require the continuous change of users, although only at the level of the user logged-into the application (*Lotus Domino/Notes*®) while the same work user can be maintained in the *Operational System*.

12. Handling of Forms:

Both products offer ample facilities for handling forms. *Lotus Domino/Notes*® has an advantage over Microsoft Exchange® in that it enables a more robust and complete handling, as previously described. In turn, distribution of the form in the case of *Lotus Domino/Notes*® is always simple and direct. This is not the same for Microsoft Exchange® in the case that personalised ActiveX controls have been incorporated, because these have to be installed in the clients (this was true in the case of the project developed). Finally, Microsoft Exchange® presents greater ease of incorporation of spreadsheets as forms, thus putting itself ahead of *Lotus Domino/Notes*® in this regard.

13. Webflow

For this point once again the comparison previously made in the diagram presenting remote access applications can be considered. *Lotus Domino/Notes*® is vastly superior in this case.

14. Task Management

Once again, this characteristic must be completely programmed. Microsoft Exchange® offers a certain advantage, as the functionality required could be performed by means of the routing structures it provides. However, as was previously mentioned, these are not easy to use and in this case might turn out to be as expensive as the development in Notes.

15. Process Management

Process management is another characteristic lacking in these products and which must be programmed. With respect to adaptation to the type of process, it is important to stress that both products present a better adaptation to collaboration

processes because these products were conceived with more precise functionalities in this area; however, they do not offer sufficient characteristics to be considered natural within the collaboration Workflow.

The facility these products offer, if accessed through a mail client or a browser enable a large number of persons to participate in the process without major difficulties. This is one advantage presented by the products to adaptation to administrative processes, slightly better in the case of *Lotus Domino/Notes*®, due to its broader Internet-integration ease. Nevertheless, given the difficulty presented by both products for the modification of the *Definition of the Process* (no easy-to-use tools are provided in this sense; see indicators 1 and 2), the adaptation thereof to administrative processes is considerably reduced.

16. Documentation

The ease in documenting the products is quite low with respect to the application description functionality. Documenting the code is really deficient in Microsoft Exchange® as it provides no proper mechanism for this in the case of programming Scripts in agents and forms, although the facilities offered by Visual Basic can be used in the components that are created. *Lotus Domino/Notes*® offers a certain code modulizing facility for easier documentation.

17. Hardware and Software Considerations

Microsoft Exchange® is currently solely supported under the Windows NT operation system (Windows NT, 95, 98 in the case of the Outlook client). Although *Lotus Domino/Notes*® also presents versions for Mac and UNIX, the system used in the company corresponds to Windows NT (Windows 95, 98 for some workstations), wherefore the support that offered by *Lotus Domino/Notes*® turns out to be of little use. With respect to hardware requirements, both products present similar requirements that are feasible within the infrastructure of the company without requiring the purchase of new equipment.

Figure 5 shows the **Average** for each technological indicator for both products.

Observe how both Workflow Software products present similarities in a broad spectrum of indicators (1,3,4,5,7,9,13,16). This obeys to the fact that the characteristics evaluated in each case are not supported by the products, although some can be programmed with a lesser or greater degree of difficulty. In the case of the *Hardware and Software Considerations* indicator (16), the similarity is in the requirements met by the company in both products, without the need for purchasing additional equipment or products (for example servers, operational systems, network elements, etc.).

It is important to note how Microsoft Exchange ® presents a higher score for the *Routing Capability* (2) and *Management of Events* (6) indicators, which are deemed to be critical in the study undertaken. This is due to Microsoft's incorporation of certain characteristics in the product for the management of Workflow. However, given the difficulty in its use these cannot be properly taken advantage of by the Workflow Software, so they do not obtain a high score. Microsoft Exchange ® presents a higher score in Integration capability, although *Lotus Domino/Notes* ® also receives a high value, indicating that both products meet the needs in this regard. Finally, it is important to highlight that, in the cases where *Lotus Domino/Notes* ® presents disadvantages compared to Microsoft Exchange ®, the differences are not that notorious. *Lotus Domino/Notes* ® in turn, stands out over Microsoft Exchange ® in a broader set of indicators (10, 11,12,14,15) and presents considerable advantages in the *Webflow* and *Handling of forms* indicators, both considered to be critical in the case study as they measure the possibility that the product may be remotely accessed and that the forms used permit the handling of application-required aspects.

Table 22 presents the Weighted Average per Technological Category for both products.

In this manner, from the technological standpoint, *Lotus Domino/Notes* ® presents itself as a better option than Microsoft Exchange ®, although an optimum level is not reached.

Organisational Indicators

The following tables show the values for each organisational-related indicator:

1. Human Factors

Lotus Domino/Notes ® offers more parameters in the environment based on the tastes and needs of designers and final users alike, thus making its use more easy. Product learning is also simpler for users due to the ease in designing user-friendly interfaces. It also provides a specialised development environment for developers. Microsoft Exchange ® does not allow for parametric in the application's environment except for a scarce amount of details; it also offers a restrictive use scheme and a disperse, confusing development scheme.

2. Process Analysts and Designers

With respect to the process analysts and designers, it can be highlighted that although they may be used to working in Visual Basic and VBScript, the limitations in the Microsoft Exchange ® programming environment greatly diminish their chances of liking this product. These limitations correspond, for instance, to the location of the totality of the code lines, whether for forms or agents, in one single text file, in some cases having to handle thousands of monolithic code lines, making programming extremely cumbersome. *Lotus Domino/Notes* ® provides more adequate programming tools that are much easier to assimilate. However, the description of the processes implemented is not a facility provided by any of the products and must be implemented, with the subsequent loss of time to process analysts and designers.

3. Sales Personnel

The trajectory of the software company is a very subjective aspect. Nevertheless, if one considers that Microsoft Exchange ® has only recently been launched into the market, the characteristics whereby it offers its product as a Workflow solution could be determined as having a shorter trajectory than *Lotus Domino/Notes* ®. On the other hand, Microsoft makes no mention of success cases resulting from the use of Microsoft Exchange ® as a Workflow solution without using an additional product. This latter is also the case for *Lotus Domino/Notes* ®.

4. Technical Support

Technical support offered by Microsoft for the development of Workflow applications under Microsoft Exchange ® is really scarce. This can be verified during the development of the project. The situation is not that negative for *Lotus Domino/Notes* ®. On the other hand, the courses offered for Microsoft Exchange ® related to the development of applications are excessively superficial and do not broach in detail the development of Workflow applications. This situation is slightly better in the case of *Lotus Domino/Notes* ®. However, it is important to stress the current lack of courses for the latest versions of the products used and the low periodicity of these courses. In the case of *Lotus Domino/Notes* ® the product proposes a trajectory in which the courses for previous versions are somehow of considerable help.

5. Implementation

Although it is feasible to carry out planning activities based on the characteristics and facilities described by both software companies; implementation prices shall suffer dramatic changes given the scarce Workflow-related characteristics offered by the products. These will have to be entirely programmed, which is time- and money consuming. Finally, the concept tests shall be extremely expensive given the difficulty in carrying out swift and direct complete prototypes.

6. Acceptance

Lotus Domino/Notes ® presents more widespread acceptance by the end users and analysts due to its ease of use and programming. However, Microsoft Exchange ® shows more acceptance by the company directors because it represents a closer commercial partner. This, nevertheless, does not become a highly differentiated element between the products in the study.

7. Cost of the Product

In this case, it is important to mention that given the agreements between the company and Microsoft Exchange ® as well as *Lotus Domino/Notes* ®, there are many facilities for purchasing the products at a minimum investment cost, although

the purchase costs of Microsoft Exchange ® are lower than for *Lotus Domino/Notes* ® in general. Training courses represent a high due to the lack of courses for the latest versions of the tools, thus entailing more difficulty in the learning process, which is reflected one way or another in the costs.

With respect to the organisational indicators it can be observed how *Lotus Domino/Notes* ® holds an advantage over Microsoft Exchange ® in almost all aspects evaluated. The only element in which Microsoft stands out is product cost. This indicator has little weight for the case study as the company has agreements with both software companies, which entail a preferential treatment, resulting in null or very low costs for the purchase of both products.

Thus, it is possible to determine that the organisational impact offered by *Lotus Domino/Notes* ® turns out to be of easier assimilation by the company than that offered by Microsoft Exchange ®. Although this might sound contradictory, as *Manapro Consultants Inc.*® presents a close relationship with Microsoft ®, this is because the project is being developed in an area in which Microsoft ® does not have much trajectory, putting it at a disadvantage with respect to *Lotus Domino/Notes* ®, at least, at the time of this evaluation.

Table 30 presents the Weighted Average for the Organisational Category for both products.

Finally, the Total General obtained for the two products is presented. **See Table 30, 31 and Figure 7** . This comprises the product index and somehow represents a summary of its potential for the development of Workflow applications:

It can be observed that both products present an index that discards them as a recommended solution, as per the criteria expressed in Table 3 (less than 4). This means that the development of the project using any of the products shall pose strong limitations. In the case of Microsoft Exchange ® it is possible to conclude that the inclusion of Workflow handling elements is not sufficient to recognize this product as a Workflow Software. In the case of *Lotus Domino/Notes* ®, it is important to note that the index obtained is close to the value considered as feasible for developing the product. Its use is however, not highly recommended.

Conclusions

1. A serious bibliographical review of the topics related to the Workflow Technology and the relation with the IS development was completed.
2. *Workflow* is a technology by means of which automation and business process co-ordination is achieved through a series of rules imposed on the process.
3. A series of indicators was presented for the selection of a Workflow based on the realities of the business world.
4. A method to examine these technological and organisational indicators was included so as to obtain an integral evaluation on the Workflow Software.
5. A study was performed for a real-life company case and the operational results obtained from the evaluation were presented.

Acknowledgements

The authors wish to thank Adriana Brea, Martha De Mingo and Juan Rosas for all their collaboration to this research, which was supported by Manapro Consultants Inc. ®, the organisation where the metrics was performed.

References

- 1 Hoffer J., George J., Valacich J. "Modern Systems Analysis and Design", Addison-Wesley Publishing Company ,Second Edition, USA , 1999.
- 2 Brea A., De Mingo M., "Análisis de la Tecnología workflow y su relación con el proceso de desarrollo de los sistemas de información", Universidad Simón Bolívar, Venezuela, Diciembre 1997

- 3 Bruce Silver Associates, "Guide to Workflow Software,
<http://www.bis.com.sb.guidem.htm>, 1995

- 4 Delphi Consulting Group Inc, " Study of the Workflow
Market" ,
<http://www.delphigroup.com/pubs/96pubs.htm>, 1996

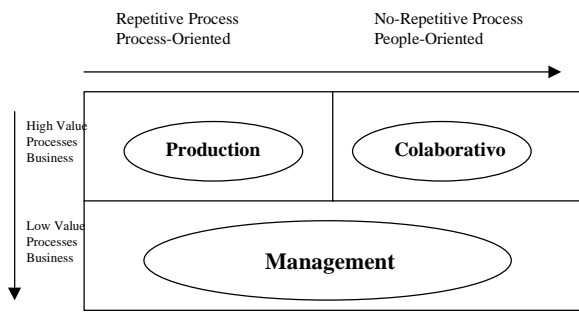
- 5 Jacobson I., Ericsson M. And Jacobson A., "The object Advantage.
Business Process
Reengineering with Object Technology". Addison-Wesley Publishing Company
, USA, 1995.

- 6 Pressman R., "Software Engineering" , McGraw Hill, Fourth Edition, Méjico
1998.

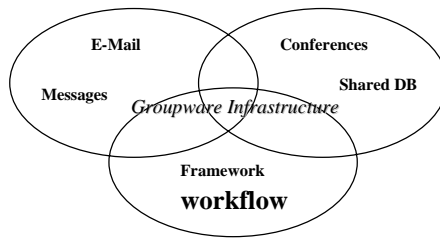
- 7 Rojas T., Pérez M., "The Impact of the Workflow Technology on the
development,
Process Model", in Proceedings AIS98, USA 1998, pp 895-

- 8 Rosas, J. "Automatización del Proceso de Facturación de Manapro
Consultores C.A.", Universidad Simón Bolívar,Venezuela, Septiembre 1999

- 9 Wainright M., De Hayes D. , "Managing Information Technology", MacMillan
Publishing Company , Second Edition, USA, 1994.



C
O
M
M
U
N
I
C
A
T
I
O
N



C
O
L
A
B
O
R
A
T
I
O
N

COORDINATION

Figure 1. Classification of Workflow Software according to the type of process it shall automate

Source: [2]

Table 1: Conceptual Definition of Technological Indicators

Source: [7]

INDICATORS	CONCEPTUAL DEFINITION
1.Availability of Graphic Tools	These tools are used to graphically design Workflow maps.
2.Routing Capability	This consists in the manner how a task is routed to a work function.
3.The Establishment of Groups	This refers to the capacity to define a "group"of individuals or work functions that will collectively develop a task.
4.Performance metrics	This is the value-benefit ratio of the tool itself and its performance
5. The cost of the product	This refers to the investment that has to be put in order to purchase a tool.
6 . Queue management	The quality of declaring a queue of tasks. Instead of sending tasks to an individual, they are sent to a queue.
7 . Management of events	As its name indicates, this refers to the management of normal and abnormal events within the Workflow operation.
8. Workload	This refers to the amount of work each user or

	group must undertake.
9. Integration capacity	This is the compatibility existing between the <i>Workflow</i> and other applications, technologies and database handlers (called third party software).
10. Monitoring	The follow-up on the <i>Workflow</i> processes and tasks.
11 .Simulation	The ability to evaluate a <i>Workflow</i> application comprehensively and on the same computer where it was designed.
12.Handling of forms	The capacity to handle data in a specific format, to be sent internally within the organization.
13.WebFlow	The capacity to generate Workflow process incidents from any BROWSER Internet or Intranet
14.Task management	Tasks can be based in computers, which frequently imply the processing of transactions and tasks carried out as standard procedures, without being modified by the users.
15. Process management	First of all the type of business process has to be identified and located. These are classified as Production Workflows, Collaboration Workflows, Management Workflows or Ad hoc Workflows [1].
16.Documentation	Documentation is considered to be any printed material describing the operation of the application (user's manual). It also refers to the system, all manners of reports, diagrams, etc

Table 2: Conceptual Definition of Organisational Indicators

Source: [7]

INDICATORS	CONCEPTUAL DEFINITION
1.Human factors	It is refers to the needs of the persons within the organization, those using the <i>Workflow software</i> as well as those designing and providing maintaining thereof.
2.Process designers and analysts:	Personnel designing and analyzing a <i>Workflow</i> application must be considered equally.
3.Sales personnel:	Prior to purchasing a tool, the company also studies the salesperson´s reputation, his trajectory and recognition in the market.
4.Technical support:	The technical support after the tool has been purchased is an essential part of its selection process.
5.Implementation:	The three <i>Workflow</i> implementation conditions have to be met: <i>Planning</i> : this consists in planning the user requirements and confirming that the to complies with them; <i>Price</i> : At the moment of implementing the tool, cost-increase due to possible problems should be avoided; <i>Concept</i>

	<i>test</i> . Consists in checking the tool on the platform and in the development of the prototypes.
6.Acceptance:	Refers to the degree of acceptance of the <i>Workflow software</i> within the organization. When a new work way arises within the organization it always meets with resistance to change in a larger or lesser degree. The manner of managing this change is relevant for the implementation of the tool to be a success.[6]
7.Cost of Product	Refers to the cost of the software product

Table 3: Recommendations

GENERAL VALUE	RECCOMENDATION
0	Does not provide support; non applicable
0,1-2,5	Scarce or zero support (the functionality described must be programmed)
2,5-4	Regular support (may require programming the functionality described)
4-6	Satisfactory (satisfies the basic needs)
7-8	Good
9-10	Excellent

Figure 2: Analysis of the situation. Billing Process

Source: [8]

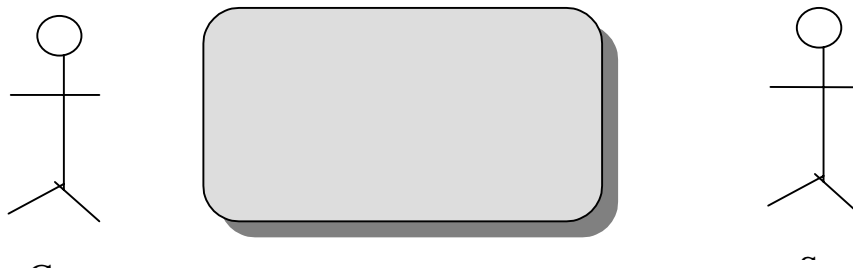


Figure 3: Subsystems comprising the totality of the situation under study

Source: [8]

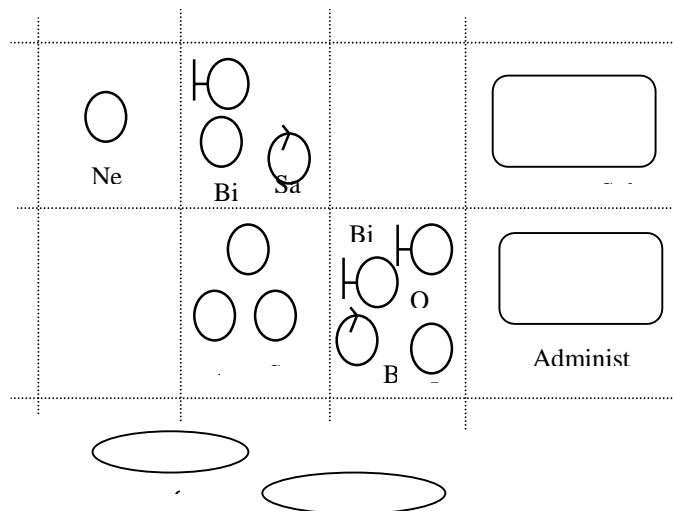


Figure 4: Partial model of entity objects corresponding to the Case Study

Source: [8]

Table 4: Weights assigned to Technological Indicators in the case study

Source: [8]

TECHNOLOGICAL INDICATORS	WEIGHT 70%
Availability of Graphic Tools	3
Routing Capability	7
The Establishment of Groups	2
Performance metrics	3
The cost of the product	3
Queue management	7
Management of events	3
Workload	7
Integration capacity	2
Monitoring	3
Simulation	7
Handling of forms	7

WebFlow	3
Task managemen	8
Process management	2
Documentation	3

Table 5: Weights assigned to Organisational Indicators in the case study

Source: [8]

ORGANIZATIONAL INDICATORS	WEIGHTS
	30%
Human Factors	6
Process Designers and Analysts	6
Sales Personel	2
Technical Support	8
Implementation	3
Acceptance	3
Cost	2

Table 6: Availability of Graphical Tools

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Graphic Editors	2	2
Graphic simulation	2	2
Average	2	2
Weight	2%	
Weighted Average	0,04	0,04

Table 7: The Establishment of Groups

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Sequential Groups	2	2
Weighted Groups	2	2
Dynamic Groups	2	2
Average	2	2
Weight	2%	
Weighted Average	0,04	0,04

Table 8: Routing Capability

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Routing based on Roles	2	2
Organisational tables for routing-based relationships	1	1
Conditional routing	4	2
Sequential routing	4	2
Parallel routing	4	2
Dynamic routing	2	2
Rendezvous routing	1	1
Average	2,57	1,71
Weight	7%	
Weighted Average	0,17	0,11

Table 9: Performance Metrics

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Cost per activity	2	2
Delay time for each step	2	2
Delay time for each process	2	2
Average	2	2
Weight	3 %	
Weighted Average	0.06	0.06

Table 10: Queue Management

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Definition of queues	1	1
Suppression queue tasks	1	1
Average	1	1
Weight	2%	1
Weighted Average	0.02	0.02

Table 11: Management of Events

Operational Definition	Exchange	Lotus
Waiting conditions	4	2
Periodic launching	2	2
Repetitive steps	2	2
"Vote" condition	4	3
Abort	2	2
E-Mail agents	8	10
Excluding days	1	1
Average	3,28	3,14
Weight	7%	
Weighted Average	0,22	0,18

Table 12: Workload

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Visualization of the workload	2	2
Assign/Remove functions from a participant	2	2
Average	2	2
Weight	2%	
Weighted Average	0,04	0,04

Table 13: Integration Capacity

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Automation Agents	8	9
Relational database handlers	10	9
Microsoft Office suite applications	10	6
Average	9,33	8
Weight	7%	
Weighted Average	0,45	0,56

Table 14: Monitoring

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
General Workflow monitoring	2	2
Monitoring a participant's status	2	2
Average	2	2
Weight	2%	
Weighted Average	0,04	0,04

Table 15: Simulation

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Capability of simulating the process prior to being put into production and preference for the same computer where it is designed	1	4
Average	1	4
Weight	3%	
Weighted Average	0,03	0,12

Table 16: Handling of Forms

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Design element completeness	5	10
Automatic distribution	8	10
Integrated worksheets for smart forms	8	7
Average	7	9
Weight	7%	
Weighted Average	0,49	0,63

Table 17: Webflow

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Ease of generating incidents from any browser	4	9
Average	4	9
Weight	7%	
Weighted Average	0,28	0,63

Table 18: Management of Tasks

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Handling of delayed tasks	2	2
Re-sending tasks	2	2
Automatic task priority	2	2
Alert days	2	2
Average	2	2
Weight	3%	
Weighted Average	0,06	0,06

Table 19: Process Management

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Suspension of processes	2	2
Handling of subprocesses	2	2
Automatic process installation	2	2
Adaptation to the type of process	2	4
Average	2	2,5
Weight	8%	
Weighted Average	0,16	0,20

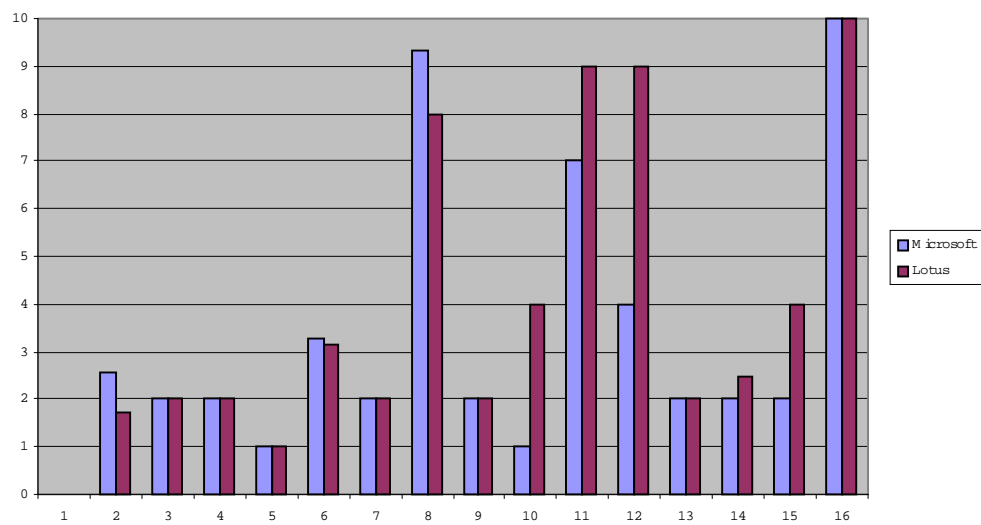
Table 20: Documentation

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Ease in the description of the application functionality	2	2
Ease in documenting the code	2	6
Average	2	4
Weight	2%	
Weighted Average	0,04	0,08

Table 21: Hardware and Software considerations

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Operation Systems supported	10	10
Hardware requirements it presents	10	10
Average	10	10
Weight	3%	
Weighted Average	0,3	0,3

Figure 5: Averages for the Technological indicators



1. Availability of Graphic Tools	2. Routing Capability	3. The Establishment of Groups
4. Performance metrics	5. The cost of the product	6. Queue management
7. Management of events	8. Workload	9. Integration capacity
10. Monitoring	11. Simulation	12. Handling of forms
13. WebFlow	14. Task managemen	15. Process management
16. Documentation		

Table 22: Weighted Average per Technological Category

Microsoft Exchange® = 2,61
Lotus Domino/Notes®, = 3,11

Table 23: Human Factors

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Learning curve	5	9
Ease of use	5	9
Work environment	5	9
Average	5	9
Weight	6%	
Weighted Average	0,30	0,54

Table 24: Process Analysts and Designers

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Adaptation to the type of programming	4	6
Ease of process description	1	1
Average	2,5	3,5
Weight	6%	
Weighted Average	0,15	0,21

Table 25: Sales Personnel

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Time the product is available in the market	3	8
Salesperson solvency	10	10
Success cases	3	6
Average	5,33	8
Weight	2%	
Weighted Average	0,11	0,16

Table 26: Technical Support

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Attention to problems of tool malfunction	4	8
Periodic existence of courses	2	3
Support availability timetable	8	8
Average	4,67	6,33
Weight	8%	
Weighted Average	0,37	0,50

Table 27: Implementation

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Planning	8	8
Stable prices	0	0
Concept test	4	4
Average	4	4
Weight	3%	
Weighted Average	0,12	0,12

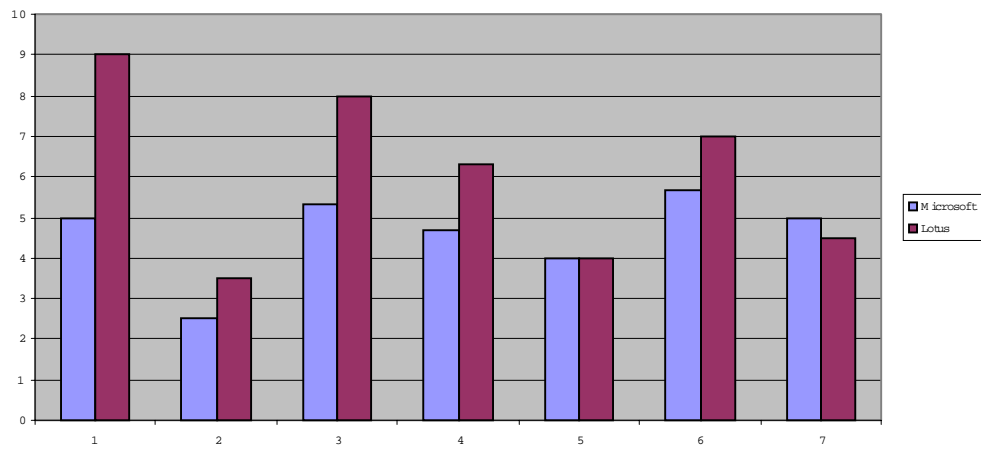
Table 28: Acceptance

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Acceptance by the end users	6	7
Acceptance by the analysts and designers	3	7
Acceptance by the shareholders and company directors	8	7
Average	5,66	7
Weight	3%	
Weighted Average	0,16	0,21

Table 29: Cost of the Product

OPERATIONAL DEFINITION	EXCHANGE	LOTUS
Tool cost scalability	8	6
Training costs	2	3
Average	5	4,5
Weight	2%	
Weighted Average	0,10	0,09

Figure 6: Average of Organisational Indicators



1. Human Factors	2. Process Designers and Analysts	3. Sales Personnel
4. Technical Support	5. Implementation	6. Acceptance
7. Cost		

Table 30: Weighted Average for the Organisational Category

Microsoft Exchange® = 1,31
Lotus Domino/Notes®, = 1,83

Figure 7: Sum of Weighted Averages for both products

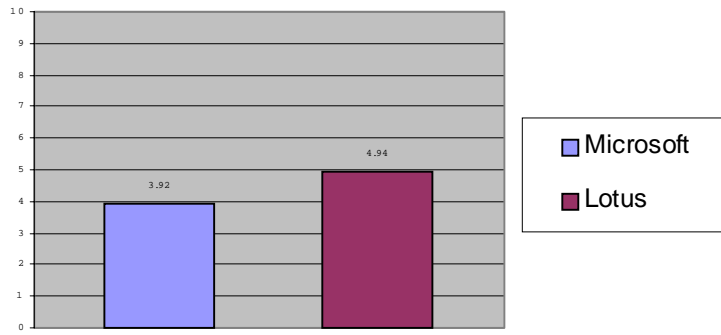


Table 31: Final Total obtained per product

Microsoft Exchange ® = 2.22
Lotus Domino/Notes ® = 2.71