

The product life cycle of project management packages : design, supply and needs

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THE PRODUCT LIFE CYCLE OF PROJECT MANAGEMENT PACKAGES:
DESIGN, SUPPLY AND NEEDS

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Abstract

There are hundreds of packages for Project Management. This is not surprising because P.M.-packages are widely used in "hard" projects (e.g. construction) as well as in "soft" projects (e.g. reorganization of an industry) and all types of projects between. Surprising, however, is that most of the packages are called standard packages, as if they are applicable in every project. Most of the packages have initially been developed in the sixties and seventies and have successively been provided with extra options. This gives rise to packages which reached the end of their product-life-cycle. A total redesign of those packages is needed, making use of modern fourth-generation languages and data bases on the one hand and results from research on the other hand.

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Introduction

In my paper I will not only talk about my own ideas. I did some homework by reading most of the papers of the 8-th Internet Congress in Rotterdam, May 1985, to see how different contributors think about the use of P.M.-packages in the field. I concluded that there are a lot of different feelings about this subject.

I shall elucidate my feelings about the, what I called, product life cycle of P.M.-packages in the light of the dramatic increase of power of computer hardware as well as programming tools.

Next the second part of the title, namely the supply and needs will be treated and illustrated by opinions of contributors of the above mentioned congress, followed by conclusions and some recommendations.

Development of computers and software

In the past forty years we have seen a dramatic increase in power of computers and an enormous decrease in size and prices. Via first, second and third generations of mainframe computers, the minicomputer came and nowadays we have, even portable, micro's which are much more powerful than the first computers. And we are by no means at the end of this development.

If we follow the path of development of P.M.-packages, we see that at the end of the fifties PERT, CPM and MPM were developed. As hardware and software was bundled, a lot of hardware suppliers developed, among others, PM-systems as a means to sell their hardware. If, at that time, one wanted to make use of automated project planning, one had to do it with software from the hardware supplier, or develop a system by his own. To run these systems one had to have a lot of computer experience. As the prices of hardware decreased and the prices of software increased, IBM started, mid seventies, the unbundling of hardware and software. At the same time many independent suppliers of PM software emerged, offering systems on specific hardware. From the late seventies until now we see that suppliers tend to support their software on different hardware. During that time the suppliers greatly enlarged the packages with options like

- subnetworks or fragnets
- hammocks

- cost to activities
- resources to activities
- splittable activities
- graphical options like
 - . (linked) barcharts
 - . histograms
 - . cumulative cost graphs
 - . cumulative resource usage graphs
 - . pie-charts
 - . network drawings
- cost management
- resource management
- maintenance or outage management
- materials procurement
- multi-project management
- decentralised processing
- helpfunctions
- database management

and last but not least a micro computer version.

And this all during an inprecedented computer and software-engineering tools revolution.

The extension of the software with a steady stream of new options via new releases and/or modules, made the software needlessly complicated and expensive to maintain. These systems are indeed at the end of their product life cycle, or beyond.

Davison [8] reported the following about research done at the Nolan, Nortan Company of Lexington, MA on the performance of data processing professionals during 1979 to 1983:

- . program sizes : medium 16 to 64 k lines
- . task schedules : 18 to 24 months
- . program staff : 6 to 8 technical personnel
- . productivity : 2500 lines of code per year
- . defect levels : > 30 defects per k lines (all causes)
- . defect removal : < 80% removal efficiency
- . delivery defects : > 6 defects per k lines.

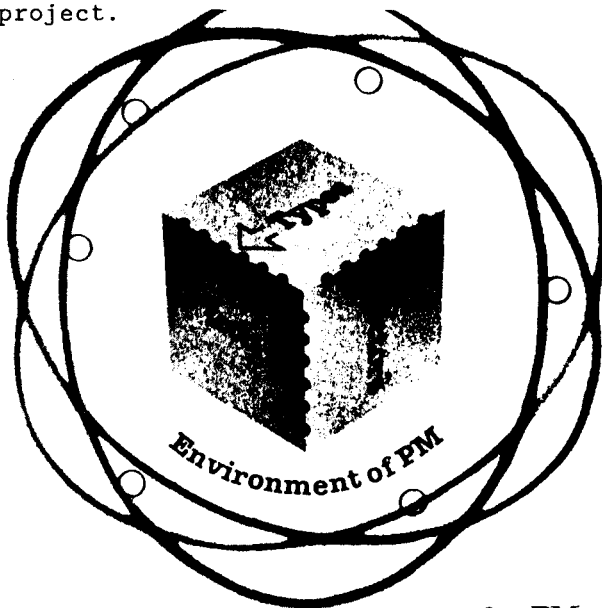
From these figures we can learn that the development of an automated project management system is a long term undertaking. The system itself has a lot of defects. Using better tools is intended to lead to:

- the shortening of the development phase,
- the reduction of the number of defects,
- better structured systems, and
- a better fit of the packages to the user requirements.

We can see now that a lot of suppliers are coming up with new systems, provided with for instance modern tools like (relational) databases and report writers, which are hopefully better structured. But do these systems better fit the users requirements?

The standard PM-systems versus non-standard projects

A lot of users have done substantial work to find out what the best system was for their projects. Why? Are these PM systems not called standard packages? So why should users spend a lot of time and money in it. In my opinion suppliers seem to be unaware that their systems indeed do not always fit the requirements for a specific type of project.



The PM Cube and its Environment

In order to design the Congress as much as possible according to the wishes of prospective participants, we would like you to indicate your interests here-below, on the back of your Reply Coupon.

To facilitate your choice a little, we have invented what we call the "PM Cube". It shows in each of its three dimensions a range of typical aspects and variables of Projects and Project Management.

You may mark, of course, as many of these items on each of the dimensions of this Cube as well as in its Environment, as you feel to be of particular interest to you as a potential participant in INTERNET 85.

Tools

Structuring Projects

- strategies
- project/formulation
- project approach
- work breakdown
- programming

Controlling Projects

- time
- money
- quality
- information
- organisation

Sectors for PM

- agriculture/rural
- construction
- education
- energy
- environment
- health
- industry
- population
- telecommunications
- tourism
- transportation
- urban development
- water supply/sanitation
- others, viz.

Types of Projects

- Physical Facilities
- Techn. control systems
- Research/Development
- Innovation
- Socio-techn.systems
- Social systems
- Knowledge transfer
- Training
- Other, viz.

Environment of PM

- Technological
- Social/economical
- Political
- Cultural
- Organisational
- Other, viz.

Please mark the items which specially interest you.

figure 1. The PM-cube

For the 8-th Internet Congress we developed a PM-Cube. In that Cube we see as one of the dimensions the "sector" [figure 1]. If we look at this we see a lot of different sectors and everyone, including the PM-system suppliers, I hope will agree that there are great differences in the demands that are placed upon PM-systems for those different sectors. Some packages offer too little for a specific environment, others too much. Too little is painful, too much is tiresome. If these newly developed systems had been developed by using fourth generation software and had been modular of structure then it should have been possible, I believe, to fit the PM system better to the specific needs of the user.

Opinions from contributors

A prerequisite is that the end-user knows his requirements. This is indeed a very crucial matter. End-users are not matched up to the very complex information flow in projects. And if they try to explain what their specific needs are, they are at least vague. I have read a lot of papers presented at the 8-th Internet Congress on PM in Rotterdam 1985. There were a lot of contributions concerning the needs of the users. I shall go through with you on some of them. I am aware that the mentioned passages are teared from their context. But nevertheless:

Mr. Avots suggests in his article "The coming impact of AI on PM" that all AI-based systems have four basic components, namely

- a knowledge base, that is developed from expert information and existing hypotheses
- procedural logic, for operating within the knowledge base
- a database, that contains project plans, schedules, budgets and other information
- interfacing between the system and the user, from terminals to voice input and speech output

and gives an overview of functions of such an AI or Expert System.

- monitor deviations from the planned schedule progress
- signal potential schedule slippages
- pinpoint the needs for human intervention and analysis
- show where to allocate special resources and reserves

- improve resource utilization

note: Basically every computer system is a kind of expert system. Which of the functions that he mentioned cannot be done with current PM software?

Mr. Barnes stated in "A framework for application of PM techniques" that:

- easier use should be the objective of development, not greater sophistication
- and further on,
- the current preoccupation with computer graphics in some quarters may well fade. They are of use but they cannot replace the real numbers used by real managers in making decisions.

notes: - what does he mean by: easier use? As this is very subjective, one should define it and illustrate it with examples.

- Mr. Barnes does not believe in computer graphics. Are there better ways to present information?

Mr. Baker presented in "The future of PM revisited" the results of a survey held at the 7-th Internet Congress, Copenhagen 1982. He interrogated 85 attendees of that congress.

The conclusions were, and I mention some of them,

- respondents are most concerned about improving PM training and developing new techniques for integrating project cost, schedule and technical performance
- PM practitioners crave more "cook-book" guides based on sound research to guide them in a variety of PM settings to enhance the probability of success
- almost all respondents expect very widespread use of sophisticated PM computer packages with graphics capabilities by 1990.

note: - Have any progressions been made in the three years from 1982 to 1985?

Mr. Hayfield stated in "Project successes and failures" the following about PM-tools.

- the PM team needs tools for its work. A key to success is to use proven tools, the simplest possible, easy to use and "friendly for the user"
 - use tools that give better and more accurately project visibility
 - use tools that take care of the boring routine work and give more time for planning, analysis and anticipation
 - the performance visibility should highlight the exceptions and the critical items. How many of us have been put to sleep by a massive volume of information.
 - be careful not to overcomputerize. There are still many project activities better carried out manually
- and about Information handling
- the lifeblood of a project is information, as it is the interface between everyone concerned with the project
 - handling of information related to the project is often relegated to people with little appreciation of its importance
 - Astute use of office mechanization can bring the information handling process to a controllable level and keep down the paper volume, but watch out for the perfectionist or idealist.

notes: Mr. Hayfield indeed is right. But what are the solutions? To use a tool I have to make a choice: How? To bring the information handling process to a controllable level? How? By astute use of office mechanization? What does that mean?

Mr. Lang stated in "Principles of modern PM-services and their application" a need for project-specific PM with three basic questions

- what are the problem areas of recent projects?
- what are the planning needs and today's trends?
- can new developments in the computer system market help and how can they be used most effectively?

note: He proposed bar-chart-based programs, as it comprises separate files for time scheduling, resource planning as well as progress control and critical path analysis.

Mr. Sorrill stated in his article "Communicating and the Project Manager" about fundamental needs of the ideal "Project Management Information System", that the system of the future must have the following characteristics:

- easy to use
- flexible and portable data capture
- flexible data analysis
- expandable to cater for small limited projects to large multi-site, multi faceted projects with thousands of related tasks
- able to transfer data and information from site to site and to head-office
- able to add on new applications as the need arise
- independent of hardware and ability to interlink with different hardware solutions.

Such a system should cater for

- screen formatting
- report generation
- aids to communicating facilities as there are
 - . multi-user remote location links
 - . telephone and data transmission workstations
 - . voice messaging.

Mr. Kwan and Mr. Takahashi stated in their article "Sayonara to traditional PM Development" that the following general objectives must be met:

- better cost performance than existing system (computer charges)
- software portability (across different hardware)
- hardware flexibility (mainframe to micro)
- userfriendly systems well-meshed with in-house procedures
- integration of PM information (the "information as project resource" concept)
- modular computer applications so that the user has the flexibility in the choice of systems
- management by exception, selective information to reach end users.

These general objectives were used in the development of a PM-system which would cover the entire management of an engineering-construction project.

I'm about half way on talking about messages from all these contributors. For a good understanding: I do not accuse all these contributors of frivolity. These are indeed good articles on relevant matters, but what can we do with them? Leave the solutions to the suppliers of PM software or, and I think it is about time, to start a cooperation between suppliers and end-users. But then the users have the duty to be more specific about their needs.

In this respect Mr. Collins stated in his article "Achieving truly integrated cost scheduling systems":

- interviews should be performed with end-users to establish aggregation criteria.

Mr. Figel stated in his article "Computerized Project Management using a Fourth Generation Project Language" that today's managers require more than just planning and scheduling. Additional features are needed to manage all project information and they need easier use of the computer software to control cost, schedule and resources. His opinion is that a single integrated system with features of a fourth generation computer language, designed specifically for project applications is needed by industry.

Features of such a system should be:

- an interactive query language
- relational database management structure
- report writer
- easy data entry facilities
- integrated graphics, and
- standard project management utility functions.

Mr. Davison produced in his article "Micro-Computers in Project Management" a long list of features that, as he termed it, a substantive project management system should contain

These features are:

- for the time analysis:
 - . network activity listing
 - . edit and validation report
 - . network analysis
 - . schedule recognizing a specified calendar, target dates and contractual constraints

- . base line report
- . base line barchart
- . variance between actual and plan
- for the resources:
 - . identification of resource e.g. labor, material, equipment, funding, support services
 - . allocation by delaying the performance of activities for which the required resources are not then available
 - . allocation by exceeding the stated availability of resources, to determine if objectives can be obtained through planned overtime, outside hiring or other means
 - . resource usage baseline histogram
- for the costs:
 - . cost by element for each combination of activity, responsibility center, account (owners, contractors, project financing institution) and property unit
 - . budget to actual
 and for the status reporting of the project (current period and cumulative):
 - . budgetted cost of work scheduled
 - . budgetted cost of work performed
 - . actual cost of work performed
 - . estimate at completion
 - . variance analysis on schedule and cost.

Mr. Arditi and Mrs. Rackas in their article "Software Needs for Construction Planning and Scheduling" present the findings of research into computer use in one aspect of the construction process: network analysis for project planning and scheduling. They interviewed six general contractors and summed up a long list of "must have" characteristics of a PM-system for use in the construction area.

One of the most frequent recommendations was in relation to output features, e.g. the ability to modify the output and gear it to the construction process. Another important suggestion involves the ability to modify the programs themselves. And as simple and personal an individual need as can be found: one of the contractors basic requirements was a fourty character activity description

field. A final conclusion was: It seems there is a large disparity between contractors needs and software provisions concerning this application.

Mrs. Sinclair stated in her contribution "Communicating to management with project management graphics" that the critical issues in using graphics are:

- clarity: graphics should not force questions to be raised
- flexibility: the project manager is the project expert and should decide what information should be drawn highlighted
- presentation oriented: the drawings produced should visually equal the output of a professional graphics art studio
- application specific: graphics must relate to the issue being discussed.

Overview of opinions from contributors

To get an overview we structured the opinions into the following seven areas:

- 1- General remarks, plus remarks on Training, Tools, Integration and User-friendliness
- 2- Time management
- 3- Resource management
- 4- Cost management
- 5- Data management/organization
- 6- Information management and graphics
- 7- Hardware and communication.

1- General issues

- do not overcomputerize (Hayfield)
- able to add in new applications (Sorrill)
- modular computer applications (Kwan & Takahashi)
- interviews with end-users to establish aggregation criteria (Collins)
- expect very widespread usage of sophisticated PM-packages (Baker)
- standard P.M. utility functions (Figel)

Training

- pinpoint need for human intervention/analysis (Avots)
- respondents are concerned about training (Baker)

- "cook-book" guides (Baker)

Tools

- procedural logic (Avots)
- (Hayfield) . simple tools
 - . proven tools
 - . tools with better project visibility
 - . tools that take care of routine work
- screen formatting (Sorrill)
- modify output/report generation (Sorrill/Figel/Arditi & Rackas)
- 4th-generation languages (Figel)

Integration

- integration of PM-information (Kwan & Takahashi)
- single integrated system with features of 4th-generation languages (Figel)
- new techniques for integrating project cost, schedule and technical performance (Baker)

User friendliness

- interfacing between system and user (Avots)
- easier use, not greater sophistication (Barnes)
- easier use (Sorrill)
- userfriendly, well mixed with in-house systems (Kwan & Takahashi)
- performance visibility should highlight exceptions and critical items (Hayfield)
- flexibility; manager decides what is highlighted (Sinclair)

2- Time management

- monitor deviations from planned schedule progress (Avots)
- variance analysis on schedule (Davison)
- features for time analysis (Davison):
 - . network activity listing
 - . edit and validation report
 - . network analysis
 - . schedule recognizing a specified calendar, target dates and contractual constraints

- . base line report
- . base line barchart
- . variance between actual and plan
- signal potential schedule slippages (Avots)

3- Resource management

- improve resource utilization (Avots)
- show where to allocate special resources and reserves (Avots)
- features for resources (Davison):
 - . identification of resource
 - . allocation by delaying if not enough available
 - . allocation by exceeding availability
 - . resource usage baseline histogram

4- Cost management

- better cost performance (Kwan & Takahashi)
- features for cost (Davison):
 - . cost by element
 - . budget to actual
- cost-reporting (Davison):
 - . budgetted cost of work scheduled
 - . budgetted cost of work performed
 - . actual cost of work performed

5- Data management/organization

- knowledge base (Avots)
- (relational) Data Base (Figel)
- interactive query language (Figel)
- flexible and portable data capture (Sorrill)
- transfer of data from site to site (Sorrill)
- easy data-entry facilities (Figel)
- flexible data analysis (Sorrill)

6- Information management

- the lifeblood of a project is information (Hayfield)

* see tools: report-writer

- handling of information is often relegated to people with little appreciation of its importance (Hayfield)
- astute office mechanization can bring the information handling process to a controllable level (Hayfield)
- management by exception, selective information (Kwan & Takahashi)
- careful analysis and application of information flow steps (Scholz)
- careful analysis of the requirements of the project in question (Scholz)

* see Data Management: interactive query language (Figel)

* see Data Management: flexible data analysis (Sorrill)

Graphics

- integrated graphics (Figel)
- expect graphics to be important (Baker)
- currently preoccupation with graphics may fade (Barnes)
- graphics should not face questions to be raised (Sinclair)
- drawings produced should be of high quality (Sinclair)
- graphics must relate to the issue being discussed (Sinclair)

7- Hardware and communication

- software portability (Kwan & Takahashi)/independent of hardware (Sorrill)
- ability to interlink with different hardware (Sorrill)
- multi-user remote location links (Sorrill)
- telephony and data transmission workstations (Sorrill)
- voice messaging (Sorrill)
- hardware flexibility (Kwan & Takahashi)

There are a lot more interesting papers presented on the subject of automated Project Management, like that of Broomfield [5], Burr [6], Hagenkötter [11], Kellis [15], Nichols and Uyttenhove [18], Pannenbäcker [19] and Peters [20].

But for all papers we can draw the following conclusions.

Conclusions on contributions

All contributors point out important and relevant matters, but:

- in different formats
- on different types of projects
- from different backgrounds
- in different organizations
- in different, general and mostly ill-defined terms
- on different levels of detail
- for different levels of users
- and often contradictory.

It's a necessity to structure the heaps of information that are coming at us, in order to build a framework for better and more effective research.

Projects and information

As said afore: the information flow in projects is rather complex. With respect to this subject Mr. Scholz stated in his article "The proper role of automation in PM" that an improved level of success can be achieved by applying some of the principles of the discipline of information science to the decisions concerning the use of computers in PM. Furthermore he stated that

- three decades of information system design have shown that careful analysis and application of the information flow steps in the earliest stages of the creation of a PM system will repay the investment of time and effort,
- and moreover,
- in fact the only reasonable approach to the problem is a careful analysis of the requirements of the Project in question.

In my opinion this is of utmost relevance.

My question to suppliers as well as to end-users is: Did you ever make a thorough Information Flow Analysis of your project(s)?

And, in addition, to suppliers: If you did, on what type of project did you make such an information flow analysis?

This is, in my opinion, the most important factor why standard PM-systems fail.

Overview of findings

Let me give you now an overview of our findings:

- . We worked with several PM-packages and they all have more or less shortcomings.
- . We have been in a lot of organizations where PM-packages are used and they all have problems and/or unfulfilled wishes.
- . We have gone through a lot of papers where users are trying to tell us, both suppliers and end-users, what PM-packages should do.
- . There have been made surveys with questions on needs.
- . Many organizations spend a lot of time and money in evaluating packages for their specific environment.
- . Many researchers are trying to contribute in evaluating and developing methods.
- . There is no agreement on standard terminology.
- . Suppliers spend a lot of money in the on-going process of improving their PM-systems and to develop new-ones.
- . There is a lot of subsidized research going on, as for instance in Holland the innovating research program on informatics in construction, where PM is an integral part of such a system. The European Committee subsidizes, as part of the ESPRIT research program, the development of an expert system called PIMS, which stands for Project Integrated Management System. This system will be developed for the management of the design and implementation of large computer systems and software.
- . If we look at different recently developed packages we can see that one never can shed his own past. Modern systems operate with a database system. But all suppliers invented their own database system and their own query language. Why don't they use a general database package? Suppliers use the same terminology as in the "old" packages. Much work is done on nomenclature. But there is still an enormous difference in terms and definitions.

So there is a lot going on and a lot more to do. But did we make real progress during the last 20 years?

A glance at the past and the present

Let me give, as an example, some remarks laid down in an article from Mr. Roland W. Gutsch [11] in the proceedings of the 2-nd Internet congress, held in Amsterdam, October 1969. Mr. Gutsch told his audience: "There was a real need for developing the existing systems further and for creating new ones. These new developments were made independent of each other at individual companies and scientific institutes. The result was a multitude of systems adjusted to the respective needs. An escalation of terms, abbreviations and definitions accompanied this development. What first looked like scientific progress - which in fact, it was partially - led to a language confusion which proved to be more and more disadvantageous. Today we are faced with the necessity of finding again a uniform language." Mr. Gutsch's opinion from 1969 is still true in 1986. But basically it has even more impact now, because the use of PM-packages has much increased. And besides, in 1969 the PM-systems were used by a happy few, highly educated and skilled people. Nowadays, with the very widespread use of PM-systems, it has come to be used by the unskilled, with little or no knowledge of PM techniques and/or computers. That's one of the reasons that there is such a tremendous demand for training.

Final conclusions and recommendations

In my review on contributors we have seen that individual researchers need a framework for better and more effective research. One of the most important matters is the message, mentioned by Mr. Gutsch in 1969 and repeated again in this article: uniform language. We have to develop standard terminology to get rid of the confusion of tongues, between end-users, suppliers and researchers. Some contributors, like for instance Fuentes [10], Harhalakis [13] and myself [16] tried to define and/or give examples to show some of the problems that can arise if terms are ill-defined. The lack of a uniform and well-defined language is one of the origins of the practicality gap between PM-systems and the real needs in the field.

Another important matter is the information flow in projects. As the information flow in projects is highly complex, this will not be easy. But if the principles of information science will be applied, making

use of the above mentioned uniform language, it must be possible to define a set of requirements for the use of computers in P.M. The high investment organizations pay in searching for the "best" PM-system for their environment, will be repaid through such an analysis . And if suppliers develop their PM-systems making use of flexible tools like fourth-generation languages and data bases they can tailor their systems to specific areas of use.

But, as stated before, we can only bridge the practicality gap between PM-systems and the real needs in the fields if this becomes a common interest of the three parties end-users, suppliers and researchers. The Internet board could fulfill an important role in structuring the efforts by creating a data base with information about research and developments that are going on. This information can be gathered by way of a questionnaire to the national societies, who have to take care of the information retrieval.

With R&D we mean

- research projects on a national basis, like the afore-said innovating research program on informatics in construction in the Netherlands
- international R&D projects like the afore-said ESPRIT project PIMS
- research at scientific institutes
- research in organizations
- research at research centres of suppliers

This information could bring researchers together with common interest, even give rise to joint research programs. There is, as you have seen in my overview of findings still so much to do in order to achieve, in terms of the motto of the 8-th World Congress on P.M., real clarity for the nineties. Structuring and coordination of the massive amount of individual efforts will be of great help. I should like to call it a "PM-AID program" for better management tools.

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