Project Families and the Unified Project Evaluation Model

Stanisław Gasik[1]
(Consultant, Sybena Consulting, Warsaw, Poland)

Abstract

Every project-performing organization needs a consistent approach to project evaluation. Such an approach should reflect genealogical dependencies between projects. The costs of the investment projects that enabled the execution of a given project, as well as income expected from operational projects as a consequence of their execution, must be components of a consistent project evaluation model. In order to handle such dependencies, two concepts are introduced: the *ancestor / descendant* project relationship and a set of projects defined by this relationship called *project family*. On the basis of these concepts, components of financial evaluation of a project – costs, income and savings – are divided into inherited, direct and expected. A model covering all these components of project evaluation, named *Unified Project Evaluation Model*, is presented. The concept of project families may be utilized for purposes other than those of financial analysis, like tracing the diffusion of innovation in an organization.

Keywords
Project family, project genealogy, project evaluation

1. Introduction

During my work for project-oriented companies I have encountered problems when evaluating the business effect of some projects that are carried out there. The first type of problems was caused by the distinction that is made between development and implementation projects. Projects of the former type developed products which later on were implemented at customer enterprises through other projects. We had to define a way of evaluating projects and their managers which would take into account income from implementation projects in development projects and, conversely, the costs of development projects in operational implementation projects. The other problem was related to the evaluation of operational projects which also functioned as investment projects. This was the case when the goal of a first, small project performed for a given customer was not only to gain revenue, but to promote the performing company at this customer organization. We also have a similar situation when a operational project develops a by-product which will be sold to other customers later on. These situations showed the need for an unified approach to project effect evaluation, which would take into account not only the direct cost of and income from given projects, but also the cost of projects which enabled the execution of a given project, as well as expected future income to be gained as a result of a project.

Looking at the same problem from the methodological point of view, projects may be related to one another in many ways. The best known types of relationships have to do with the operational goal – sets of projects related this way are called *programs*. Sets of projects related through the organization's strategic business goals are called *portfolios*. But there exist other types of relationships between projects, too. One important type of dependency between projects is that of enabling the achievement of the goals of one project through another or that of improving the performance of one project through another project. This paper introduces concepts needed to describe and analyze this type of dependencies between projects by way of their exemplary application to the practical problem stated above.

2. Project Families

Organizations perform **operational** and **investment** projects. Operational projects are those projects that are executed in order to directly meet organization's business goals (not necessarily strictly commercial). And there are investment projects, which according to Bonham (2005) may be divided into two groups:

- Projects changing business directions – they extend the range of products or services provided by an organization to its clients (**scope-extending** projects, or even more simply, **extension** projects)
- Projects improving the efficiency of an organization's business (**efficiency improvement** projects, or more simply: **improvement** projects).

[1] Stanisław Gasik, ul. Południowa 30/19/4; 04-789 Warsaw, Poland; sgasik@sybena.pl

Projects use the results of each other's work. They are mutually related in the **parent / child relationship**. Two projects are related in this way when outputs of the former are used by or influence execution of the latter. The investment projects are **parents** of operational projects, as investment projects enable the execution of new types of operational projects or improve the efficiency of operational projects. The business effect of a operational project is not only its directly incurred costs and gained income, but also – in the right proportion – costs incurred by its parent investment projects. We will denote the relationship of parenthood between projects with the → symbol. The text **p → r** means that the project **p** is a parent of project **r**. Within this relationship project **p** will be called an **ancestor (parent)** of project **r** and project **r** is a **descendant (child)** of project **p**.

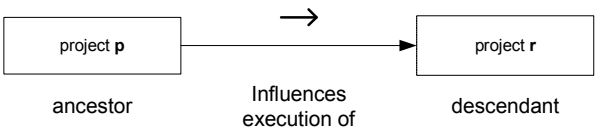

Figure 1. Ancestor / descendant relationship among projects

Example 1

Project **p** develops IT system **S**. Projects **q**, **r**, **s** implement system **S** at customer organizations. So the following relationships hold: **p → q**, **p → r**, **p → s**.

Project **a** implements a project management system **Z**. Project **b** implements accounting system **F**. For every project **c** performed after these implementations the following relationships hold: **a → c** and **b → c.**

The set of all projects linked by the parent / child relationship is called a **project family**. The project families may be seen from two vantage points: that of investment and the operational one. The project family defined from the operational side consists of one or more operational projects and all ancestors – this will be called an **operational family**. Consider a project **k** intended to integrate and implement a set of internally produced applications at a particular customer organization. This project, together with all projects which developed the applications being integrated and implemented, constitutes an example of an operational family. Projects may be seen from the investment perspective, too. An investment project that introduces a new technology and all the projects that apply this technology is a well-defined project family. This type of project family will be called an **investment family**.

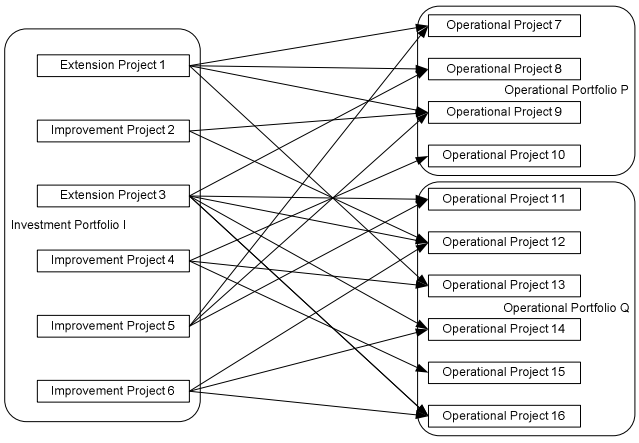

Figure 2. Examples of ancestor / descendant relationships

Figure 2 shows examples of project relationships that define project families. Projects from the investment portfolio designated with numbers 1 and 3 belong to the category of scope-extending projects. The rest of the investment projects belong to the category of projects improving an organization's efficiency. Projects numbered 7 to 16 are of the operational type.

Figure 3 shows the investment family of project 3. The set of descendants of project **p** will be denoted by D (p):

$$D(p) = U\ \{x: p \rightarrow x\} \quad (1)$$

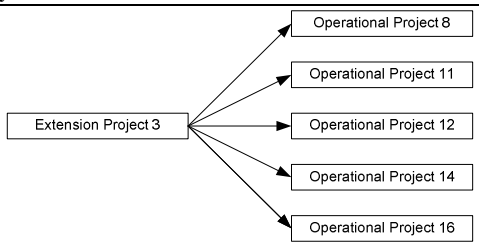

Figure 3. Project investment family

The investment family of project **p** will be denoted by IF (p):

$$IF(p) = \{p\} + D(p) \quad (2)$$

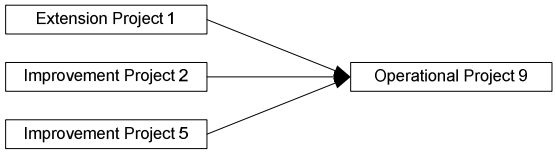

Figure 4. Project operational family

Figure 4 shows an example of operational project family. This family includes project 9 and all its ancestors. They are the scope-extending project 1, which enabled execution of project 9 and efficiency improvement projects 2 and 5. This example depicts, with some simplification, a situation that is typical in project-based organizations. The capability of performing a project has been developed by a scope-extending project (1) and after that this capability has been improved by other efficiency improvement projects (2, 5).

The set of ancestors of project **p** will be denoted by A (p):

$$A(p) = U\{x: x \rightarrow p\} \quad (3)$$

The operational family of project **p** will be denoted by OF (p):

$$OF(p) = \{p\} + A(p) \quad (4)$$

Example 2

D (3) = {8, 11, 12, 14, 16}
IF (3) = {3, 8, 11, 12, 14, 16}
IF (1) = {1, 7, 8, 9, 13}
A (9) = {1, 2, 5}
OF (9) = {9, 1, 2, 5}

Note that the concept of project family is substantially different from those of program or portfolio. An investment family may contain projects belonging to more than one portfolio – the results of a project implementing software development technology may be used by projects from several business sectors, associated with different operational portfolios. Different operational portfolios may have intersecting sets of ancestors – their investment families intersect.

3. The Unified Project Evaluation Model

The concept of project family plays an essential role in the evaluation of project business effects. When assessing the business effect of an investment project one must analyze the effects of all projects from its investment family. From the other vantage point, when one analyzes the financial effect of a operational project one must take into account its costs and income as well as an appropriate portion of the costs of all its ancestors. Projects not only use "direct" resources such as labor or materials, but profit from using output developed by other projects. Such output may be used by many projects executed later.

3.1 Classification of project costs and incomes

There are three types of costs in projects:

- **Scope extension cost**
  Cost incurred with the aim of developing a new product or service by the performing organization.

- **Efficiency improvement cost**
  Cost incurred with the aim of improving the way of delivering earlier developed products or services.
- **Operational costs**
  Costs for effects that will be used only in the project in which they were incurred.

Any project may have each of these types of costs. Especially when a project is basically of a operational nature, it may develop some products that will be further utilized by its descendant projects. An operational project may also prepare some improvements for other projects. In order to properly evaluate a project's business effect, the scope extension cost and the efficiency improvement cost should be divided into two categories:

- **Direct cost**
  Costs incurred in a particular project.
- **Inherited costs**
  A share of ancestors' costs. If a project uses output from its ancestors, it must be charged with the appropriate portion of the costs of developing this output.

The operational costs, because of their very nature, are never transferred to other projects, so they invariably belong to the category of direct costs. The sum of all direct and inherited costs makes the full project cost. Every project may have the following cost components:

- Direct scope extension cost: DEC (p)
- Direct efficiency improvement cost: DIC (p)
- Direct operational costs: DOC (p)
- Full direct cost: DC (p) = DEC (p) + DIC (p) + DOC (p)
- Inherited scope extension cost: IEC (p)
- Inherited efficiency improvement cost: IIC (p)
- Full inherited cost: IC (p) = IEC (p) + IIC (p)
- Full cost: C (p)

For these cost components the following formulas hold:

$$C(p) = DC(p) + IC(p) = DEC(p) + DIC(p) + DOC(p) + IEC(p) + IIC(p) \quad (5)$$

Projects have income and develop methods of cost reduction (achieving savings). These values too should be precisely defined, as they constitute a part of a project's full evaluation. Income and savings, like project costs, may be divided into two categories: direct (effected in a given project) and expected (effected in children of the project in which they were developed). To denote these concepts for project p, the following naming conventions will be used:

- Direct project income: DI (p)
- Expected project income: EI (p)
- Full project income: I (p) = DI (p) + EI (p)
- Direct project savings: DS (p)
- Expected project savings: ES (p)
- Full project savings: S (p) = DS (p) + ES (p)

In order to fully evaluate project's financial effect, one must take into account all its income, savings and costs,, direct, inherited and expected. Generally the financial effect evaluation of project p, is equal to:

$$E(p) = I(p) + S(p) - C(p) = DI(p) + EI(p) + DS(p) + ES(p) - DEC(p) - DIC(p) - DOC(p) - IEC(p) - IIC(p) \quad (6)$$

3.2 Calculating components of UPEM

In order to perform an accurate project evaluation, one has to define the way in which all non-direct elements of its evaluation are calculated. If project p is of the scope extension type, then its execution should bring in income in all its descendant projects, thus:

$$EI(p) = \Sigma (x \in D(p) \mid VIN(p, x)) \quad (7)$$

where VIN (p, x) stands for value of income expected in project **x** due to scope extension performed by project p (VIN is an input parameter of the model). This formula may be rewritten using the coefficient CIN (p, x) having values in the <0, 1> interval, describing the share of project p in the income of its descendant x**,** and the value of DI:

$$EI(p) = \Sigma (x \in D(p) \mid CIN(p, x) * DI(x)) \quad (8)$$

Dependencies analogous to income dependencies hold for investment family savings, which are attributable to

efficiency improvement projects:

$$ES(p) = \Sigma (x \in D(p) \mid VSI(p, x)) \quad (9)$$

And finally:

$$ES(p) = \Sigma (x \in D(p) \mid CSI(p, x) * DS(x)) \quad (10)$$

Where VSI (p, x) and CSI (p, x) stand respectively for value and coefficient of savings expected in project x due to efficiency improvement works performed in project p.

In order to calculate the value described by Formula 6, one has to calculate the IEC (p) and IIC (p) values too. Let VES (r, p) denote the monetary value of project p's share in the scope extension cost of ancestor r. The share of parents' costs DEC (r) should be proportionate to the income share gained by selling products developed by parents' projects (CIN). This is described by the following formula:

$$VES(r, p) = CIN(r, p) * DEC(r) \quad (11)$$

And all the scope extension cost inherited by a descendant is calculated according to the following formula:

$$IEC(p) = \Sigma (x \in A(p) \mid CIN(x, p) * DEC(x)) \quad (12)$$

It means that the costs of all the parent projects, when extending scope with the products sold by children, must be taken into account proportionally. For the inherited efficiency improvement costs (i.e. costs that reduce other costs of product development; VIC), analogous dependencies such as for inherited scope extension cost, hold, but the proportionality coefficient of savings CSI is used:

$$VIC(r, p) = CSI(r, p) * DIC(r) \quad (13)$$

And all of the efficiency improvement costs inherited by a descendant are calculated according to the following formula:

$$IIC(p) = \Sigma (x \in A(p) \mid CSI(x, p) * DIC(x)) \quad (14)$$

When we substitute the values defined by formulas 8, 10, 12, and 14 into formula 6 we finally get:

$$E(p) = DI(p) + \Sigma (x \in D(p) \mid CIN(p, x) * DI(x)) + DS(p) + \Sigma (x \in D(p) \mid CSI(p, x) * DS(x)) - DEC(p) - DIC(p) - DOC(p) - \Sigma (x \in A(p) \mid DEC(x) * CIN(x, p)) - \Sigma (x \in A(p) \mid CSI(x, p) * DIC(x)) \quad (15)$$

Example 3

In order to demonstrate use of the project family concept for evaluation of project financial effect, we will use the structure of projects shown in Figure 5.

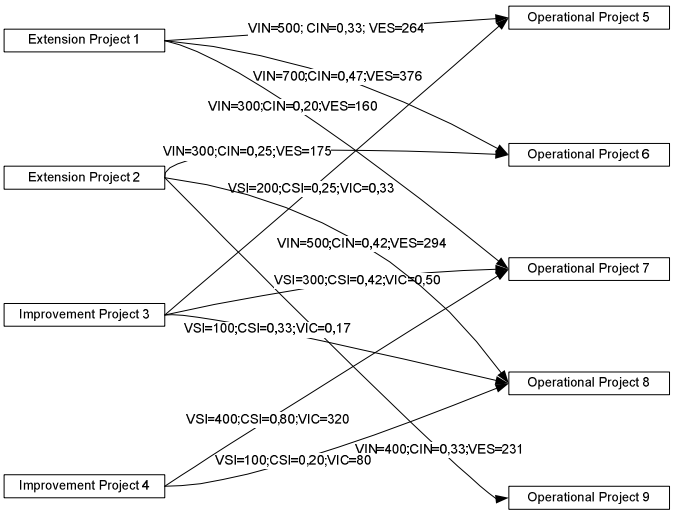

Figure 5. Exemplary project relationships

The final, full projects evaluation is shown in table 2 presented below. This example of analyzing the financial effect of projects illustrates the use of concepts related to the ancestor/descendant characteristic and the concept of project families built through direct application of this relationships.

	EI	ES	DEC	DIC	DOC	DI	DS	DC	IEC	IIC	IC	C	I	S	E
p1	1500		800					800				800	1500		**700**
p2	1200		700					700				700	1200		**500**
p3		600		300				300				300		600	**300**
p4		500		400				400				400		500	**100**
p5					200	500	200	200	264	100	364	564	500	200	**136**
p6					300	1000		300	551		551	851	1000		**149**
p7					400	300	700	400	160	470	630	1030	300	700	**-30**
p8					200	500	100	200	194	130	324	524	500	100	**76**
p9					100	400	100	100	231		231	331	400	100	**169**

Table 2. Example of full project evaluation

4. Extensions of the project family and UPEM concepts

Many organizations achieve their business goals by performing continuous processes. Health service units or post offices are good examples of such organizations. Some organizations more and more often gain business effect by performing projects as well as by performing continuous processes. Where operational business processes instead of operational projects are conducted, the effect of investment projects may be observed in processes as well as in projects. The name "business entity" stands for business process or operational project – both types of these entities earn income, or more generally, perform organization's business. So for the purposes of the Unified Project Evaluation Model, the investment family concept should be extended to include all business entities influenced by the investment projects. If the main goal of project u is to improve client servicing process k, e.g. by implementing information system **S**, then the relationship u → k holds. The next, further extension of UPEM will generalize the concept of investment project to the concept of "organizational entity". Organizational entity is a process or project which output is used for internal organization's goals; it does not generate any deliverables for organization's customers. There are two types of organizational entities: investment projects and supporting processes (e.g. training or accounting). Supporting processes must be components of the final evaluation model for several reasons – one of them is that they are implemented by investment projects, so full model of project evaluation would be incomplete without them. The most general model of organization's performance is shown in figure 6. The Unified Project Evaluation Model describes a part, marked by shadowed boxes and bold lines, of this model. The final extension of the UPEM will cover all below presented organizational and business entities and all their interrelationships.

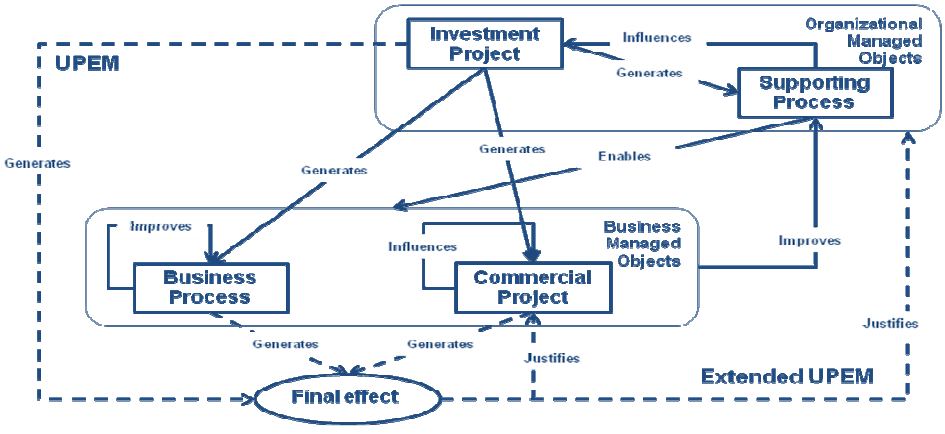

Figure 6. The full model of projects & processes interrelationships in an organization

Acknowledgment

I wish to thank Dr. Russell Archibald for his comments on earlier version of this paper and encouragement which made me submit this paper to the Rome IPMA World Congress.

5. Reference

Bonham, S. B. (2005), *IT Project Portfolio Management*, Boston, Artech House