

# PROJECT PORTFOLIO PLANNING (P<sup>3</sup>) METHODOLOGY

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## ABSTRACT

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Alignment of information technology (IT) with the business is a major priority for many organizations. Selecting an appropriate portfolio of projects is an important part of effective IT alignment. The Project Portfolio Planning (P<sup>3</sup>) Methodology provides an organized and comprehensive process for developing project portfolios that support the business. The methodology is most appropriate for organizations that continually generate myriads of projects and project ideas that compete for a limited number of available resources. Issues addressed by the methodology include harvesting new project ideas, documenting the business case, evaluating projects on a consistent basis, prioritizing projects, selecting the best portfolio, and planning required resources.

The P<sup>3</sup> Methodology employs the following techniques:

- Program planning to develop a stream of projects that align with business objectives and move the organization to where it wants to be
- A defined project idea harvesting process to capture and capitalize on ad hoc project ideas
- Customized project scoring and ranking methods as well as a predefined scoring and ranking method: the BAR Score
- Risk-adjusted estimation using Monte Carlo techniques to provide cost justification
- Binary integer optimization to select portfolios that maximize total portfolio utility subject to budget and other constraints
- Time-phased resource planning to proactively identify and rectify resource imbalances that might jeopardize the portfolio

**Note:** Due to volume considerations, only Appendix A is included in this paper. For information regarding remaining appendices, please contact the author.

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## 1 INTRODUCTION

A portfolio is a group of similar items that together constitute a greater whole, and that are managed as a whole to achieve some objective. Although the individual items are all integral to the portfolio, the characteristics and performance of individual items are typically less important than the contribution they make to the characteristics and performance of the portfolio as a whole. This does not mean that individual items in the portfolio are unimportant or that their performance is unimportant; rather, the implication is that membership in the portfolio must be determined by criteria that are beyond those used to measure or judge individual items in isolation. Otherwise, the portfolio would comprise many items that individually may seem very attractive, but which, taken together, sub-optimize the portfolio.

For example, many people have or are familiar with investment portfolios. These are groups of individual investments that are managed as a whole to achieve an overall investment objective. Such objectives might include some combination of financial return (e.g. current income, capital growth, etc.) and risk. Individual investments are selected for inclusion in the portfolio based not just on the characteristics of that specific investment but also on the contribution the investment will make to the goals of the portfolio as a whole. So, for example, although investment A may typically provide greater return than investment B, the portfolio manager may select investment B because it provides greater diversification (and hence lower risk) for the overall portfolio. Also, while the portfolio manager must carefully monitor performance of each investment in the portfolio and make adjustments, as necessary, to ensure that overall portfolio goals are being met, the portfolio owner may typically be concerned only with the performance of the portfolio as a whole, and may care little, if at all, about performance of individual investments.

A similar situation exists for project portfolios. Many businesses and other organizations have large portfolios of information systems projects. Sometimes these are true portfolios, planned and managed as a whole to achieve organizational objectives. In these cases, projects may be selected for portfolio membership based on considerations beyond individual project performance. So, for example, an infrastructure project may stack up poorly against other potential projects when measured on financial return. The infrastructure project may nevertheless be selected for portfolio membership because it supports or enables another project that will provide important business benefit. Also, as in the financial portfolio example, although every project in the portfolio is planned, managed, and expected to be successful (and, in fact, project and technical managers will be evaluated on the success of each project), business managers may have only perfunctory interest in individual projects so long as the needed business results are being produced and supported by the combined portfolio.

In many organizations, however, project portfolios are pseudo-portfolios—a group of projects consisting of whatever happens to be in-process and in-queue at the time and managed on a project-by-project basis instead of as a group. The difference between true and pseudo project portfolios is often closely correlated to organizations that view information systems as a valuable enabler of the business as opposed to organizations that view information systems as an expensive

boondoggle that is not responsive and never seems to be doing what the organization needs.

There are several common challenges in project portfolio management. These include:

- Harvesting project ideas,
- Developing believable business cases,
- Consistently and appropriately evaluating individual projects,
- Determining the best portfolio for the organization, and
- Feasibly scheduling the portfolio and required resources.

These challenges will be explored briefly below:

### **Harvesting Project Ideas**

Project ideas are the fuel of an information systems organization. They are what give it life and keep it going. There are two major types of project ideas that typically arise and need to be captured: pre-planned project ideas, and ad hoc project ideas. Pre-planned projects are planned in advance as a group to meet specific objectives. These projects may be part of a larger program designed to transform the organization over time. Ad hoc projects are not known in advance. Ideas for these projects may occur at any time, from any source, and for any reason. Both types of project ideas must be accounted for and considered together in a common pool for portfolio membership.

Harvesting new project ideas is an important task that is often poorly managed. Common problems include not enough good ideas being generated or too many ideas being generated. The first case is often the result of people not knowing that they can submit ideas, an undefined submission process (no one knows how to submit an idea), or a submission process that is so onerous that it discourages anyone from bothering. The result is an organization that is probably not progressing and is undoubtedly suffering enormous opportunity costs. The second case may also be the result of an undefined submission process (ideas come from all directions in all forms using all modes) or of one that is not sufficiently discriminatory to separate valid, well-defined ideas from ideas that, though well-intentioned, may be uninformed, contradictory, or ill-conceived. The result, in this case, is an organization choked and confused by the volume of requests and unable to steer a proper course.

The ability to obtain a continual but manageable stream of valid, well-defined ideas and turn these into project proposals is critical to good portfolio management. The P<sup>3</sup> Methodology addresses these issues by incorporating program planning concepts and by providing standard templates and procedures for capturing project ideas.

### **Developing Believable Business Cases**

The business case is a justification for why a particular project or initiative should be undertaken. Good business cases, however, tend to be a rarity. If developed at all, they are commonly perfunctory. Supposed benefits are typically overblown, and costs are often undervalued. Additionally, many business cases consider only hard financial benefits and ignore “soft benefits” that are no less real and can sometimes be of overriding importance. The result is a common phenomenon experienced by many organizations: an inordinate number of projects that fall short of the promise advanced by their business case.

Another issue is that risk is seldom adequately or properly accounted for in the business case. In this context, *risk* is the probability that the conclusions advanced by the business case are incorrect. The potential risk may manifest itself either as false positive error (i.e. the project is approved when it should not have been) or false negative error (i.e. the project is rejected when it should not have been). These types of errors can be minimized by evaluating the potential variability of projected costs and benefits as well as the resulting business case risk. To address these issues, the P<sup>3</sup> Methodology includes methods for effective business case risk analysis using Monte Carlo simulation.

### **Consistently and Appropriately Evaluating Individual Projects**

Projects that have been proposed and defined must then be evaluated for *eligibility* to be included in the project portfolio. This selection process is often fraught with pitfalls, and many organizations do not have an effective, consistent, and equitable method for performing the selection. Sometimes, because there are no defined criteria for making selection decisions, virtually anything proposed gets approved. In other cases, lack of a formal selection method allows politics or spurious reasons to dictate the decision. Even when formal selection criteria exist, they may not be the proper criteria to accomplish the overall objectives of the organization. Or, the criteria may be inconsistently applied, resulting in biased decisions.

The problem of establishing criteria for rating projects has two components: First, an appropriate set of criteria must be developed that reflect the true priorities of the organization. Second, a method must exist for consistently scoring projects against these criteria so that projects can be fairly compared. The P<sup>3</sup> Methodology addresses this area first by describing how to develop a customized scoring method, and second by including an optional, pre-developed scoring model—the BAR Score—that has been developed specifically for this methodology to evaluate projects against the dimensions of Benefit, Alignment, and Risk.

### **Determining the Best Portfolio for the Organization**

Just because projects may be favorably evaluated does not mean that they will necessarily be selected as part of the final portfolio. Some projects may be contradictory. Some may encompass alternate ways to accomplish the same thing. In addition, there are usually constraints that limit, bound, or shape the projects that can be selected. For example, a budget constraint may require the projects selected to fit within pre-approved funding limits. Projects may also be limited by availability of key resources, by the amount of change that can be assimilated at a time, or by many other factors.

Even with such constraints, unless there are only a handful of projects being considered, there may be many potential combinations of projects that could be selected for the portfolio. There must therefore be some way to determine what subset of projects satisfies all restrictions and results in the best portfolio. The P<sup>3</sup> Methodology employs Integer Programming as a method of selecting a portfolio that satisfies all constraints and provides the most utility to the organization.

### **Feasibly Scheduling the Portfolio and Required Resources**

*Feasibility* refers to the ability to successfully implement the portfolio given available resources. Merely selecting projects is not sufficient to ensure that the resulting portfolio is feasible, and even a portfolio comprised of the optimum group of projects is useless if it cannot be implemented. Typical resources required to implement a portfolio include people (skills), dollars, facilities, hardware, and time. All must be available in sufficient quantity *when needed*. Understanding when resources are needed is dependent upon how projects in the portfolio are scheduled. Many organizations do not bother to master schedule projects in the portfolio, and do not bother to plan resources (supply) in conformance with the portfolio requirements (demand). The result is often an unpleasant surprise that is discovered too late.

By way of illustration, a major organization that was typically bogged down with hundreds of projects each year decided to plan a portfolio consisting of twelve major corporate initiatives for the following year. All company efforts were oriented towards these twelve projects. Corporate communication programs kept status of the initiatives in constant view. Incentive programs were changed so that all bonuses were dependent upon achievement of the twelve initiatives. In spite of all this attention, by the end of the year, only a handful of the initiatives had been completed. Why?—because all of the initiatives were started at about the same time, all were time-boxed as yearlong efforts, and all involved substantial custom development. Consequently, all of the efforts entered the testing phase of the development life cycle at about the same time. And, not surprisingly, as in many organizations, there happened to be an acute shortage of experienced Testers. As a result, the projects came to a screeching halt, bonuses were lost, the Information Systems Department suffered extreme embarrassment and loss of credibility, and the business incurred lost opportunity costs. All because of a simple bottleneck that could have been spotted in advance and avoided if feasible portfolio planning had been practiced.

The P<sup>3</sup> Methodology addresses these types of issues through the use of time-phased scheduling techniques to plan required resources and develop a feasible master portfolio schedule.

## 2 P<sup>3</sup> METHODOLOGY OVERVIEW

The Project Portfolio Planning Methodology is organized into successive levels of detail beginning at the highest level with phases. Phases group large areas of work that are similar in nature and that occur in similar timeframes. Phases are broken into one or more major activities, activities are broken into one or more tasks, and tasks are broken into one or more steps. Steps are the lowest level of organization and provide the most detail for how to actually perform work. Not all tasks will have supporting steps.

The following table illustrates the three phases, five activities, and sixteen tasks of the P<sup>3</sup> Methodology:

PROJECT PORTFOLIO PLANNING (P <sup>3</sup> ) METHODOLOGY			
Phase	Activity	Task	Description
A Setup	A.1	<i>Develop a Portfolio Planning Infrastructure:</i>	
		A.1.1	Establish a Portfolio Management Board
		A.1.2	Develop a Project Utility Ranking Method
		A.1.3	Create Process Assets
B Harvesting	B.1	<i>Harvest Project Ideas:</i>	
		B.1.1	Identify Ad Hoc Projects
		B.1.2	Identify Pre-Planned Projects
		B.1.3	Perform Preliminary Screening
	B.1.4	Develop Detailed Project Proposals	
	B.2	<i>Determine Project Utility:</i>	
B.2.1		Risk-Adjust Project Financial Performance	
	B.2.2	Compute Utility Score	
C Planning	C.1	<i>Select the Portfolio:</i>	
		C.1.1	Create Portfolio Short List
		C.1.2	Optimize the Portfolio
		C.1.3	Review and Approve the Portfolio
	C.2	<i>Plan the Portfolio:</i>	
		C.2.1	Develop the Portfolio Master Schedule
		C.2.2	Determine Resource Demand
		C.2.3	Determine Resource Supply
	C.2.4	Reconcile Resource Supply and Demand	

Table 1: Organization of the P<sup>3</sup> Methodology

The diagram below illustrates the general flow of events.

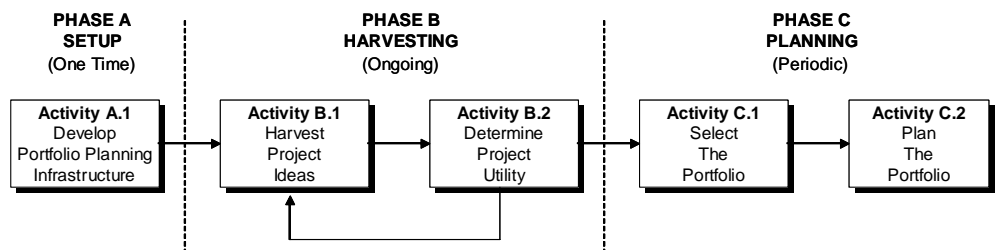


Figure 1: Flow of the P<sup>3</sup> Methodology

The methodology is described in detail in the remaining sections.

**PHASE A: SETUP**

The first phase of the P<sup>3</sup> Methodology addresses initial setup for project portfolio planning. This includes standup of the organization necessary to support portfolio planning, development of the specific method to be used for portfolio selection, and creation of the process assets that will be used to support the methodology. In general, this phase is performed once, though it may be revisited over time to make adjustments.

**ACTIVITY A.1: DEVELOP PORTFOLIO PLANNING INFRASTRUCTURE**

The first and only activity of the Setup Phase is devoted to establishing the infrastructure for portfolio management. This has both an organizational and a procedural component. While the appropriate organization will vary for each company, the fundamental element should be a central portfolio planning group with representation from each major corporate entity. This allows decisions to be made from a company-wide perspective with the knowledge and involvement of all major constituents. From a procedural standpoint, development of a standardized project ranking system helps to compare projects on an equal footing and provide an objective measure of the project's value to the company. The diagram below illustrates the procedural flow for this activity:

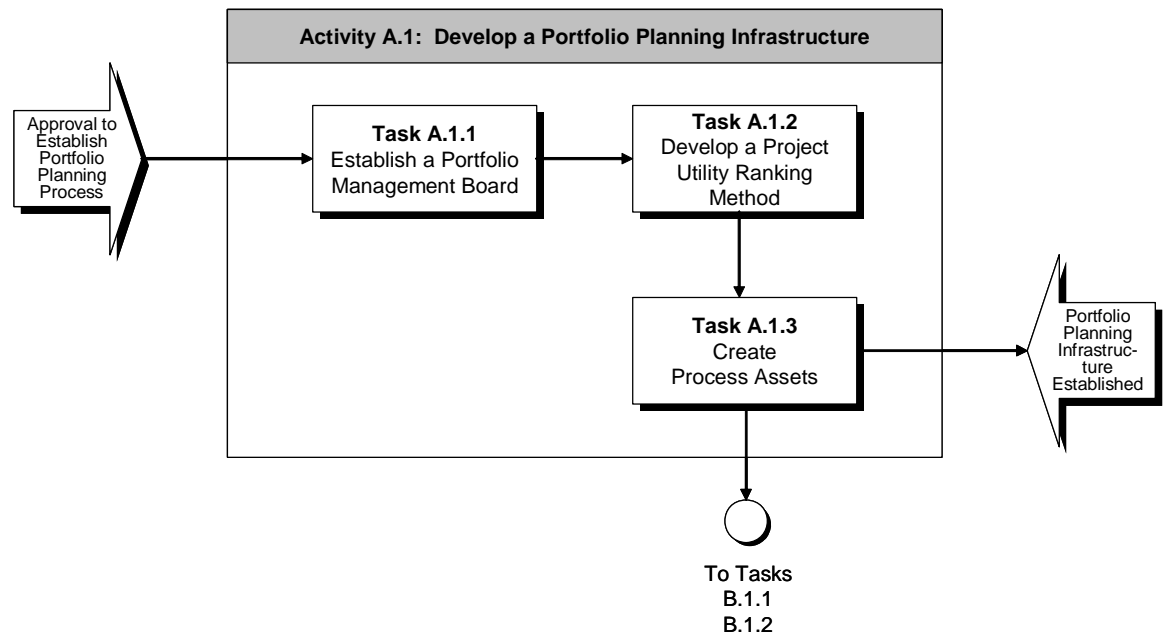


Figure 2: Procedural Flow for Activity A.1

## TASK A.1.1: ESTABLISH A PORTFOLIO MANAGEMENT BOARD

Inputs	Outputs
<ul style="list-style-type: none"> <li>Approval to establish a Portfolio Planning Process</li> </ul>	<ul style="list-style-type: none"> <li>Portfolio Management Board</li> <li>Portfolio Management Board Charter</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>P<sup>3</sup> Methodology</li> <li>Word Processing software</li> </ul>	

Portfolios must be managed on an ongoing basis to ensure that they are periodically reviewed, refreshed, and adjusted to reflect changing business conditions and new project opportunities. The Portfolio Management Board is the body with responsibility for administering the portfolio. Specific duties of the Board will vary but should include specification of portfolio management policies and procedures, determination of project selection criteria, review and selection of projects eligible for inclusion in the portfolio, and selection and approval of the final portfolio.

Because a portfolio is an organization-wide collection of projects, organization-wide representation is required on the Portfolio Management Board to help ensure equity and minimize parochialism. Every major entity within the organization should have representation on the board. The exact structure of the Board, however, may vary greatly depending on the size and diversity of the overall organization. In fact, the Board itself may be part of a larger, multi-level governing structure. For example, initial project ideas may be submitted by individual employees or groups, reflecting the needs and desires of those individuals or constituencies. Department boards may then select the projects they want to sponsor based on Department-wide needs and objectives. Selected project ideas would be submitted to the Division level. Division boards may then choose the projects they want to sponsor from the Department submissions based upon Division-wide objectives and priorities. These selections would then be submitted in turn to the organization-wide Portfolio Management Board, which makes the final, cross-division selection decisions that are in the best interest of the organization as a whole.

Regardless of the actual implementation, the overriding consideration is that the portfolio be actively managed from an organization-wide perspective.

TASK A.1.2: DEVELOP A PROJECT UTILITY RANKING METHOD

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Organizational priorities and objectives</li> <li>• Potential utility components</li> </ul>	<ul style="list-style-type: none"> <li>• Standard Utility Ranking Process</li> <li>• Utility scoring templates</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Word Processing software</li> <li>• Spreadsheet software</li> </ul>	

Not all projects are created equal. They come in all shapes, sizes, and flavors, and are difficult to compare on an apples-to-apples basis. To facilitate the comparison and ranking of projects, a uniform method of evaluation is required. This may be accomplished by devising a generic measure of project utility: the higher the level of utility, the more desirable the project.

Any type of utility measure may be used so long as it makes sense for the organization and is defined and applied consistently. Good measures of utility will assess the project from multiple dimensions. Two approaches to utility ranking are provided by the P<sup>3</sup> methodology. A standardized, pre-defined utility measure called a BAR score—which evaluates a project in terms of its net Benefit, Alignment with organizational objectives, and overall Risk—has been developed for use with this methodology and is included in Appendix A. The procedure for developing a customized utility ranking method from scratch is explained below.

*Step A.1.2.1: Identify Utility Components*

Multiple component measures may be defined to help quantify the various dimensions of project utility. These measures should be identified by the Board to cover the aspects of project utility that are most important to the organization. The following table is an example of utility components defined for a hypothetical company:

Utility Component	Definition
Financial Case	The Financial Case measures how attractive the project is from a purely financial perspective. Development of the Financial Case is covered in more detail in Phase B of the Methodology.
Business Case	The Business Case measures how well the project supports the strategy, direction, objectives, and initiatives of the organization from a non-financial, but business-oriented perspective.
Technical Case	The Technical Case measures how well the project fits the mold of the organization’s desired technical computing direction and standards.
Success Case	The Success Case measures how likely the project is to be successful based upon critical success factors.

**Table 2: Example of Utility Components for a Hypothetical Company**

These sample utility components are defined in more detail shortly.

*Step A.1.2.2: Weight the Utility Components*

While it is important to evaluate a project from the perspective of multiple dimensions, not all dimensions are necessarily equally important. In this step, each utility component is assigned a weight reflective of its relative degree of importance. Weighting schemes of varying complexity are possible; however, a simple 100-point scheme suffices. To accomplish this, assume each project has total possible utility of 100. The 100 utility points must then be allocated to the utility components. The number of utility points assigned to a component is its relative weight. If component A gets 40 utility points while component B gets 20, then component A will be weighted twice as heavily as component B in the final analysis. Hypothetical weights for the four example utility components are provided below:

Utility Component	Component Weight
Financial Case	30
Business Case	25
Technical Case	20
Success Case	25
<b>Total</b>	<b>100</b>

**Table 3: Example of Utility Component Weighting**

*Step A.1.2.3: Develop Component Scoring Method*

Eventually, each project will be assigned an actual score for each of the utility components. To accomplish this, a standard scoring method must be devised for each component. The method of scoring and the number of possible points assigned may be unique for each utility component. Develop scoring schemes that make sense for the component without worrying, at this point, about consistency across components. The tables below illustrate possible scoring methods for the example components. (Note that the scoring methods described below are strictly illustrative and are not presented as recommended procedures).

As an example, consider the Financial Case scoring method. The Financial Case is evaluated in terms of three categories: Internal Rate of Return (IRR), payback period, and implementation cost. A project may score up to 250 points for the Financial Case. Internal rate of return may account for up to 100 of these points. Note that if the internal rate of return for the project is below the hurdle rate of 25%, the score is  $-\infty$ . This effectively prevents any project from being selected for the portfolio if it does not exceed the organizational hurdle rate of return. For a project with an internal rate of return that is up to 100% over the hurdle rate (i.e. up to 125%), the score must be computed. So, a project with a return of 30% would have a computed IRR score of  $100 \times (.30 - .25) = 5$ . Any project with return greater than 125% scores the maximum (i.e. 100 points). (Again, note that this is just an illustrative example. In practice, develop unique scoring methods that make sense for your organization.)

Category	Assessment	Score
Internal Rate of Return (%) (Hurdle Rate = 25%)		Max=100
	Below hurdle rate	-∞
	Up to 100% over hurdle rate: Score = 100 x (IRR – Hurdle Rate)	Computed
	More than 100% over hurdle rate	100
Payback Period		Max=100
	Less than 6 months	100
	Between 6 and 12 months	80
	Between 12 and 18 months	60
	Between 18 and 24 months	40
	Between 24 and 30 months	20
	Between 30 and 36 months	0
Over 36 months	-∞	
Implementation Cost		Max=50
	Greater than or equal to \$10 million	0
	Less than \$10 million: Score = (10 million – cost) / 200,000	Computed
<b>Total</b>		<b>Max=250</b>

**Table 4: Example of a Financial Case Scoring Method**

Category	Assessment	Score
Strategic Advantage		Max=10
	The project will provide competitive advantage	10
	The project will help improve current competitive position	7
	The project will help maintain current competitive position	4
	The project may jeopardize competitive position	-∞
Operational Advantage		Max=10
	The project will decrease operating or overhead costs	10
	The project will help increase revenues	8
	The project will improve customer satisfaction	6
	The project will improve product or service quality	5
	The project improves internal IS or other department capability or ability to support the business	3
	The project provides no operational advantage	0
Alignment		Max=10
	Score = 10 x No. of Objectives Supported / Total No. of Business Objectives	Computed
<b>Total</b>		<b>Max=30</b>

**Table 5: Example of a Business Case Scoring Method**

Category	Assessment	Score
Compatibility		Max=10
	Proposed technology is compliant with current, acceptable standards	10
	Technology is not compliant but will become a future standard	10
	Technology is not totally compliant but differences are relatively minor and acceptable	5
	Technology is not compliant and differences will cause additional support problems	0
Technical Risk		Max=10
	Technology is proven and current	10
	Technology is cutting edge but generally reliable	8
	Technology is outdated	0
Project Risk		Max=10
	Risk of both cost and schedule overrun is low	10
	Risk of schedule but not cost overrun is high	4
	Risk of cost but not schedule overrun is high	2
	Risk of both cost and schedule overrun is high	0
Resource Availability		Max=10
	Required technical resources are currently onboard	10
	Resources are not all onboard but are readily available	6
	Required resources are scarce	0
<b>Total</b>		<b>Max=40</b>

**Table 6: Example of a Technical Case Scoring Method**

Category	Assessment	Score
Critical Success Factor 1		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 2		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 3		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 4		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 5		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 6		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 7		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 8		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 9		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
Critical Success Factor 10		Max=10
	Project satisfies success factor	10
	Project does not satisfy success factor	0
<b>Total</b>		<b>Max=100</b>

**Table 7: Example of a Success Case Scoring Method**

*Step A.1.2.4: Determine Component Rationalization Factors*

Rationalization factors are adjustments made to project scores for each utility component. These adjustments are necessary because scoring methods for each component were developed independently without regard for the relative weights previously assigned to the component. For example, according to the desired weighting, the Business Case and the Success Case should be weighted equally. However, because the Business Case can be scored with a maximum of 30 points, and the Success Case can be scored with a maximum of 100 points, it is possible that the Success Case would carry three and a third times the weight of the Business Case in the final scoring. Rationalization factors correct these types of imbalances in utility component scores.

To determine rationalization factors, it is first necessary to know the maximum possible score for each utility component. Next, for each component, a judgment call must be made as to whether or not any project could reasonably achieve the maximum score. If not, then a reasonable, maximum, *achievable* score should be selected for use instead. Once this is accomplished, rationalization factors are computed for each component as follows:

$$\text{Rationalization Factor} = \text{Desired Component Weight} / \text{Maximum Achievable Score}$$

The resulting score parameters for each utility component are summarized below:

Utility Component	Desired Weight	Max Possible Score	Max Achievable Score	Rationalization Factor
Financial Case	30	250	100	0.30
Business Case	25	30	25	1.00
Technical Case	20	40	40	0.50
Success Case	25	100	60	0.4167
<b>Total</b>	<b>100</b>	<b>420</b>	<b>225</b>	

**Table 8: Example of Rationalized Scoring Factors**

(Note: Maximum Achievable Score need only be used in those cases where it is not likely that any project could obtain the maximum score. In these cases, use of the Maximum Achievable Score helps ensure that the utility component is fairly evaluated.

For example, consider the Financial Case scores in Table 8. The Financial Case should account for 30% of the total utility score and has a maximum possible score of 250. Based on these numbers, a rationalization factor of  $30/250 = .12$  could be used to adjust actual project Financial Case scores to the desired weighting. A project scoring the full 250 points would then have an adjusted financial score of 30—or 30% of the total possible utility score, as planned.

Suppose, however, that no project can realistically score more than 100 points on the Financial Case. Such a project scoring 100 points would only have an adjusted Financial Case Score of  $.12 \times 100 = 12$ . The Financial Case would therefore be represented in the total utility score not by 30% of the total utility score but only by 12%. The Financial Case would therefore be undervalued.

Computation of the rationalization factor using the maximum achievable score avoids this type of situation. In the example, the rationalization factor using the maximum achievable score is  $30/100 = .30$ . A project scoring the maximum achievable 100 points on the Financial Case would have an adjusted score of 30, or 30% of the maximum utility score, as planned.)

*TASK A.1.3: CREATE PROCESS ASSETS*

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Portfolio Management Board Charter</li> <li>• Utility ranking method</li> </ul>	<ul style="list-style-type: none"> <li>• Portfolio Planning Process</li> <li>• Portfolio Planning procedures</li> <li>• Portfolio Planning templates</li> <li>• Portfolio Planning tools</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Word Processing software</li> <li>• Flowcharting software</li> </ul>	

This task creates various types of aids that will assist in execution of the P<sup>3</sup> Methodology. This includes processes, procedures, templates, and tools that can be used by individuals when applying the methodology. Although the methodology provides guidance and examples, these should be customized for the individual organization by incorporating any special considerations, commonly used terminology, and references to specific roles and organizations.

*Step A.1.3.1: Create a Portfolio Planning Process*

A specific process that tailors the methodology for the organization in which it will be used should be created. The process should address who will do what, when. It should include overall precedence and flow of events at a high level, and serves as the unifying mechanism for portfolio planning. How to actually accomplish the work specified in the process should be left to specific procedures that support the larger process.

*Step A.1.3.2: Create Portfolio Planning Procedures*

Procedures supply the detail of how to accomplish work. There are several procedures that should be created in support of the portfolio planning process. These include (but are not limited to):

- Project Idea Submission Procedure
- Program Planning Procedure
- Risk-Adjustment Procedure
- Standard Utility Ranking Procedure
- Portfolio Optimization Procedure
- Time-Phased Planning Procedure

Guidance provided within the methodology provides the basis for creation of these procedures. Other procedures should be created, as needed.

*Step A.1.3.3: Create Portfolio Planning Templates*

Templates provide standard formats that may be used when creating artifacts called for by the methodology. Some of the templates that will be required include:

- Project Idea Log
- Project Idea Submission Form
- Project Proposal Form
- Utility Scoring Forms
- Trade-Off Table Form
- Integer Programming Problem Form
- Time-Phased Planning Form

Some examples of work product templates are included in the appendices. These may serve as the basis for actual templates used, but should be modified, as required, to be pertinent in the organization.

*Step A.1.3.4: Identify and Select Portfolio Planning Tools*

Because of the nature of the P<sup>3</sup> Methodology, some of the work requires the use of various types of automated tools. This includes tools for common as well as not so common purposes. Examples are:

- A word processing tool (e.g. Microsoft Word) for creation of project proposals and other documentation
- A spreadsheet tool (e.g. Microsoft Excel) to support utility scoring methods
- A flowcharting tool (e.g. Visio) to support procedure flows
- A Monte Carlo Simulation tool (e.g. DecisionPro) to support risk-adjustment of financial performance factors
- An integer programming tool (e.g. Microsoft Excel Solver) to support portfolio optimization
- A time-phased planning tool (e.g. Microsoft Excel or specialized resource planning tool) to support aggregate planning of resources

Appropriate tools should be identified, researched, and if necessary, acquired and installed prior to initiating the Portfolio Planning process. Training in use of these tools must also be conducted.

**PHASE B: HARVESTING**

To “harvest” is to reap or gather. One of the primary purposes of the P<sup>3</sup> Methodology is to establish a pipeline of solid project proposals by soliciting, documenting, collecting, and evaluating ideas for new projects. The second phase of the methodology addresses this challenge. This phase is performed in an ongoing manner, with project ideas collected and analyzed continually over time.

**ACTIVITY B.1: HARVEST PROJECT IDEAS**

In a large organization, ideas for literally hundreds of potential projects may be generated at any one time from all areas of the company. There needs to be an effective method for capturing these ideas, weeding out the weak ones, fleshing out the strong ones, and getting them into the pipeline in an organized and standardized manner. This method must account for projects that are pre-planned to accomplish a future result (such as a business transformation) as well as ad hoc project ideas generated at any time. Accomplishing this is the focus of this activity. The diagram below illustrates the procedural flow for this activity:

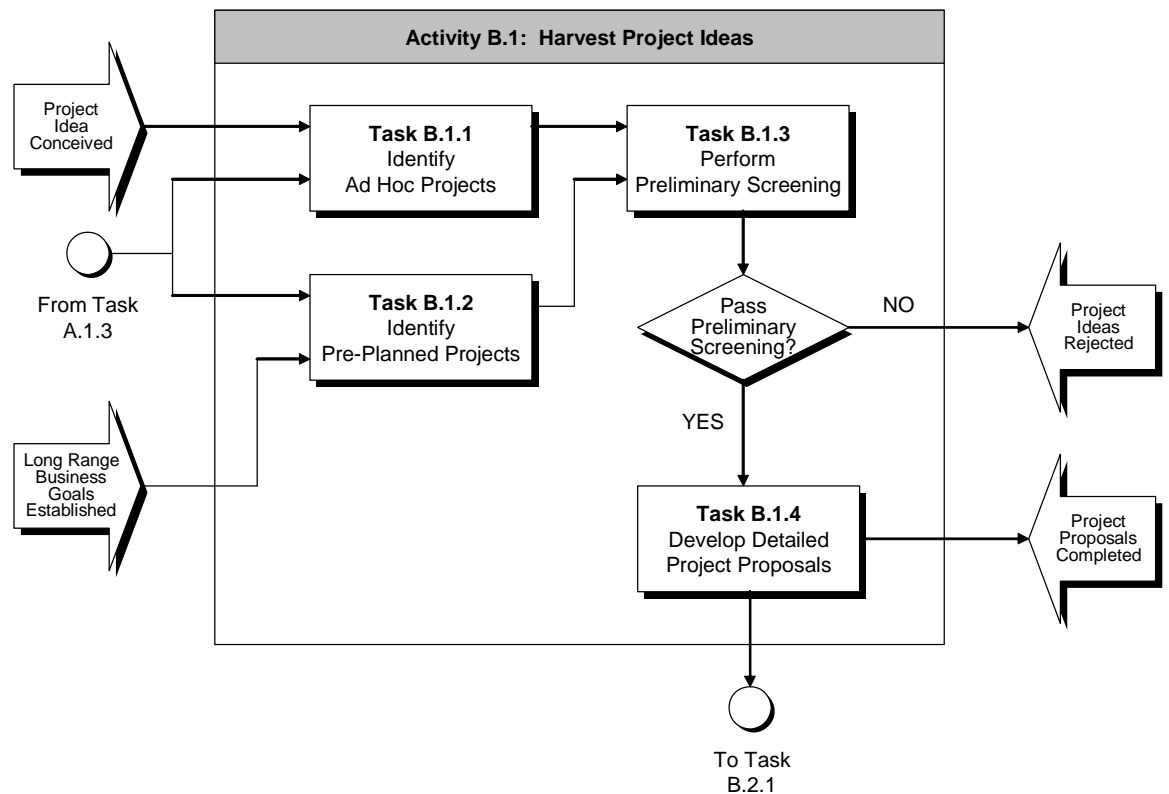


Figure 3: Procedural Flow for Activity B.1

## TASK B.1.1: IDENTIFY AD HOC PROJECTS

Inputs	Outputs
<ul style="list-style-type: none"> <li>Project ideas</li> <li>Project Idea Log</li> </ul>	<ul style="list-style-type: none"> <li>Completed Project Idea Submission Form</li> <li>Project Idea Log updated with new project idea</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>P<sup>3</sup> Methodology</li> <li>Portfolio Planning Process</li> <li>Project Idea Submission Procedure</li> <li>Project Idea Submission Form Template</li> </ul>	

A portfolio consists of numerous projects; however, not all project ideas make it into the portfolio. The organization should develop a standard process for capturing and evaluating ad hoc ideas for potential projects. This process should be simple enough that it does not discourage the submission of creative ideas. At the same time, the process should require serious thought and analysis so that it does not discourage submission of ideas that are frivolous or poorly defined. Any employee (perhaps with the help of an Analyst) should be able to initiate a project idea. The submission process should be clear, accessible, and known to all. Each idea should be documented on a standard Project Idea Submission Form. The following list outlines some of the information that might be included in an initial project idea submission:

Information	Description
<b>Originator</b>	Name of the person initiating the project idea
<b>Business Analyst</b>	Name of the Business Analyst, if any, assisting with the idea definition
<b>Technical Analyst</b>	Name of the Technical Analyst, if any, assisting with the idea definition
<b>Submission Date</b>	Date the idea was submitted
<b>Sponsoring Department</b>	The department championing the idea
<b>Program</b>	Name of the higher-level program (if any) of which the project is a part
<b>Priority</b>	The project's degree of urgency. Use any simple ranking (e.g. Critical, High, Medium, Low) but provide clear definition of each
<b>Objective(s)</b>	What the proposed project is supposed to accomplish
<b>Description</b>	Brief description of the proposed project in as much detail as necessary to make the idea clear
<b>Deliverables</b>	Listing of concrete artifacts the project would produce
<b>Business Objectives Supported</b>	Listing of formal business objectives supported by the project
<b>Technical Objectives Supported</b>	Listing of formal technical objectives supported by the project
<b>High-Level Benefits</b>	Listing of envisioned benefits the project would provide (with gross quantification, if possible)
<b>High-Level Costs</b>	Listing of costs the project would incur (with gross quantification, if possible)
<b>High-Level Risks</b>	Listing of known risks or likely categories of risk that might be faced
<b>Departments Affected</b>	Identification of the departments that would be affected by the project (with the nature of the impact)
<b>Systems Affected</b>	Identification of existing systems that would be affected by the project (with the nature of the impact)
<b>Implementation Time</b>	Estimate of the amount of time it would take to implement the solution
<b>Deadlines</b>	Identification of any deadlines affecting the proposed project
<b>Analysis Requirements</b>	The amount of resources, time, and cost required to do a full, in-depth analysis of the project idea
<b>Management Approval</b>	Signature of the manager who has reviewed and approved the submission

**Table 9: Example of Information Needed to Document a Project Idea**

Upon receipt, each Project Idea Submission Form should be logged in a Project Idea Log to formally record and track the idea and its disposition throughout the Portfolio Planning Process. This helps ensure that ideas are not lost and provides the courtesy of feedback to those who have taken the time to submit ideas.

*TASK B.1.2: IDENTIFY PRE-PLANNED PROJECTS (OPTIONAL)*

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Long-Range Organizational Goals Established</li> <li>• Project Idea Log</li> </ul>	<ul style="list-style-type: none"> <li>• Future Vision</li> <li>• Transformation Plan</li> <li>• Completed Project Idea Submission Forms</li> <li>• Project Idea Log updated with new project ideas</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Program Planning Procedure</li> <li>• Project Idea Submission Procedure</li> <li>• Project Idea Submission Form Template</li> </ul>	

There are often situations where a number of related projects may be planned together in advance to satisfy a specific purpose or goal. This is what occurs for many types of programs. For example, a business transformation program may establish long-range goals and objectives for the business then define numerous projects that will be executed over time to achieve those goals. These project definitions are not typically developed on an ad hoc basis. Rather, they must be specified at a high-level in advance to justify the program and to demonstrate how program goals will be achieved. Pre-planning projects in this manner as part of a program to support future business direction is a fundamental technique for aligning projects with the business.

This task addresses such pre-planning of projects and is performed only in those cases where pre-planned project definitions must be developed and included in the project portfolio. Note that, unlike ad hoc projects, there is usually a relationship between pre-planned projects in a program. Each project has a role in accomplishing program objectives. However, because these projects may be implemented at different times over a number of years, they may not all be accepted into the project portfolio at the same time. Care must therefore be taken to understand what projects are associated with what higher-level programs, and to ensure that program objectives are not jeopardized by project-level portfolio decisions.

(Note that the steps below are themselves complex topics that require elaboration in a detailed Program Planning Procedure.)

*Step B.1.2.1: Develop Future Vision*

Once it has been decided to establish a program for accomplishment of organizational goals, a vision of the future organization and how it would be supported by information systems should be conceived. This vision should describe how the organization should look, act, and perform in the future in order to fulfill its mission, goals, and objectives and should identify the automated capabilities that will be crucial to success. This sets an end state that should be achieved over time.

*Step B.1.2.2: Develop Transformation Plan*

The Transformation Plan describes how the organization is going to migrate from its current state to the future state defined by the vision. It describes the current state, identifies gaps to be closed, describes specific functional capabilities to be developed, specifies intermediate states to be achieved, estimates resources required, and outlines a phased implementation over a set time horizon. Note that this plan should describe both the organizational transformation and the concomitant system transformation that must occur to support the organization.

*Step B.1.2.3: Identify and Describe Pre-Planned Projects*

Specific projects should be identified to implement the Transformation Plan. Each project should produce measurable progress towards achieving the desired end result. Some of these projects may be able to be conducted concurrently, and some will need to occur serially according to precedence and dependencies defined in the Transformation Plan. These pre-defined projects should be documented at a high level on Project Idea Submission Forms and logged in the Project Idea Log.

**TASK B.1.3: PERFORM PRELIMINARY SCREENING**

<b>Inputs</b>	<b>Outputs</b>
<ul style="list-style-type: none"> <li>• Project Idea Log</li> <li>• Completed Project Idea Submission Form</li> </ul>	<ul style="list-style-type: none"> <li>• Project Idea Submission Form updated with preliminary screening disposition</li> <li>• Project Idea Log updated with preliminary screening disposition</li> </ul>
<b>Supporting Tools</b>	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Project Idea Submission Procedure</li> </ul>	

Once a project idea has been documented, several forms of review should occur. The need for and degree of formality of these reviews will vary depending on the organization. Typical reviews might include those outlined in the steps below.

*Step B.1.3.1: Obtain Analyst Review*

If an Analyst did not participate in drafting the initial project idea, have a Business and/or Technical Analyst review the Project Idea Submission Form. This subjects the idea to a second pair of eyes, helps ensure validity, and provides input from sources that are more experienced in properly describing project ideas.

*Step B.1.3.2: Obtain Sponsor Review*

The sponsoring manager should also review the project idea description. This ensures that the manager is aware of the idea and is, in fact, willing to sponsor it.

*Step B.1.3.3: Obtain Board Review*

Before a project idea can be evaluated for inclusion in the project portfolio, a detailed project proposal must be developed. The fully defined project must then be rated against the various utility factors. In some cases, this can involve a significant amount of time and effort, and may require personnel from several departments. Because of resource limitations, most organizations do not have the ability to pursue every project idea to this level. By having the Portfolio Management Board review sponsor-approved project ideas, decisions can be made as to the best use of resources to evaluate projects from a corporate-wide perspective.

After the final screening review, the Project Idea Log should be updated to record whether or not the idea will be further evaluated. There may be many reasons for excluding ideas from further analysis. Such reasons may include conflicting ideas, duplicative ideas, ideas that are not sufficiently elaborated, ideas not in support of current priorities, etc. The reason for rejecting any idea at this point should be recorded in the Project Idea Log.

**TASK B.1.4: DEVELOP DETAILED PROJECT PROPOSALS**

<b>Inputs</b>	<b>Outputs</b>
<ul style="list-style-type: none"> <li>• Project Idea Log</li> <li>• Project Idea Submission Form for ideas receiving preliminary screening approval</li> </ul>	<ul style="list-style-type: none"> <li>• Completed Project Proposal</li> <li>• Project Idea Log updated with proposal completion</li> </ul>
<b>Supporting Tools</b>	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Project Idea Submission Procedure</li> <li>• Project Proposal Form Template</li> </ul>	

Project Proposals are developed for each of the projects selected by the Board for full analysis. A cross-functional team of business and information systems personnel should be selected to develop the proposal. The Project Proposal should be a detailed supplement to the original Project Idea Submission Form, and

should provide enough information to allow later evaluation of the project against all of the utility factors. Typical information might include:

Information	Description
<b>Background</b>	A description of the business and/or technical conditions that have resulted in the need for the project
<b>Objectives</b>	What the proposed project is supposed to accomplish (may be the same as or a refinement of the prior stated objectives)
<b>Scope</b>	Description of project boundaries along multiple dimensions (e.g. business processes, organizations, locations, data, applications, and technologies included)
<b>Assumptions and Constraints</b>	Suppositions used in making project decisions along with restrictions that limit options
<b>Approach</b>	The high-level strategy and plan for attacking the problem and conducting the project
<b>Schedule</b>	High-level schedule showing the project timeline with key phases, milestones, and deliverables
<b>Resources and Organization</b>	Types and numbers of resources required to staff the project along with the envisioned project organization and resource schedule
<b>Responsibilities</b>	Definition of roles to be played by key project participants
<b>Deliverables</b>	Detailed description of artifacts to be produced by the project and that should be formally accepted by the sponsor or other appropriate person
<b>Completion Criteria</b>	Description of the conditions that must be satisfied to complete the project
<b>Costs</b>	Comprehensive listing of costs the project will incur with analyzed estimates of those costs
<b>Benefits</b>	Comprehensive listing of tangible and intangible benefits the project will produce with analyzed estimates of those benefits
<b>Risks</b>	Description of specific risks including potential magnitude of impact and likelihood of occurrence.
<b>Critical Success Factors</b>	Pivotal things that need to be available or to occur for the project to be successful
<b>Business Feasibility</b>	How likely is the project to be successful from a business standpoint? [High (>70%), Medium (50%-70%), Low <50%)]
<b>Technical Feasibility</b>	How likely is the project to be successful from a technical standpoint? [High (>70%), Medium (50%-70%), Low <50%)]

**Table 10: Example of Information Needed for a Detailed Project Proposal**

After submission of the completed proposal, the Project Idea Log should be updated to reflect this status.

**ACTIVITY B.2: DETERMINE PROJECT UTILITY**

Once a Project Proposal is submitted, it must be evaluated to determine the amount of utility the project would provide. This is accomplished by evaluating the proposal against the standard measure of utility previously established in task A.1.2. In performing this evaluation, special consideration is given to evaluating measures of financial performance. This is because financial measures usually are assigned a high degree of importance, yet often involve high degrees of uncertainty. This activity addresses this uncertainty through the concept of risk-adjustment, then proceeds with general evaluation of utility. The following diagram illustrates the procedural flow for this activity:

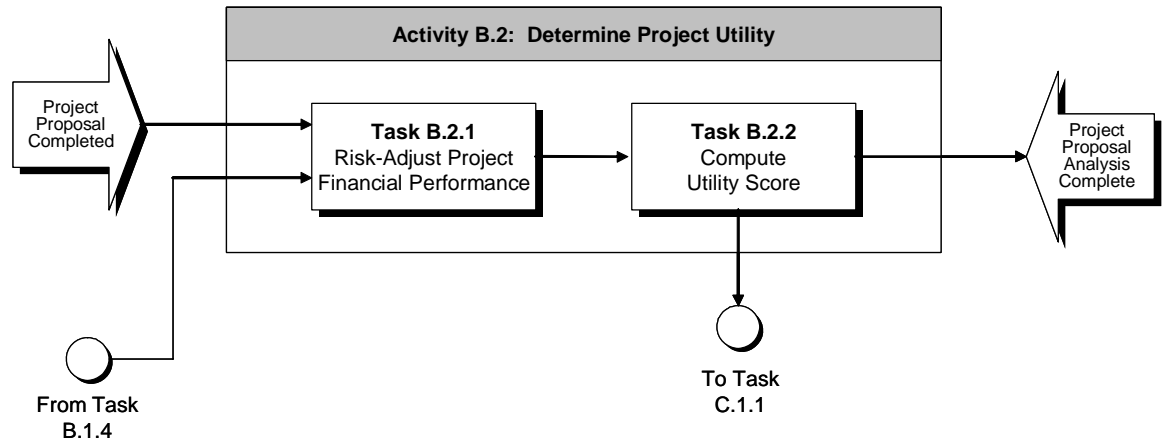


Figure 4: Procedural Flow for Activity B.2

*TASK B.2.1: RISK-ADJUST PROJECT FINANCIAL PERFORMANCE*

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Project financial data from Project Proposal</li> <li>• Desired financial utility components from the Utility Scoring Templates</li> </ul>	<ul style="list-style-type: none"> <li>• Financial Performance Model</li> <li>• Trade-Off Table</li> <li>• Risk-Adjusted Financial Performance</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Risk-Adjustment Procedure</li> <li>• Trade-Off Table Template</li> <li>• Monte Carlo Simulation software</li> </ul>	

Although many companies profess otherwise, for many organizations, the financial case remains the single most important factor in the project selection process. In addition, it is often the most elusive. There are well-known and often-used measures of financial performance for projects. These include such measures as payback period, net present value (NPV), and internal rate of return. These measures are all based on the estimates of project costs and benefits. However, although these methods are well-established, they are often misleading because of uncertainty in the data they are based on—the costs and benefits. For example, there is usually uncertainty in the magnitude of project costs. There is, as well, uncertainty in both the magnitude and timing of project benefits. It is possible that some benefits may not be achieved at all. Finally, the accumulation of all this uncertainty across all of the envisioned costs and benefits makes the resulting financial measure very “iffy”.

This activity addresses the above issues using the concept of risk-adjustment. Risk-adjustment involves analyzing an estimate in light of the inherent estimation risk, then modifying the estimate, if necessary, to a value reflective of a more acceptable level of risk.

*Step B.2.1.1: Simulate Financial Performance*

Simulation is the process of performing experiments on a model to learn about how the model behaves under varying conditions. This is extremely useful when it is uneconomical or impossible to otherwise obtain this type of insight. Simulation is a powerful tool to use when estimating in highly uncertain situations. Because estimates are projections of future outcomes, they are a form of forecast. As such, it is usually impossible to determine how valid an estimate is until after the fact, when the actual outcome has already occurred. Simulation, however, provides a unique opportunity to obtain a glimpse into the future. By simulating the variable being estimated, we are able to see the range of potential results ahead of time. This allows us to “try out” our estimate, compare it to those potential results, determine how good or bad the estimate is, and adjust the estimate to a value that is likely to be more accurate. The risk associated with our estimate can therefore be controlled and potentially reduced.

Monte Carlo is a relatively simple yet flexible and powerful type of simulation that provides an effective means of dealing with uncertainty. It allows replacement of uncertain “point estimates” with “fuzzy values”, then analyzes the impact of those fuzzy values on the final result by generating the range of potential outcomes as well as the probability of hitting various target values within the range. Monte Carlo is especially useful in situations where an estimate is composed of numerous other fuzzy estimates. In these types of cases, it is very difficult to properly determine the effects of multiple sources of uncertainty on the final result. With Monte Carlo simulation, however, these types of interactions are handled automatically.

All of this is important because our expression of project financial performance, regardless of whether it is stated in terms of ROI, NPV, IRR, or other measures, is an estimate comprised of many individual, uncertain estimates of costs and benefits. The process below may be used to perform a simulation of project financial performance:

1. Establish a range for each cost and benefit in each period  
There is uncertainty associated with most statements of costs and benefits. Establish the limits of uncertainty for each cost and benefit in each time period by stating the range of potential outcomes. The upper and lower limits of the range should reflect the best and worst case outcomes, and the width of the range should be reflective of the degree of uncertainty. For example, suppose that the potential benefit of a project in period 5 is \$100,000. If we are pretty certain of this benefit, the resulting range might be fairly narrow: for example, \$85,000-\$110,000. If there is a high degree of uncertainty, the resulting range might be wide: for example, \$50,000-\$200,000. Also, don't omit the possibility, if it exists, that the benefit will not be achieved: for example, \$0-\$200,000. Costs would be handled in a similar manner.

2. Characterize each range with a probability distribution

Establishing a range around the estimates provides important information about the degree of reliance that can be placed on the numbers. An additional piece of information is needed, however, to fully understand the nature of the estimate. The additional information involves the likelihood of results within the range. For example, consider the range of \$0-\$200,000 discussed above. Is there any difference in the likelihood that actual results will fall in different parts of this range? Although there are many possible ways to characterize the answer, two common situations predominate and suffice for our purposes:

- a) Results are equally likely to fall anywhere in the range, and
- b) Results are most likely to fall near the target (\$100,000) and progressively less likely to fall near the extremes of the range.

These two situations may be modeled by common probability distributions. The first case may be represented by a Uniform (a.k.a. Rectangular) probability distribution, and the second case may be represented by a Triangular probability distribution. All that is required in this step is to determine which type of distribution is most appropriate for each cost and benefit estimate: Uniform or Triangular? The answer may be different for each individual estimate. The selected distribution will be used later in the simulation to generate trial values for the estimate.

3. Determine trial values for each cost and benefit

The simulation uses the probability distributions and random probabilities to determine trial values for costs and benefits. For each cost or benefit estimate, a random probability number is generated. This random probability (a number between 0 and 1) is then applied to the estimate's probability distribution to produce a randomly determined trial value for that cost or benefit. If the estimate's probability distribution is Uniform, over the course of the simulation an approximately equal number of trial values will be generated from the estimate's entire range. If the estimate's probability distribution is Triangular, trial values will also be generated over the course of the simulation from the estimate's entire range; however, the greatest number of estimates produced will be clustered around the estimate's target value. The number of estimates selected will be progressively less towards both the upper and lower limit values. This process continues until a trial value has been determined for each cost and benefit in each period.

4. Determine a trial value for the financial performance measure

Once trial values have been determined for all cost and benefit estimates, these trial values are combined according to the formula for the selected financial performance metric to produce a trial value for that metric. If, for example, the desired metric is net present value, the result would be a trial value for NPV—a result that could reasonably occur given the individual estimates.

5. Repeat steps 3 and 4 a large number of times

Although the trial result for the financial performance metric is a reasonable representation of that metric, it is only one of innumerable values that the metric could assume. After all, if any of the randomly produced probabilities had been different, the resulting value of the financial metric would also have been different. To account for this, the process in steps 3 and 4 is repeated by the simulation a very large number (e.g. 10,000–100,000) of times. The end product is an entire set of values for the financial performance metric. This set provides a good representation of the range and probable distribution of the metric and properly incorporates all of the probabilistic interactions that can occur between the individual estimation components—interactions that are impossible to properly evaluate in any other practical manner. In essence, it provides a view into the future. We can see what financial performance is likely to be without having to wait for the actual project.

*Step B.2.1.2: Make Financial Performance/Risk Trade-Offs*

The raw output of the simulation is the set of results for the financial performance metric described above. To be of value, however, this result set must be summarized, analyzed, and presented in a useful manner. While there are many possible ways to perform such analysis, the discussion here will be limited to description of a format called the Trade-Off Table. A Trade-Off Table provides visibility to the fact that there is a trade-off to be made between the magnitude of the estimate and the resulting level of confidence in that estimate. The smaller or more conservative the estimate of financial performance, the higher the level of confidence that the estimate will be achieved. The Trade-Off table lists levels of confidence from 0% to 100% and shows the corresponding estimate value for each level of confidence.

To construct the Trade-Off Table, the simulation first sorts all of the values in the result set in ascending order. Suppose, for example, that the simulation produced a trial set consisting of 100,000 values. Then, to determine the estimate corresponding to, say, 60% confidence, the 40,000<sup>th</sup> entry in the sorted set would be found. Because 60,000 of the 100,000 trial estimate values are greater than or equal to this number, there is a 60% chance that actual project results will achieve this estimate. Conversely, since 40,000 of the 100,000 trial results are less than this number, there is a 40% risk that actual results will fall short of the estimate. This process is repeated for various confidence levels, and the results presented in a simple but powerful table.

Trade-Off Table for Project Net Present Value			
Level of Confidence Is:	That Actual Results Will Be At Least:	Level of Confidence Is:	That Actual Results Will Be At Least:
0%		65%	
10%		70%	
20%		75%	
30%		80%	
40%		85%	
50%		90%	
55%		95%	
60%		100%	

**Table 11: Example of a Trade-Off Table**

Estimation risk is defined as the probability that the estimate will not be achieved, which translates, in this case, to the probability that the project will under-perform the financial estimate. Acceptable risk levels are the personal preference of the management team. Some will choose to be conservative, and some will be comfortable living with a relatively high level of risk. The beauty of using Monte Carlo simulation is that it allows selection of an appropriate estimate based upon whatever level of risk is desired.

Having said this, some guidelines are worth proposing. First of all, 0% risk is seldom an option since the corresponding estimate is usually so extreme as to be unworkable. Even 50% risk is usually not viable. There is nothing inherently wrong with choosing this level of risk, and the corresponding estimate is usually of a reasonable magnitude. However, 50% risk essentially means that the chance of successfully achieving the estimate is no better than the odds on flipping a coin. In most business situations, it is prudent to have better odds than that.

What, then, is reasonable? In general, risk should not be so high as to make achievement of the estimate unlikely. On the other hand, risk should not be so low as to make achievement of the estimate a virtual certainty. Either of these situations can result in estimates that are too extreme. While the following chart is subjective, it provides a starting point that may be modified, as appropriate, to meet individual needs:

If the risk level is:	Or, conversely, the confidence level is:	The estimate is probably:
0%–14%	100%–86%	Too Conservative
15%–25%	85%–75%	About Right
26%–100%	74%–0%	Too Aggressive

**Table 12: Guidance for Selecting an Appropriate Level of Estimation Risk**

Once a satisfactory risk level has been decided upon, it is an easy matter to determine a risk-adjusted estimate. Simply enter the Trade-Off Table at the confidence level corresponding to the selected level of risk. The estimate value for that level of confidence is the risk-adjusted estimate—the most aggressive estimate consistent with the selected level of risk.

Note that the financial case for selecting a project may contain multiple financial performance factors. Although it may be possible to include all of these factors in a single simulation model, it may be easier to perform a separate simulation for each financial factor.

**TASK B.2.2: COMPUTE UTILITY SCORE**

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Project Idea Log</li> <li>• Project Proposal</li> <li>• Risk-adjusted financial performance</li> </ul>	<ul style="list-style-type: none"> <li>• Completed Utility Scoring Forms</li> <li>• Project Idea Log updated with utility scoring completion</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Standard Utility Ranking Procedure</li> <li>• Utility Scoring Templates</li> <li>• Spreadsheet software</li> </ul>	

Once financial performance of the project has been evaluated, its utility value may be determined. This involves assigning raw scores to each utility component using the standard scoring method for that component; adjusting the raw scores by the rationalization factor for the component; and totaling the scores to arrive at the final utility value.

*Step B.2.2.1: Assign Raw Scores*

Using the standard scoring process developed in Task A.1.2 along with information from the Project Proposal, raw scores are assigned to each utility component. For example, suppose Project #1 is found to have a payback period of two years, a return on investment of 30%, and an implementation cost of \$8 million. (Note that

these should be risk-adjusted values, if necessary.) A financial case score for the project would then be determined as follows:

Project #1 Financial Case Score		
Factor	Value	Raw Score
Internal Rate of return	30%	$100 \times (.30 - .25) = 5$
Payback period	24 months	40
Implementation Cost	\$8 million	$(10 \text{ million} - 8 \text{ million}) / 200,000 = 10$
<b>Total Score</b>		<b>55</b>

**Table 13: Example of Computing Raw Utility Score for the Financial Case**

Proceed in a similar manner until raw scores have been determined for each utility component.

*Step B.2.2.2: Adjust Raw Scores*

Once raw scores are available, they must be adjusted using the rationalization factor to ensure that each utility component has the desired weighting in the final utility score. Adjusted utility scores are determined as follows:

$$\text{Adjusted Utility Score} = \text{Raw Score} \times \text{Rationalization Factor}$$

*Step B.2.2.3: Determine Total Project Utility*

Compute total utility for the project by adding the adjusted utility scores, as in the example below:

Utility Component	Raw Score	Rationalization Factor	Adjusted Score
Financial Case	55	.30	16.5
Business Case	20	1.00	20.0
Technical Case	30	.50	15.0
Success Case	60	.4167	25.0
<b>Total Utility</b>			<b>76.5</b>

**Table 14: Example of Project Utility Scoring**

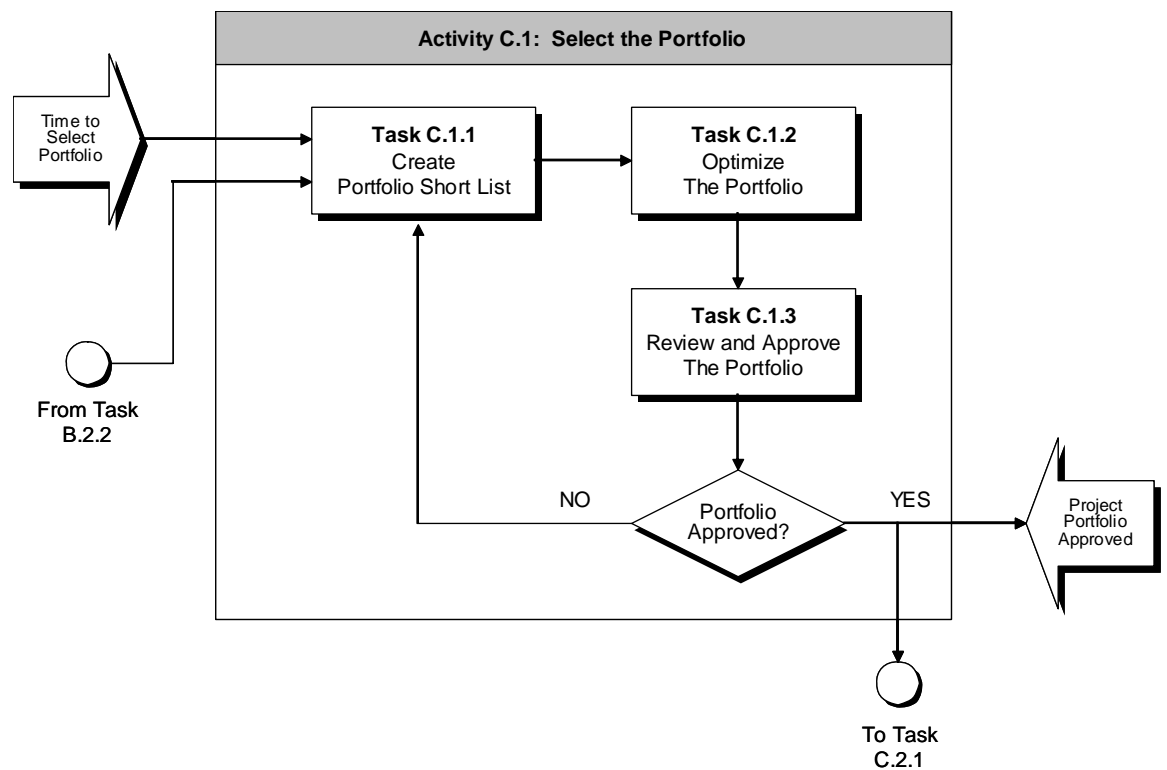
Completed Utility Scoring Forms should be attached as a supplement to the Project Proposal. The Project Idea Log should be updated at this point to record completion of utility scoring of the Project Proposal.

**PHASE C: PLANNING**

The final phase of the P<sup>3</sup> Methodology is planning the portfolio. This involves selecting the project proposals that will actually be included in the portfolio, then ensuring that the selected portfolio is feasible with respect to available resources. The Planning Phase is performed periodically on a set schedule. This usually coincides with annual budgeting, but may be performed or updated perhaps semi-annually or quarterly, depending on the amount of project activity.

**ACTIVITY C.1: SELECT THE PORTFOLIO**

The first planning activity is to actually select the specific projects to include in the company’s project portfolio. This, of course, is only really an issue if there are not sufficient resources available to include all projects. However, because many organizations have many more potential projects than they have resources to perform them, a rational method of selecting the subset of projects to include is needed. The method incorporated in the methodology is optimization. Using optimization, the methodology selects the subset of projects that provide maximum utility to the organization while satisfying imposed constraints such as budget limitations. The diagram below illustrates the procedural flow for this activity:



**Figure 5: Procedural Flow for Activity C.1**

TASK C.1.1: CREATE PORTFOLIO SHORT LIST

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Project Idea Log</li> <li>• Completed Project Proposals (with Utility Scoring Forms)</li> </ul>	<ul style="list-style-type: none"> <li>• Portfolio Short List</li> <li>• Project Idea Log updated with Short List results</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> </ul>	

At this point, many project proposals may have been generated, screened, and assigned utility. The final list of proposals that will be entered in the optimization must now be selected. Note that while this is called a “Short List” it may, in fact, still be a fairly lengthy list.

Candidate proposals for the Portfolio Short List will be selected from the Project Idea Log from among the proposals that have not yet been eliminated from consideration. When making Short List selections, be sure to include projects that have previously been included but may still be in-flight. Also, be cognizant of projects that are part of larger programs and that may need to be included to support the overall program.

Not all Project Proposals will necessarily be selected, however. Reasons for not selecting proposals for the Portfolio Short List may be due to proposals without sufficient information to be adequately scored, proposals receiving a score of  $-\infty$  on any dimension of utility, or due to any last minute considerations that arise. If for any reason an eligible proposal will not be selected for the Portfolio Short List, the reason should be recorded in the Project Idea Log.

A minimal amount of information is needed for the short list, including:

- Project identifier
- Project name
- Project utility score
- Project cost

Backup documentation for each project on the Portfolio Short List should be available for reference, if needed.

Task C.1.2: OPTIMIZE THE PORTFOLIO

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Project Idea Log</li> <li>• Portfolio Short List</li> <li>• Optimization objective</li> <li>• Budget</li> <li>• Portfolio constraints</li> </ul>	<ul style="list-style-type: none"> <li>• Optimization results:               <ul style="list-style-type: none"> <li>– Optimized utility value</li> <li>– Optimized portfolio</li> </ul> </li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Portfolio Optimization Procedure</li> <li>• Integer Programming Problem Template</li> <li>• Integer Programming software</li> </ul>	

When selecting a portfolio from a group of projects, common practice is to rank available projects from highest to lowest utility and select projects from the top of the list until the total cost of selected projects exceeds budget. Suppose, for example, that our budget is \$10 million and we must select projects from the following list:

Project	Utility	Cost (\$million)
A	5	10
B	4	5
C	3	3
D	2	5
E	1	1

**Table 15: Example of Potential Projects for Inclusion in a Portfolio**

Following the standard procedure, we would select only project A, which would cost \$10 million and provide total portfolio utility of 5. However, while expedient, this method does not necessarily provide the best solution. For example, we could select projects B and D, resulting in total utility of 6 for the same cost. Or, we could select projects B, C, and E, resulting in total utility of 8 for a cost of only \$9 million.

As this simple example illustrates, selection of a portfolio is not necessarily straightforward. One way of addressing the problem would be to enumerate and evaluate all of the possibilities. This is easy for our five-project example since there are only 2<sup>5</sup> or thirty-two different possibilities. In general, however, solution of this problem is not trivial, especially for large numbers of projects. With as few as twenty projects, there would be a total of 2<sup>20</sup> or over one million possible portfolios. With thirty projects, the number of possible portfolios would be 2<sup>30</sup> or over one billion! One way of addressing the problem is through the use of optimization using mathematical programming. This approach is explained below.

Optimization is the process of finding the best solution to a problem. Mathematical programming is a type of optimization that seeks to maximize or minimize an objective subject to a defined set of constraints. (Note: in this context, the term “programming” refers to a specific genre of optimization, not to computer programming). Project portfolio planning may be modeled as a classical mathematical programming problem. In this instance, the variables of interest are the potential projects that have been identified. Each project has a cost and a utility measure, and each project may or may not be selected as part of the portfolio. The problem is to select a project portfolio such that total cost of the portfolio is within a set budget and such that total utility of the portfolio is maximized. Complicating the situation is the fact that there might be additional constraints to take into account. For example, there are often dependency considerations that require a project to be included in the portfolio if another, related project is selected.

The method appropriate for solving this problem is known as integer programming or, more specifically, as a subset of integer programming known as pure binary integer programming. In this type of problem, the variables are restricted to having values of either 0 or 1. For portfolio planning, a variable (i.e. project) would be assigned a value of 1 if it is selected as part of the portfolio or a value of 0 if it is not selected as part of the portfolio. The mathematical programming solution tells what projects are selected for inclusion in the portfolio, the cost of the portfolio, and the total portfolio utility value.

The optimization process will be illustrated with the following ongoing example:

Suppose we have five potential projects— $P_1$ ,  $P_2$ ,  $P_3$ ,  $P_4$ , and  $P_5$ —with associated costs of 5, 2, 4, 6, and 3 million dollars respectively and utilities of 10, 3, 6, 8, and 5. We are working with a budget of \$12 million and have to select the best project portfolio. In addition, due to dependency requirements, if project 1 is in the portfolio, project 2 must also be in the portfolio, and if project 3 is in the portfolio, project 5 must also be in the portfolio. The variables in the problem are  $P_1$ ,  $P_2$ ,  $P_3$ ,  $P_4$ , and  $P_5$ , the representations assigned to the potential projects. These variables will be assigned a value of either 0 or 1 in the solution, depending on whether or not the project is selected as part of the portfolio.

#### *Step C.1.2.1: Formulate the Objective Function*

The objective function is an expression of the value to be optimized—in this case, total portfolio utility. The expression below defines the objective for the example:

$$MAX [10P_1 + 3P_2 + 6P_3 + 8P_4 + 5P_5]$$

Note that while we are illustrating utility maximization as one of the most common objectives, other types of objectives (e.g. cost minimization) are possible.

*Step C.1.2.2: Formulate Constraints*

Prior to optimizing the composition of the project portfolio, any constraints that would affect the projects selected must be determined. Typical constraints are illustrated below.

Budget Constraint

If a proposed or approved budget exists for the portfolio, and the portfolio projects must be selected in conformance with this budget, then the budget constraint must be specified such that total cost of the portfolio does not exceed the budget. This is modeled in the example as follows:

$$5P_1 + 2P_2 + 4P_3 + 6P_4 + 3P_5 \leq 12$$

When using a budget constraint, however, timing issues must be dealt with correctly. Budgets are typically prepared on annual cycles. Projects, however, may span multiple years. Although financial performance factors are time-phased, overall project utility is devoid of any overt time reference. It does not make sense to select a portfolio based on maximizing portfolio utility but to subject the portfolio to an annual budget constraint. To resolve this issue, the budget constraint must be based on a budget estimate that spans enough years to cover the horizon of the projects proposed for the portfolio.

This does not mean that projects selected for the portfolio will not ultimately have to fit within annual budgets. If the annual budget turns out to differ significantly from the budget estimate originally used to plan the portfolio, the portfolio may have to be re-optimized. In this case, take care to ensure that in-flight projects are not selected out of the new optimized portfolio. This may be prevented using a selection constraint that ensures inclusion of such projects in the revised portfolio (see Selection Constraints below.)

Selection Constraints

Often, there are constraints imposed that serve to shape overall content of the project portfolio. These constraints may reflect inherent dependencies between the projects or artificial restrictions imposed by management. For example, suppose we are dealing with two projects (Project A and Project B). There are four unique portfolio possibilities involving these two projects: either both are included, A is included but B is not, B is included but A is not, or neither is included. There are then 2<sup>4</sup> or sixteen selection constraints that may be formed from these four possibilities (the combination of four taken none at a time, plus four taken one at a time, plus four taken two at a time, plus four taken three at a time, plus four taken four at a time = 1+4+6+4+1=16). Seven of these constraints, however, are trivial and, in practice, would not be specified. These trivial constraints include:

No constraints apply

This option (four taken none at a time) is trivial since it involves no constraints.

All constraints apply

This option (four taken four at a time) is trivial since it results in a set of contradictory constraints.

The five constraints listed below are trivial because they always exclude a project from the portfolio. A project should be excluded by not considering it in the first place, not by making it a possible candidate then excluding it via constraints:

Select neither project

This gives rise to the following portfolio possibility:

1. Neither A nor B is selected

Project A must not be selected

This gives rise to the following portfolio possibilities:

1. Neither A nor B is selected
2. B is selected but not A

Must only select project A

This gives rise to the following portfolio possibility:

1. A is selected but not B

Project B must not be selected

This gives rise to the following portfolio possibilities:

1. Neither A nor B is selected
2. A is selected but not B

Must only select project B

This gives rise to the following portfolio possibility:

1. B is selected but not A

The remaining nine constraints are more viable and may be applicable in certain situations:

Project A must be selected

This gives rise to the following portfolio possibilities:

1. A is selected but not B
2. Both A and B are selected

If project A is selected, B must also be selected

This gives rise to the following portfolio possibilities:

1. Neither A nor B is selected
2. Both A and B are selected
3. B is selected but not A

Project B must be selected

This gives rise to the following portfolio possibilities:

1. B is selected but not A
2. Both A and B are selected

If project B is selected, A must also be selected

This gives rise to the following portfolio possibilities:

1. Neither A nor B is selected
2. Both A and B are selected
3. A is selected but not B

Select both projects

This gives rise to the following portfolio possibility:

1. Both A and B are selected

Do not select both projects

This gives rise to the following portfolio possibilities:

1. Neither A nor B is selected
2. A is selected but not B
3. B is selected but not A

Select all or none

This gives rise to the following portfolio possibilities:

1. Both A and B are selected
2. Neither A nor B is selected

Select one and only one of the projects

This gives rise to the following portfolio possibilities:

1. A is selected but not B
2. B is selected but not A

Select at least one of the projects

This gives rise to the following portfolio possibilities:

1. A is selected but not B
2. B is selected but not A
3. Both A and B are selected

These selection constraints are subtly different and may be somewhat confusing. If used, take care to specify the constraint that properly reflects the intent.

Generic modeling of the nine viable selection constraints described previously is presented below for reference:

Constraint	Equation
Project P <sub>1</sub> must be selected	$P_1=1$
If project P <sub>1</sub> is selected, P <sub>2</sub> must also be selected	$P_1 - P_2 \leq 0$
Project P <sub>2</sub> must be selected	$P_2=1$
If project P <sub>2</sub> is selected, P <sub>1</sub> must also be selected	$P_2 - P_1 \leq 0$
Select both projects	$P_1 + P_2 = 2$
Do not select both projects	$P_1 + P_2 < 2$
Select all or none	$P_1 - P_2 = 0$
Select one and only one of the projects	$P_1 + P_2 = 1$
Select at least one of the projects	$P_1 + P_2 > 0$

**Table 16: Mathematical Equations for Project Selection Constraints**

The expressions below model the two dependency constraints in the example:

$$P_1 - P_2 \leq 0$$

$$P_3 - P_5 \leq 0$$

Representation Constraints

Projects are often assigned various attributes and classified according to those attributes. Examples include classifying projects by type of technology (e.g. legacy or new), by system type (e.g. transaction processing, decision support, etc.), or by sponsoring department. Representation constraints impose rules for ensuring that various attributes are represented in the portfolio in specified ways.

Representation constraints are a type of selection constraint. The difference is that selection constraints specify rules for including specific *projects* in the portfolio while representation constraints specify rules for including specific *attributes* in the portfolio. An example of a representation constraint would be that every department must have at least one project in the portfolio.

The example contains no representation constraints. An illustration of how to model such constraints, however, is included here for reference. Suppose that projects are classified according to sponsoring department and that there are three departments: department A, department B, and department C. Department A is sponsoring three projects: P<sub>A,1</sub>, P<sub>A,2</sub>, and P<sub>A,3</sub>. Department B is sponsoring two projects: P<sub>B,1</sub>, and P<sub>B,2</sub>. Department C is sponsoring four projects: P<sub>C,1</sub>, P<sub>C,2</sub>, P<sub>C,3</sub>, and P<sub>C,4</sub>. Suppose further that we want to impose the constraint that each

department has at least one project in the selected portfolio. The three equations below are required to implement this constraint:

$$\begin{aligned}
 P_{A,1} + P_{A,2} + P_{A,3} &> 0 \\
 P_{B,1} + P_{B,2} &> 0 \\
 P_{C,1} + P_{C,2} + P_{C,3} + P_{C,4} &> 0
 \end{aligned}$$

The same types of concepts may be used to ensure more specific forms of portfolio diversification. Suppose, for example, that the overall portfolio budget is \$B, and that the costs of the projects are C<sub>A,1</sub>, C<sub>A,2</sub>, ..., P<sub>C,4</sub> respectively. Further, instead of just ensuring that each department has at least one project in the portfolio, suppose we want Department A to represent at least 25% of the portfolio (as measured by project cost), Department B to represent at least 25% of the portfolio, and Department C to represent at least 25% but no more than 40% of the portfolio. These constraints may be modeled as shown below:

$$\begin{aligned}
 C_{A,1}P_{A,1} + C_{A,2}P_{A,2} + C_{A,3}P_{A,3} &\geq .25B \\
 C_{B,1}P_{B,1} + C_{B,2}P_{B,2} &\geq .25B \\
 C_{C,1}P_{C,1} + C_{C,2}P_{C,2} + C_{C,3}P_{C,3} + C_{C,4}P_{C,4} &\geq .25B \\
 C_{C,1}P_{C,1} + C_{C,2}P_{C,2} + C_{C,3}P_{C,3} + C_{C,4}P_{C,4} &\leq .4B
 \end{aligned}$$

Binary/Integer Constraints

The problem variable must be restricted to values of 0 or 1. This is to prevent the solution from containing a fraction of a project. The following expressions model this requirement:

$$\begin{aligned}
 \text{For } i=1...5, P_i &= \text{integer} \\
 \text{and } 0 &\leq P_i \leq 1
 \end{aligned}$$

*Step C.1.2.3: Run the Optimization*

After mathematically formulating the problem in terms of an objective and constraints, the optimization is executed. This requires an automated optimization program for integer programming. A convenient tool for this purpose is provided by the Solver add-in for Microsoft Excel. Use of Excel to solve the integer program in the example is explained in Appendix E.

Regardless of the tools used, the result of the integer program is selection of an optimized subset of the portfolio shortlist. This optimized subset conforms to all constraints and provides the best value for the objective function.

The table below illustrates the optimized portfolio for the example:

Project	Utility	Cost
P <sub>1</sub>	10	5
P <sub>2</sub>	3	2
P <sub>5</sub>	5	3
<b>Total</b>	<b>18</b>	<b>10</b>

**Table 17: Example of Results for Portfolio Optimization**

Note that this combination of projects represents the highest possible utility that can be obtained without exceeding the budget. In fact, the selected portfolio uses only \$10 million of the \$12 million budget. Also note that the dependency constraints are met. Both P<sub>1</sub> and P<sub>2</sub> are in the portfolio. Although there was a constraint indicating that P<sub>5</sub> must be in the portfolio if P<sub>3</sub> is, there is not a constraint indicating that P<sub>3</sub> must be in the portfolio if P<sub>5</sub> is. So, all constraints have been met.

**TASK C.1.3: REVIEW AND APPROVE THE PORTFOLIO**

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Optimization results</li> <li>• Project Idea Log</li> <li>• Project Proposals</li> </ul>	<ul style="list-style-type: none"> <li>• Approved portfolio</li> <li>• Project Idea Log updated with portfolio approval</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Portfolio Optimization Procedure</li> </ul>	

Once the optimized portfolio has been determined, it should be reviewed in detail by the Board. No automated technique can infallibly select the best portfolio. The Board should therefore review the portfolio to ensure that selections make sense both individually and as a group. They should understand what projects have been omitted as well as where this particular set of projects will take the organization. Substitutions should be made, as required, to arrive at a final portfolio that makes the most sense for the organization as a whole. This final portfolio should then be formally endorsed by the Board and communicated to the organization.

Update the Project Idea Log at this point to indicate whether or not the project proposal has been accepted into the portfolio.

**ACTIVITY C.2: PLAN THE PORTFOLIO**

Once the final portfolio has been selected, a feasible, high-level, time-phased, aggregate plan should be developed to maximize potential for the portfolio to actually achieve the results for which it was selected. This planning is necessarily high-level, since at this point detailed project plans or statements of work have not typically been developed. Planning should also be time-phased. This involves planning on a period-by-period basis over a horizon sufficient to allow decisions to be planned in the future without creating crisis situations. In addition, the planning should be aggregate—that is, it should consider not just the individual projects but the portfolio as a whole. Recall the true story related in the introduction of the organization whose portfolio of projects came to a screeching halt due to a bottleneck created by a lack of Testers. Aggregate planning—a comprehensive look at the portfolio as a whole—would have detected and hopefully avoided this problem. Finally, the portfolio plan must be feasible. Feasibility includes several dimensions. For example:

- The portfolio plan must account for and observe natural dependencies that exist among the individual projects.

- The plan must be feasibly time-phased. This means not only that the schedule must observe dependencies, but also that the time allotted for individual projects is sufficient, and that the organization can successfully absorb the planned amount of change.
- The plan must be feasible with respect to available resources. Such resources include dollars, personnel, and facilities. Note that this requirement does not mean that portfolios must necessarily be forced to conform to the limitations of current resource levels. Rather, it means that the plan must balance resource supply with resource demand, which includes specification of actions both to reduce demand for and/or increase supply of resources, as appropriate.

The diagram below illustrates the procedural flow for this activity:

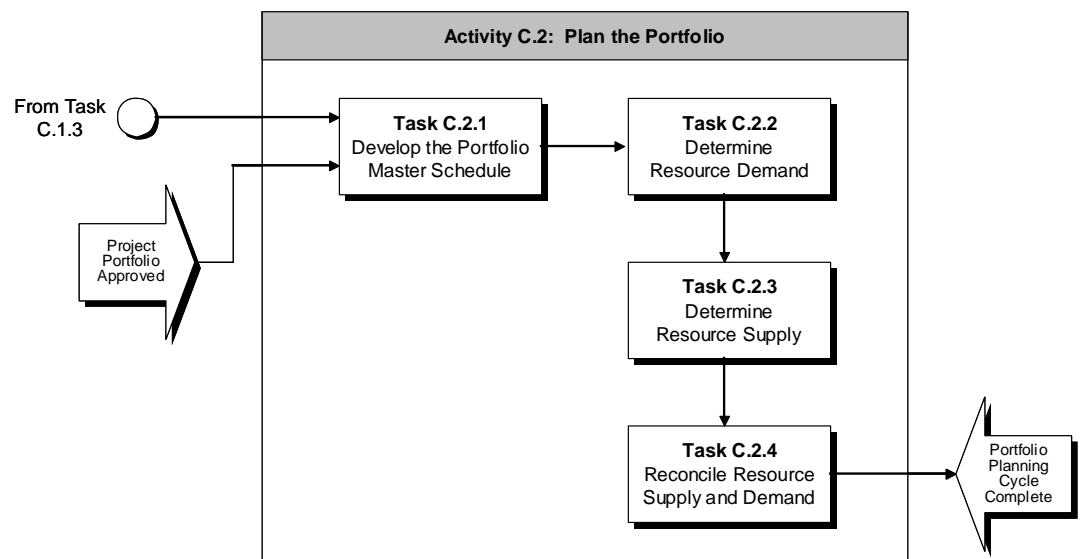


Figure 6: Procedural Flow for Activity C.2

TASK C.2.1: DEVELOP THE PORTFOLIO MASTER SCHEDULE

Inputs	Outputs
<ul style="list-style-type: none"> <li>• Approved portfolio</li> <li>• Project Proposals</li> <li>• Organization Transformation Plan and/or Enterprise Architecture</li> </ul>	<ul style="list-style-type: none"> <li>• Time-Phased Planning Template updated with Master Schedule</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>• P<sup>3</sup> Methodology</li> <li>• Portfolio Planning Process</li> <li>• Time-Phased Planning Procedure</li> <li>• Time-Phased Planning Template</li> <li>• Time-Phased Planning software</li> </ul>	

The Portfolio Master Schedule is a time-phased representation of the portfolio over a planning horizon sufficient to include all projects in the portfolio. Some of the considerations when developing the Master Schedule are identified below.

*Step C.2.1.1: Determine the Planning Horizon*

While the number of periods in the portfolio horizon may extend over multiple years to show the entire portfolio, a shorter time horizon may sometimes be used for resource planning. For purposes of planning, a rolling horizon may be used. This horizon must cover the maximum of either the required budgeting period or the number of periods needed to plan and execute the longest type of resource action that might be needed. This ensures that actions undertaken to balance resource supply and demand can be planned as future actions that can be modified, as needed, without causing a crisis situation. (For example, suppose we deal with two types of resources: personnel and facilities, and that there is a 1 year budget cycle. Further, the most difficult type of skill to obtain is that of Tester. It takes 3 months to find and hire a Tester. Suppose we must also consider the possibility of downsizing, and that it takes 6 months to plan a downsizing program. Due to possible expansion in some areas, new facilities may need to be constructed, and it takes two years to plan and bring a new facility online. In this case, to ensure adequate planning time, the horizon used would need to be at least two years.)

*Step C.2.1.2: Determine When Specific Functionality and Capabilities Are Needed*

The project portfolio exists to support the business. The Master Schedule must therefore provide planned benefits at the time the business needs those benefits. Sometimes there will be a hard deadline or a window of opportunity that dictates when specific capabilities or benefits are needed. The Board must ensure that such business considerations are identified and properly reflected in the Master Schedule.

*Step C.2.1.3: Determine Dependencies between Projects*

There are often hard dependencies between projects in a portfolio that help dictate the order in which the projects are scheduled. A dependency occurs if one project cannot be implemented until one or more other projects are complete. This might occur due to a processing interface between systems or because one project provides capabilities or functionality that is a foundation or stepping stone for more advanced capability.

*Step C.2.1.4: Specify a Transformation Sequence*

Even if there are no business deadlines or hard dependencies between projects, unless the organization can simultaneously undertake all projects in the portfolio, a workable sequencing must still be determined. This sequencing may be impacted by multiple factors, such as:

- Relative priority of the projects, as specified in the Project Proposals
- A desired or arbitrary transformation sequence as specified by an Organization Transformation Plan or by a migration sequence specified in an Enterprise Architecture
- The amount of change the organization can absorb at any one time

*Step C.2.1.5: Determine the Duration of Each Project*

The Master Schedule reflects and is dependent on the estimated elapsed time for each project in the portfolio. Duration should already have been estimated in the Project Proposal and used as a primary determinant of project cost. If, however, there is not a good estimate of duration, prepare one now. This should be a risk-adjusted duration estimate that provides a high level of confidence that the duration is reasonable. (Note: if duration is developed or modified here, the entire project must be re-evaluated for cost, financial benefit, utility, etc.).

*Step C.2.1.6: Document the Master Schedule*

The Master Schedule may be presented as a Gantt Chart or in any other format that is convenient and which provides a good overview of the portfolio. All programs, projects, and releases (see Appendix C) included in the portfolio should be represented on the chart. Projects may overlap to any degree consistent with previously described dependencies and constraints. Time periods on the chart are typically in months, quarters, or years, as appropriate to the portfolio. An example of a simple Portfolio Master Schedule is illustrated below:

Portfolio Master Schedule	Period (Month)																																										
	0 1	0 2	0 3	0 4	0 5	0 6	0 7	0 8	0 9	1 0	1 1	1 2	1 3	1 4	1 5	1 6	1 7	1 8	1 9	2 0	2 1	2 2	2 3	2 4	2 5	2 6	2 7	2 8	2 9	3 0	3 1	3 2	3 3	3 4	3 5	3 6							
XYZ Program	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x								
Release 1	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																												
Project 1	x	x	x	x	x	x	x	x	x																																		
Project 2										x	x	x	x	x	x																												
Release 2																x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Project 3																x	x	x	x	x	x	x	x	x																			
Project 4																																											
Project 5																																											
Project 8	x	x	x	x	x	x	x	x	x	x	x	x																															
Project 6				x	x	x	x	x	x																																		
Project 10								x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x																				
Project 7														x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x						
Project 9																																						x	x	x	x	x	x

Figure 7: Example of Time-Phased Planning Showing Portfolio Master Schedule

Note that this chart represents a rolling horizon with the current point in time at the double vertical bar. All periods shown on the chart are future periods.

TASK C.2.2: DETERMINE RESOURCE DEMAND

Inputs	Outputs
<ul style="list-style-type: none"> <li>Time-Phased Planning Template updated with Master Schedule</li> <li>Project Proposals</li> </ul>	<ul style="list-style-type: none"> <li>Demand Profile</li> <li>Time-Phased Planning Template updated with Demand Profile</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>P<sup>3</sup> Methodology</li> <li>Portfolio Planning Process</li> <li>Time-Phased Planning Procedure</li> <li>Portfolio Resource Demand Profile</li> <li>Time-Phased Planning Template</li> <li>Time-Phased Planning software</li> </ul>	

Resource demand includes needs for all resources required to support and enable the project portfolio. As mentioned previously, this may include the need for capital, for personnel, for facilities and equipment, and for other types of resources. The steps below cover developing time-phased estimates of resource demand.

Step C.2.2.1: Identify the Resources to Be Evaluated

Specific resources to be evaluated must first be identified. Not all resources necessarily need to be included in this analysis—only those that are or which have the potential for being critical. Understand, however, that omitting a resource from the analysis leaves open the possibility of being blindsided by an unanticipated problem involving that resource. In addition to resources that may typically be common to all projects, review each project individually to catch any unique resource requirements that may be present.

*Step C.2.2.2: Estimate Requirements for Each Resource for Each Project*

For purposes of portfolio planning, resource requirements may be dealt with at a high-level. This means that rough order of magnitude estimates may be used based on rules of thumb or prior experience unless more detailed and specific analyses are available. Such estimates should already be available in the Project Proposal.

*Step C.2.2.3: Time-Phase the Resource Requirements*

Resource requirements must be time-phased. This means that it is not enough to know just the quantity of the resource required. In addition, the timing of the need with respect to the project is also required. Examples of such time-phased requirements include:

- Project 1 will require 2000 square feet of floor space for the duration of the project
- Project 1 will require a Business Architect for the first 6 months

*Step C.2.2.4: Determine Total Resource Demand by Period*

Resource demand may be summarized using a Portfolio Resource Demand Profile as illustrated in Table 18 below. The profile is used to determine total resource demand by period. Suppose, for example, we are interested in demand for Business Architects and that, as a general rule, Business Architects are needed fulltime for the first half of a project and halftime for the second half. Using the Master Schedule to drive the demand, the resulting profile is summarized below:

DEMAND FOR BUSINESS ARCHITECTS		
Period	Demand	Source of Demand
1	2	1 for Project 1 + 1 for Project 8
2	2	1 for Project 1 + 1 for Project 8
3	2	1 for Project 1 + 1 for Project 8
4	3.5	1 for Project 1 + 1 for Project 8 + 1 ½ for Project 6
5	3.5	1 for Project 1 + 1 for Project 8 + 1 ½ for Project 6
6	3	½ for Project 1 + 1 for Project 8 + 1 ½ for Project 6
7	2.5	½ for Project 1 + ½ for Project 8 + ½ for Project 6 + 1 for Project 10
8	2.5	½ for Project 1 + ½ for Project 8 + ½ for Project 6 + 1 for Project 10
9	2.5	½ for Project 1 + ½ for Project 8 + ½ for Project 6 + 1 for Project 10
10	2.5	1 for Project 2 + ½ for Project 8 + 1 for Project 10
11	2.5	1 for Project 2 + ½ for Project 8 + 1 for Project 10
12	2.5	1 for Project 2 + ½ for Project 8 + 1 for Project 10

**Table 18: Example of a Portfolio Resource Demand Profile**

Once total demand is known, it can be illustrated in the Demand row of a Resource Supply and Demand Chart. This is a time-phased chart that may be produced standalone or may be appended to the Project Master Schedule as in Figure 8 below.

Resource Supply and Demand		Period (Months)											
Master Schedule		1	2	3	4	5	6	7	8	9	10	11	12
Project 1 (period 1 – 9)		x	x	x	x	x	x	x	x	x			
Project 2 (period 10 – 15)											x	x	x
Project 3 (period 16 – 24)													
Project 4 (period 25 – 27)													
Project 5 (period 28 – 33)													
Project 8 (period 1 – 12)		x	x	x	x	x	x	x	x	x	x	x	x
Project 6 (period 4 – 9)					x	x	x	x	x	x			
Project 10 (period 7 – 24)								x	x	x	x	x	x
Project 7 (period 13 – 30)													
Project 9 (period 31 – 36)													
Resource Planning													
Business Architects (LT=2)	On Hand												
	Supply												
	Demand	2	2	2	3.5	3.5	3	2.5	2.5	2.5	2.5	2.5	2.5
	Available												
	Initiate Action												

Figure 8: Example of Time-Phased Planning Showing Master Schedule and Demand

TASK C.2.3: DETERMINE RESOURCE SUPPLY

Inputs	Outputs
<ul style="list-style-type: none"> <li>Time-Phased Planning Template updated with Demand Profile</li> <li>Project Proposals</li> <li>Resource availability</li> </ul>	<ul style="list-style-type: none"> <li>Time-Phased Planning Template updated with resource availability</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>P<sup>3</sup> Methodology</li> <li>Portfolio Planning Process</li> <li>Time-Phased Planning Procedure</li> <li>Time-Phased Planning Template</li> <li>Time-Phased Planning software</li> </ul>	

Resource supply measures current resources as well as additional resources planned to be available. The steps below cover identification and documentation of resource supply.

*Step C.2.3.1: Determine Current Resource Availability*

Current resource availability is the amount of resources actually on-hand and available for immediate use as of the planning date for the portfolio. This is determined by conducting an inventory of each required resource. Do not include resources that “might” be available or that could be available, just those that are actually currently usable to support the portfolio. If resources exist but are already committed to some other purpose, they should not be included. In the example, suppose that there are two Business Architects currently onboard. This is indicated in the On Hand row of the Supply and Demand Chart as a beginning quantity of 2. (See Figure 9 below.)

*Step C.2.3.2: Determine Currently Planned Future Resource Availability*

If there are modifications to resource supply that are already planned as of the portfolio planning date, these modifications should be identified for use in determining resource availability. Such modifications include both planned increases and decreases in resource supply. Examples include:

- 1000 square feet of office space will be lost on January 1 when the lease for the satellite office expires
- 2 new servers have been ordered and are scheduled to be installed on May 15
- 3 new project managers have been hired. One will be onboard April 1, one on May 1, and one August 1
- Number of programmers will be reduced by 20% on July 1

For purposes of the ongoing example, suppose that a task order has been issued to a contractor to obtain a halftime Business Architect beginning in period 3. This is indicated in the Supply and Demand Chart by the .5 in period 3 of the On Hand row. (See Figure 9.)

*Step C.2.3.3: Determine Total Resource Supply by Period*

To fully represent time-phased resource supply on a period-by-period basis, cumulative resource availability is determined from current and planned availability, and is recorded in the Supply row of the Supply and Demand Chart. From the example, the starting availability of 2 Business Architects provides a total supply of 2 in periods 1 and 2. The halftime contractor comes onboard in period 3, resulting in available supply of 2.5 Business Architects in periods 3 through 12.

Resource Supply and Demand		Period (Months)											
Master Schedule		1	2	3	4	5	6	7	8	9	10	11	12
Project 1 (period 1 – 9)		x	x	x	x	x	x	x	x	x			
Project 2 (period 10 – 15)											x	x	x
Project 3 (period 16 – 24)													
Project 4 (period 25 – 27)													
Project 5 (period 28 – 33)													
Project 8 (period 1 – 12)		x	x	x	x	x	x	x	x	x	x	x	x
Project 6 (period 4 – 9)					x	x	x	x	x	x			
Project 10 (period 7 – 24)								x	x	x	x	x	x
Project 7 (period 13 – 30)													
Project 9 (period 31 – 36)													
Resource Planning													
Business Architects (LT=2)	On Hand	2			.5								
	Supply		2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Demand		2	2	2	3.5	3.5	3	2.5	2.5	2.5	2.5	2.5
	Available												
	Initiate Action												

Figure 9: Example of Time-Phased Planning Showing Master Schedule, Supply, and Demand

TASK C.2.4: RECONCILE RESOURCE SUPPLY AND DEMAND

Inputs	Outputs
<ul style="list-style-type: none"> <li>Time-Phased Planning Template updated with resource availability</li> </ul>	<ul style="list-style-type: none"> <li>Time-Phased Planning Template updated with net resource position</li> <li>Corrective actions</li> </ul>
Supporting Tools	
<ul style="list-style-type: none"> <li>P<sup>3</sup> Methodology</li> <li>Portfolio Planning Process</li> <li>Time-Phased Planning Procedure</li> <li>Time-Phased Planning Template</li> <li>Resource Action Chart</li> <li>Time-Phased Planning software</li> </ul>	

In order to have a resource-feasible portfolio, resource supply and demand must be balanced. This entails planning *in advance* those actions necessary to ensure availability of sufficient resources at the time needed by the project portfolio. This provides several benefits:

- Resource crises such as the lack of sufficient testers that doomed multiple projects in the previously-related story can be detected and avoided
- Changes in resource strategy can be planned in advance without affecting the current situation

- Resource overages and shortages can be minimized
- Cost of resources can be determined over time and used to support budgeting

The steps below address resource supply and demand reconciliation.

*Step C.2.4.1 Determine Time-Phased Resource Position by Period*

Time-phased resource position is the net resource availability determined on a period-by-period basis. For any time period  $t$ ,

$$\text{Resource Position}_t = \text{Supply}_t - \text{Demand}_t$$

That is, resource position *at the end* of any period is the available supply *at the beginning* of that period less planned demand *during* the period. Perfectly balanced supply and demand is reflected by a resource position of 0. A negative available quantity in any period reflects a resource shortage that should potentially be covered in some manner. Similarly, a positive available quantity in any period reflects a resource overage that may need to be addressed in some manner.

[Note: Care must be taken to distinguish between consumable and persistent resources. Time-phased planning of this type is traditionally associated with planning of consumable resources such as inventory items using Material Requirements Planning (MRP). With consumable resources, the resource, once used, is no longer available. For example, if we have an inventory of 10 widgets, and we use 4 of them in period 1, then there are only 6 widgets available for use in period 2. With persistent resources (e.g. personnel), however, the resource is only consumed in a given period but is “renewed” for the following period. For example, suppose we have 1 Business Architect onboard, and we commit 40% of his or her time in period 1. In period 1, we still have 60% of a BA available. In period 2, however, we again have a full BA available, not just 60%.]

Step C.2.4.2: Document Time-Phased Resource Position over the Total Horizon

Resource position, as determined above, is documented in the “Available” row of the Resource Supply and Demand Chart:

Resource Supply and Demand		Period (Months)											
Master Schedule		1	2	3	4	5	6	7	8	9	10	11	12
Project 1 (period 1 – 9)		x	x	x	x	x	x	x	x	x			
Project 2 (period 10 – 15)											x	x	x
Project 3 (period 16 – 24)													
Project 4 (period 25 – 27)													
Project 5 (period 28 – 33)													
Project 8 (period 1 – 12)		x	x	x	x	x	x	x	x	x	x	x	x
Project 6 (period 4 – 9)					x	x	x	x	x	x			
Project 10 (period 7 – 24)								x	x	x	x	x	x
Project 7 (period 13 – 30)													
Project 9 (period 31 – 36)													
Resource Planning													
Business Architects (LT=2)	On Hand	2			.5								
	Supply		2	2	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5	2.5
	Demand		2	2	2	3.5	3.5	3	2.5	2.5	2.5	2.5	2.5
	Available		0	0	.5	-1	-1	-.5	0	0	0	0	0
	Initiate Action												

Figure 10: Example of Time-Phased Planning Showing Computed Resource Position

Note from the Available row that the 2 BA’s currently on-board exactly cover portfolio needs in the first 2 months (i.e. available =0). There is, however, a surplus of .5 BA in month 3, a net shortage of 1 BA in months 4 and 5, and .5 BA in month 6.

Step C.2.4.3: Plan Corrective Actions

Corrective actions are planned in advance to rectify any supply and demand imbalances that will adversely affect the portfolio. These corrective actions may include many options such as:

- Hiring resources from outside the company
- Transferring resources from another division
- Transferring resources to another division
- Deferring planned hires
- Training existing personnel
- Reduction in force
- Etc.

Continuing the previous example, we need to cover the resource imbalances noted above. Here are some options:

- Defer the start of the contracted halftime BA from period 3 to period 4. This will eliminate the .5 BA overage in period 3 while still covering part of the shortage in period 4. Note in Figure 11 that the .5 BA on hand has been moved from period 3 to period 4. Also note that the notation "D (.5)" has been placed in the Initiate Action row indicating that we must undertake this change (i.e. deferring .5) in period 3.
- This still leaves a projected shortage of 1 BA beginning in period 4. Suppose the lead time (LT) for obtaining a Business Architect is typically 2 months. In order to have the BA onboard in period 4 when needed, we would need to start the process of obtaining a new BA in period 2. The method planned for obtaining the additional resource should be specified. For example, a resource might be borrowed from another division. Note that the notation "H (1)" has been placed in the Initiate Action row indicating that we must undertake this change (i.e. hiring 1) in period 2.
- The above actions rectify imbalances through period 5 but leave us with an overage of .5 BA in period 6 and 1 BA in periods 7 through 12. As a result, we can plan to release the contracted BA in period 6. This is indicated by the -.5 in the on-hand row in period 6 and the corresponding notation of "R (.5)" (i.e. release .5) in the Initiate Action row.
- The final action is to plan to release the borrowed BA in period 7. This is indicated by the -.5 in the on-hand row in period 7 and the corresponding notation of "R (.5)" in the Initiate Action row.

The revised chart below summarizes these actions and reflects the resultant totally balanced supply and demand for the year:

Resource Supply and Demand		Period (Months)											
Master Schedule		1	2	3	4	5	6	7	8	9	10	11	12
Project 1 (period 1 – 9)		x	x	x	x	x	x	x	x	x			
Project 2 (period 10 – 15)											x	x	x
Project 3 (period 16 – 24)													
Project 4 (period 25 – 27)													
Project 5 (period 28 – 33)													
Project 8 (period 1 – 12)		x	x	x	x	x	x	x	x	x	x	x	x
Project 6 (period 4 – 9)					x	x	x	x	x	x			
Project 10 (period 7 – 24)								x	x	x	x	x	x
Project 7 (period 13 – 30)													
Project 9 (period 31 – 36)													
Resource Planning (H = hire, D = delay, R = release)													
Business Architects (LT=2)	On Hand	2				.5+1			-.5	-.5			
	Supply		2	2	2	3.5	3.5	3	2.5	2.5	2.5	2.5	2.5
	Demand		2	2	2	3.5	3.5	3	2.5	2.5	2.5	2.5	2.5
	Available		0	0	0	0	0	0	0	0	0	0	0
	Initiate Action			H (1)	D (.5)				R (.5)	R (.5)			

Figure 11: Example of Time-Phased Planning Showing Corrective Actions

Often, required actions are summarized for convenience from the Supply and Demand Chart onto a separate Resource Action Chart, as in the example below:

Period	Action	Quantity
2	Initiate borrow of a fulltime BA from Division X. Target onboard in period 4.	1
3	Delay onboard of contracted halftime Business Architect from period 3 to period 4	.5
6	Release the contracted halftime BA in this period	.5
7	Release the borrowed fulltime BA in this period	.5

**Table 19: Resource Action Chart**

The actions specified above are just an example of how the resource imbalances could be addressed. Any number of different actions might be taken to obtain the same results. Note also that while the example specified a lead time of 2 periods to onboard a new BA, no lead time was specified for other actions. More realistically, some lead time might be required for releasing resources or other pertinent actions.

Portfolio planning should be revisited at the start of every period to ensure that the plan continually reflects the current status of projects and resources.

## APPENDICES

The following Appendices provide material that supplements and supports use of the P<sup>3</sup> Methodology. Due to volume considerations, only Appendix A is included in this paper. For information regarding remaining appendices, please contact the author.

### Appendix A: The BAR Model

This appendix provides details of a pre-defined model that can be used to score and rank projects. The model evaluates projects according to their net benefit, alignment with organizational objectives, and degree of risk. The result is a single number—the BAR Score—that can be used to compare projects.

### Appendix B: Portfolio Effects

This appendix illustrates and explains the aggregate impact of individual project risks on overall portfolio performance and suggests how these phenomena can be used to advantage.

### Appendix C: Program and Release Considerations

This appendix examines adaptation of portfolio concepts as they apply to multiple project releases and to projects that are part of a larger program.

### Appendix D: Project Financial Performance Simulation Example

This appendix illustrates Monte Carlo Simulation of an ROI estimate.

### Appendix E: Using Excel to Solve Integer Programming Problems

This appendix gives an example of how to use the Solver add-in for Microsoft Excel to solve integer programming problems.

### Appendix F: Financial Measures

This appendix presents definitions of some of the financial measures commonly used to assess projects.

### Appendix G: Forms and Templates

This appendix contains examples of forms and templates that may be used in conjunction with the methodology.

**APPENDIX A: THE BAR MODEL**

The BAR Model is a method for assigning relative scores to systems projects. The model evaluates a project in terms of three primary dimensions: Benefit (B), Alignment (A), and Risk (R). Benefit is a measure of the total advantage gained by the organization as a result of the project. This advantage may be a combination of both financial and non-financial benefits. Alignment is a measure of how well the project fits and supports the strategic direction of the organization. Risk is a measure of potential negative impact to the project or to the organization itself as a result of the project.

The three dimensions of the BAR Model have some important interrelationships:

- Benefit and Risk combine to form a unique characterization of the project, as summarized in the table below.

		BENEFIT	
		LOW	HIGH
RISK	HIGH	<i>AVOID THESE IF POSSIBLE</i>	<i>EVALUATE THESE FURTHER</i>
	LOW	<i>EVALUATE THESE FURTHER</i>	<i>SELECT THESE IF POSSIBLE</i>

**Table 20: Project Characterization in Terms of Benefit and risk**

For example, projects characterized by high benefit and low risk are potentially very attractive, while projects providing low benefit but high risk should probably be avoided. The case is not as clear, however, for projects characterized by high benefit and high risk or by low benefit and low risk. These usually require further analysis.

- Of the three BAR dimensions, alignment is of primary importance. For example, it is of little consequence that a project has extremely low risk if the project does not support any desired business directions. Even a project that promises to deliver high benefit should not be of interest if that benefit is in an area that the business doesn't care about. Benefit and Risk, therefore, are only meaningful in light of a project's degree of Alignment.

The BAR Model is represented by the following equation, which captures the essence of the above interrelationships:

$$BAR = (BENFIT + RISK) \times ALIGNMENT$$

In this equation, the three BAR dimensions are each evaluated on a scale from 0 to 1, as follows:

BAR Scores	Score	
BAR Dimension	0	1
Benefit	Low Benefit	High Benefit
Alignment	Low Alignment	High Alignment
Risk	High Risk	Low Risk

**Table 21: Evaluation of BAR Score Dimensions**

To get a feeling for how the BAR Model ranks projects with different characteristics, assume, for purposes of illustration, that the three BAR dimensions can only assume three values: 0, .5, or 1. (In practice they may assume any value between 0 and 1). There would then be a total of 27 different combinations of BAR dimension scores that could occur. These are enumerated in the table below:

BAR = (Benefit + Risk) x Alignment				
	Benefit	Risk	Alignment	BAR Score
1	High (1)	High (0)	Low (0)	0
2	High (1)	Medium (1/2)	Low (0)	0
3	High (1)	Low (1)	Low (0)	0
4	Medium (1/2)	High (0)	Low (0)	0
5	Medium (1/2)	Medium (1/2)	Low (0)	0
6	Medium (1/2)	Low (1)	Low (0)	0
7	Low (0)	Medium (1/2)	Low (0)	0
8	Low (0)	Low (1)	Low (0)	0
9	Low (0)	High (0)	Low (0)	0
10	Low (0)	High (0)	Medium (1/2)	0
11	Low (0)	High (0)	High (1)	0
12	Medium (1/2)	High (0)	Medium (1/2)	.25
13	Low (0)	Medium (1/2)	Medium (1/2)	.25
14	High (1)	High (0)	Medium (1/2)	.50
15	Medium (1/2)	High (0)	High (1)	.50
16	Medium (1/2)	Medium (1/2)	Medium (1/2)	.50
17	Low (0)	Medium (1/2)	High (1)	.50
18	Low (0)	Low (1)	Medium (1/2)	.50
19	High (1)	Medium (1/2)	Medium (1/2)	.75
20	Medium (1/2)	Low (1)	Medium (1/2)	.75
21	High (1)	High (0)	High (1)	1.00
22	High (1)	Low (1)	Medium (1/2)	1.00
23	Medium (1/2)	Medium (1/2)	High (1)	1.00
24	Low (0)	Low (1)	High (1)	1.00
25	High (1)	Medium (1/2)	High (1)	1.50
26	Medium (1/2)	Low (1)	High (1)	1.50
27	High (1)	Low (1)	High (1)	2.00

**Table 22: Possible Combinations of BAR Dimension Scores**

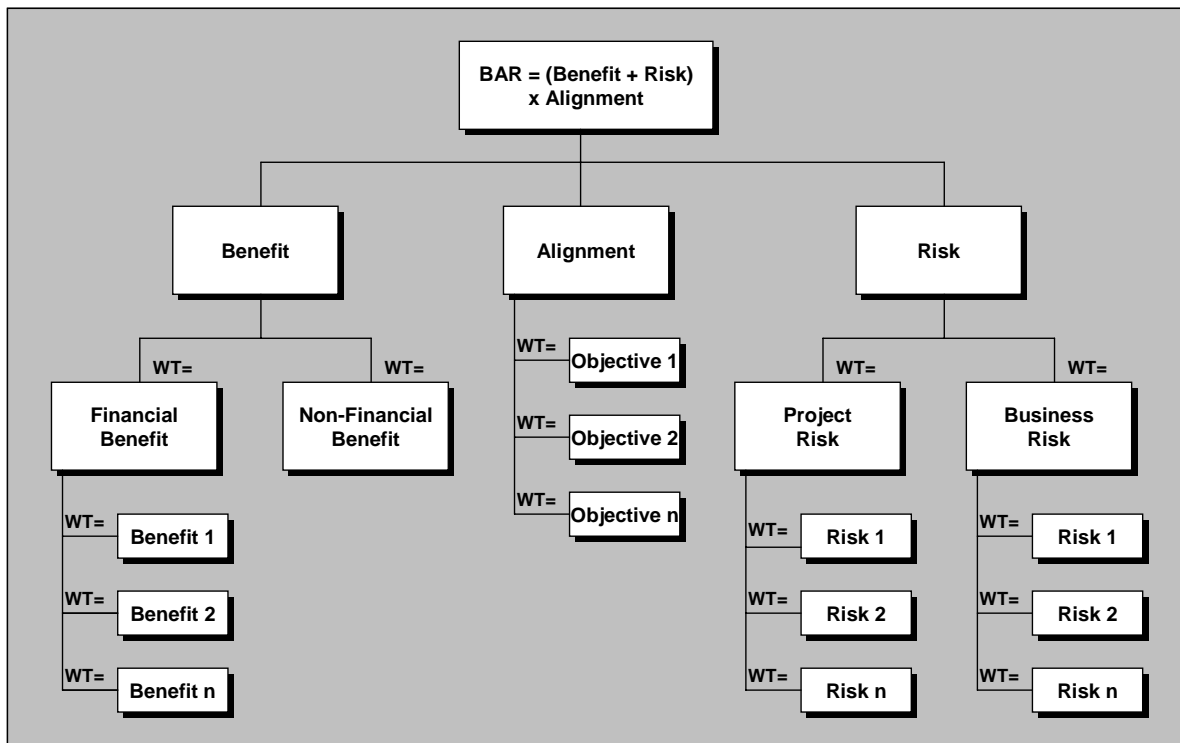
From this table, note the following:

- The BAR scores range from a low of 0 to a high of 2
- Projects with high benefit, low risk, and high alignment score the maximum (2)
- Projects with low benefit and high risk and/or low alignment score the minimum (0)
- The remaining table entries show that various combinations of dimension scores can produce projects with identical BAR scores

The overall BAR score for the project, then, is a number between 0 and 2 that provides a relative measure of the project's overall attractiveness taking into account its potential benefit, degree of risk, and alignment with organizational objectives.

**Establishing the BAR**

Each project is evaluated according to various criteria to arrive at a BAR Score. The BAR Score is computed according to the general model illustrated below:



**Figure 12: Illustration of the BAR Score Model**

Key elements of this model include:

- A single BAR score is computed for each project and used as a measure of relative project value. The score is computed as:  
 $BAR = (Benefit + Risk) \times Alignment.$

- Individual scores are computed for each of the three BAR dimensions: project Benefit, Alignment, and Risk. Each BAR dimension is scored from 0 to 1.
- Each of the three BAR dimensions is composed of multiple components:
  - Project Benefit is composed of a Financial Benefit Component and a Non-Financial Benefit Component. The Financial Component measures the dollar value of the project in various standard financial terms. The Non-Financial Component measures soft benefits that, while not quantifiable in dollar terms, are nonetheless real. This allows for projects that may have poor or even negative financial consequences but which have other considerations that make them worthy of serious evaluation. Weights are assigned to each of the two benefit components to indicate relative degree of importance. The assigned weights should sum to 1.
  - Project Alignment is composed of multiple components. These components correspond to the business and technical objectives that are important to the organization and which the project should support. An example of a business objective might be “Reduce the amount of time required to bring a new product to market from two years to six months”. An example of a technical objective might be: “Implement a state-of-the-art information network that will provide the organization with competitive advantage for the next five years”. Weights are assigned to each objective to indicate relative degree of importance. The assigned weights should sum to 1.
  - Risk is composed of a Project Risk Component and a Business Risk Component. Project risk is a measure of *an unacceptable level of impact* to the project itself while business risk is a measure of *an unacceptable level of impact* to the organization, its operations, or performance arising as a result of the project. Weights are assigned to each of the two risk components to indicate relative degree of importance. The assigned weights should sum to 1.

A distinction must be made between risks and risk conditions. Often, we hear statements such as “one of the project’s risks is that it is using unproven technology”. This is not a correct statement of the situation. Remember that a risk is a consequence that may or may not occur. That the project is using unproven technology might be a fact or, perhaps, an opinion, but it is not a risk. It is, more accurately, a risk condition—that is, a condition possessed by the project that makes the project more susceptible to impact by a true risk (e.g. producing a solution that doesn’t work reliably).

- Financial Benefit is composed of multiple factors, each of which is assigned a weight to indicate relative degree of importance. Any number of factors may be included so long as the assigned weights sum to 1. Whatever factors are the most relevant may be selected. Examples of potential factors include those described in Appendix F.

- A measure of Non-Financial Benefit is included in the model to complement the Financial Benefits. Examples of Non-Financial Benefits include:
  - Improved employee morale,
  - Increased customer loyalty,
  - Enhanced company image, and
  - More effective organizational learning.

Although it would be possible to pre-select a listing of such benefits for use in evaluating projects, many projects have unique non-financial benefits that would likely be excluded by such a pre-selected list. Therefore, to ensure fairness to all projects, the model does not pre-select a listing but includes only an overall measure of Non-Financial Benefit, measured on a scale of 0 to 1.

- Project Risk is composed of multiple factors, each of which is assigned a weight to indicate relative degree of importance. Any number of factors may be included so long as the assigned weights sum to 1. Examples of project risks include:
  - The project may exceed schedule
  - The project may exceed budget
  - The project may not produce a solution that meets requirements
  - The project may not produce a high quality, reliable solution.
- Business Risk is composed of multiple factors, each of which is assigned a weight to indicate relative degree of importance. Any number of factors may be included so long as the assigned weights sum to 1. Examples of business risks include:
  - Project benefits may not be achieved
  - The solution may cause business disruption
  - The organization may not be able to accept the degree of change required.

### **Evaluating Benefit**

Evaluating a project along the Benefit dimension results in a benefit score between 0 and 1 for use in the BAR equation. The evaluation process is performed as follows:

1. Assign weights to the financial and non-financial benefit components  
Since the Benefit dimension has both financial and non-financial components, the relative importance of these two components must be decided. This is accomplished by assigning weights to each component such that the weights sum to 1. For example, if financial and non-financial benefits are to have equal weight relative to each other, assign both components a weight of .50. Or, if financial benefits are to carry twice the weight of non-financial benefits, use

weights of .67 and .33 respectively.

2. List all pertinent financial and non-financial benefit factors  
Two listings of benefit factors should be developed to measure the project against: a listing of financial benefit factors and a separate listing of non-financial benefit factors. Financial factors are fairly standard. An appropriate subset of the factors described earlier may be used or bolstered by any additional measures favored by the Finance Department. The resulting list is used to measure all projects. As mentioned previously, however, non-financial benefits tend to be more unique. Therefore, an individual listing of non-financial benefits must be developed for each project.
  
3. Assign weights to all financial benefit factors to indicate relative importance  
A set of weights should be assigned to the selected financial benefit factors. Each factor would be assigned a weight indicating its relative importance compared to the other financial benefit factors and such that the total of all financial benefit weights is 1. Guidance on assigning relative weights is provided in a subsequent section.
  
4. Develop a Benefit scoring method  
A standardized scoring method should be developed to evaluate project benefit. Since the final Benefit score must range from 0 – 1 and the weights assigned to individual benefit factors must sum to 1, the scoring method for benefit factors must then assign scores that range from 0 – 1. Any method that results in a 0 – 1 score may be used. For non-financial benefits, a single scoring method for overall non-financial benefit is needed. An example is illustrated below:

<b>Non-Financial Benefit Scoring Criteria</b>	<b>Score</b>
The project is highly likely (i.e. probability >75%) to produce extremely important non-financial benefits.	1.00
The project is likely (i.e. probability 25% - 75%) to produce extremely important non-financial benefits.	0.75
The project is highly likely (i.e. probability >75%) to produce some non-financial benefits that would be nice to have but not of great importance.	0.50
The project is likely (i.e. probability 25% -75%) to produce some non-financial benefits that would be nice to have but not of great importance.	0.25
The project is unlikely (i.e. probability <25%) to produce any significant non-financial benefit.	0.00

**Table 23: Example of Non-Financial Benefit Scoring Criteria**

For financial benefits, different scoring methods may be appropriate for each benefit factor. The example below illustrates a scoring scheme for 2 financial benefit factors.

Financial Benefit Factor	Scoring Criteria	Score
Internal Rate of Return (IRR)%	More than 20% over hurdle rate	1.00
	Between 15% - 20% over hurdle rate	0.80
	Between 10% - 15% over hurdle rate	0.60
	Between 5% - 10% over hurdle rate	0.40
	Up to 5% over hurdle rate	0.20
	Equal to hurdle rate	0.00
	Payback Period	Less than 6 months
	Between 6 and 12 months	0.80
	Between 12 and 18 months	0.60
	Between 18 and 24 months	0.40
	Between 24 and 30 months	0.20
	Over 30 months	0.00

**Table 24: Example of Financial Benefit Scoring Criteria**

5. Develop the Benefit score

To develop a Benefit score, the project is first scored against the individual financial benefit factors according to the scoring method developed earlier. When this initial scoring is complete, the raw score for each financial benefit factor is multiplied by the factor’s assigned weight. These weighted scores are then summed, resulting in the Financial Benefit score.

The project is then scored for non-financial benefit according to the scoring method developed earlier. This is done by reviewing the project’s unique listing of non-financial benefit factors, and using this listing to judge the most appropriate overall Non-Financial Benefit score.

After obtaining Financial and Non-Financial Benefit scores, these scores are combined by multiplying each by their respective weights and adding the results. The end product is the project’s Benefit score for use in the BAR equation.

**Evaluating Alignment**

Evaluating a project along the Alignment dimension results in an Alignment score between 0 and 1 for use in the BAR equation. Use the following evaluation process:

1. Develop an alignment scoring method

A standardized scoring method should be developed to evaluate projects against individual objectives. Since the final Alignment score must range from

0 – 1 and the weights assigned to objectives must sum to 1, the scoring method for individual objectives must then assign scores that range from 0 – 1. Any method that results in a 0 – 1 score may be used. An example would be:

Alignment Scoring Criteria	Score
The project is a critical enabler of this objective. The objective cannot be reasonably achieved without the project.	1.00
The project significantly increases the probability of successfully accomplishing this objective; however, absence of the project does not necessarily preclude accomplishment of the objective.	0.75
The project minimally enhances the ability to accomplish this objective.	0.50
The project produces results compatible with the intent of the objective.	0.25
The project neither supports nor hinders accomplishment of this objective.	0.00

**Table 25: Example of Alignment Scoring Criteria**

2. List all pertinent organizational objectives

A listing of organizational objectives serves as the criteria for determining how well aligned the project is. The objectives may come directly from the organization’s vision, strategy, long-range plans, or other pertinent sources. The Board should ensure that the selected objectives are accurate and complete, and should bolster the list with additional items, if necessary, to reflect priorities that may otherwise not be included. For example, not all projects are performed for business or operational purposes. Perhaps the Information Systems Department needs to perform an internal project that is necessary for the Department but which has no direct benefit to the organization as a whole. Often, these projects tend to be overlooked or undervalued in portfolios because they don’t score well against business objectives. Including objectives that address such needs is appropriate and helps ensure that all legitimate projects are evaluated on a comparable footing.

3. Assign weights to all objectives to indicate relative importance

Once a listing of objectives has been agreed upon, the Board must take the further step of weighting the objectives. The weights assigned should reflect the relative importance of the objectives and should sum to 1. If there are only a few objectives, this task may not be too difficult. It becomes, however, increasingly difficult as the number of objectives increases. Guidance on assigning relative weights is provided in a subsequent section.

4. Develop the Alignment score

To develop an Alignment score, the project is first scored against individual objectives according to the scoring method developed earlier. When this initial scoring is complete, the raw score for each objective is multiplied by the objective’s assigned weight. These weighted scores are then summed, resulting in the project’s Alignment score.

**Evaluating Risk**

Evaluating a project along the Risk dimension results in a Risk score between 0 and 1 for use in the BAR equation. The evaluation process is performed as follows:

1. Assign weights to the project and business risk components  
 Since the Risk dimension has both a project and business risk component, the relative importance of these two components must be decided. This is accomplished by assigning weights to each component such that the weights sum to 1. For example, if project and business risks are to have equal weight relative to each other, assign both components a weight of .50. Or, if business risks are to carry twice the weight of project risks, use weights of .67 and .33 respectively.
  
2. List all pertinent project and business risks  
 Two listing of risks should be developed to measure the project against: a listing of project risks and a separate listing of business risks. Be sure that risks selected are true risks and are universally applicable to all projects. There are only a handful of such risks (see examples presented earlier). Also, recall that risks are defined here as *unacceptable levels of impact*. So, for example, while there may be risk of a small cost overrun, we would be concerned here only with the risk of an unacceptable cost overrun.
  
3. Assign weights to all project and business risks to indicate relative importance  
 A set of weights should be assigned first for project risks. Each risk would be assigned a weight indicating its relative importance compared to the other project risks and such that the total of all project risk weights is 1. Next, a similar set of weights should be assigned for business risks. Each risk would be assigned a weight indicating its relative importance compared to the other business risks and such that the total of all business risk weights is 1. Guidance on assigning relative weights is provided in a subsequent section.
  
4. Develop a Risk scoring method  
 A standardized scoring method should be developed to evaluate Risk. Since the final Risk score must range from 0 – 1 and the weights assigned to individual risks must sum to 1, the scoring method for risks must then assign scores that range from 0 – 1. Any method that results in a 0 – 1 score may be used. An example is illustrated below:

<b>Risk Scoring Criteria</b>	<b>Score</b>
The probability of this risk occurring is >30%	0.00
The probability of this risk occurring is between 20% and 30%	0.25
The probability of this risk occurring is between 10% and 20%	0.50
The probability of this risk occurring is between 5% and 10%	0.75
The probability of this risk occurring is <5%	1.00

**Table 26: Example of Risk Scoring Criteria**

(Note that this example does not assign points to risks with probabilities greater than 30%. This is because risks with high probabilities are rare—they usually have already been mitigated).

5. Develop the Risk score

To develop a Risk score, the project is first scored against individual project risks according to the scoring method developed earlier. When this initial scoring is complete, the raw score for each project risk is multiplied by the risk's assigned weight. These weighted scores are then summed, resulting in the Project Risk score.

Similarly, the project is then scored against individual business risks according to the scoring method developed earlier. When this initial scoring is complete, the raw score for each business risk is multiplied by the risk's assigned weight. These weighted scores are then summed, resulting in the Business Risk score.

After obtaining Project and Business Risk scores, these scores are combined by multiplying each by their respective weights and adding the results. The end product is the project's overall Risk score for use in the BAR equation.

It is worth noting the role of risk factors in development of individual risk scores. Recall that risk factors are project conditions that may make the occurrence of risks more likely. Examples of risk factors related to project risks may include:

- The project team is inexperienced,
- The project has been estimated aggressively, and
- There are a large number of legacy system interfaces to be developed.

Examples of risk factors related to business risks may include:

- Top management is not fully committed to the effort,
- The organization is resistant to change, and
- A large number of organizations must cooperate to implement the solution.

While many risk factors may be universally applicable to all projects, each project tends to have some risk factors that are unique. It is not possible, therefore, to enumerate all risk factors in advance for use in scoring risks. Although a chosen subset of risk factors is often developed and used for scoring risks, this ignores the contribution of unique risk factors on potential risk. That is why the proposed scoring method outlined above is stated in terms of universal risks and not in terms of risk factors.

Risk factors should not, however, be ignored in the scoring process. It is difficult, for example, to determine in a vacuum the probability that a risk will occur. However, enumerating risk factors possessed by each project being evaluated helps in setting a more realistic probability. For example, risk of schedule overrun for a project with 1 risk factor related to schedule overrun would probably be much less than the risk of schedule overrun for a project

with 5 risk factors related to schedule overrun. A method such as that shown below may be used to assist the process of scoring risks:

Number of Relevant Risk Factors	Probability of Risk Occurrence
0	0%
1	20%
2	40%
3	60%
4	80%
5	100%

**Table 27: Use of Risk Factors to Evaluate Probability of Risk Occurrence**

**Rough Screening**

Prior to computing a BAR score, it may be desirable to perform a rough screening of projects based upon preset threshold criteria. That is, there may be certain conditions that would automatically eliminate a project from further consideration. For example, perhaps we don't want to consider any project with a payback of more than 3 years; or any project that is detrimental to a business objective; or any project having a high risk of business disruption. After scoring projects along all BAR dimensions, we may then eliminate projects that fail to meet any such threshold criteria, and determine BAR scores only for the subset of projects that pass the rough screening.

**Determining the BAR Score**

Once the project has been scored along the Benefit, Alignment, and Risk dimensions and has passed any rough screening criteria, a final BAR score can be computed. This is simply accomplished by plugging the dimension scores into the BAR equation to arrive at the BAR score:

$$BAR = (Benefit + Risk) \times Alignment$$

Recall that the BAR formula and scoring method will produce a score for the project between 0 and 2. While this is perfectly valid for ranking projects, the idea of a score between 0 and 2 is not intuitively appealing. Therefore, if desired, a revised BAR score may be determined by multiplying the original score by 50:

$$BAR = 50 \times (Benefit + Risk) \times Alignment$$

The result is that the same relative project ranking will be maintained, but the individual scores will now range from 0 to 100—a difference that is cosmetic but somewhat more appealing.

**Assigning Weights**

Assigning relative weights to a list of criteria can be difficult. When a constraint that the sum of the weights must equal 1 is added, the difficulty increases even more. If there are only a handful of criteria being ranked, the problem is not too bad. For instance, if we are ranking 3 objectives, it would not be too difficult to decide on some appropriate weights, as in the example below:

Criteria	Weight
Objective 2	.5
Objective 3	.3
Objective 1	.2
<b>Total</b>	<b>1.0</b>

**Table 28: Simple Example of Objective Weighting**

When the number of criteria gets larger, however, the task quickly becomes much harder. Suppose, for example, that we have to rank and assign weights to a group of 10 objectives:

Criteria	Weight
Objective 1	???
Objective 2	???
Objective 3	???
Objective 4	???
Objective 5	???
Objective 6	???
Objective 7	???
Objective 8	???
Objective 9	???
Objective 10	???
<b>Total</b>	<b>1.0</b>

**Table 29: Difficulty of Ranking Ten Objectives**

Some simplifications may be made to make the task easier. First, instead of a strict ordered ranking of all objectives against each other, objectives can be grouped into a few categories, each containing objectives of similar importance. Second, the categories can be pre-assigned relative weights that reflect the degree of difference between them. The following steps illustrate the process:

1. Establish weight categories

Identify categories that define a range of importance levels, from high to low. The table below is an example of such a categorization:

Category		Relative Value
1	Significantly Above Average	1.50 A
2	Somewhat Above Average	1.25 A
3	Average Importance	A
4	Somewhat Below Average	.75 A
5	Significantly Below Average	.50 A

**Table 30: Example of Definition of Weight Categories**

In this example, category 3 would contain those objectives considered to be of about average importance and would be assigned (for now) an arbitrary weight of “A”. Category 2 would contain those objectives considered to be somewhat more important than those in category 3 and would carry 25% more weight. Category 4 would contain those objectives considered to be somewhat less important than those in category 3 and would carry 25% less weight than category 3, etc. (Note: the number of categories and the relative weightings of the categories can be varied to suit the situation).

2. Categorize the individual objectives

Each objective is now evaluated against the weight categories and slotted in the most appropriate category. If, for instance, objective 9 were judged to be of significantly higher than average importance, it would be placed in category 1. The table below shows assignment of the example objectives to the categories:

Category		Relative Value	Objectives	# Objectives
1	Significantly Above Average	1.50 A	9	1
2	Somewhat Above Average	1.25 A	1,3	2
3	Average Importance	A	2,5,7,8	4
4	Somewhat Below Average	.75 A	6,10	2
5	Significantly Below Average	.50 A	4	1
<b>Total</b>		<b>1.00</b>		

**Table 31: Assignment of Objectives to Weight Categories**

After assigning each objective to a category, the number of objectives in each category are counted (see “# Objectives” column). With this information, the actual weights of each category can now be determined.

3. Compute category weights

The following equation is formed from the information in the table:

$$(1 \times 1.5A) + (2 \times 1.25A) + (4 \times A) + (2 \times .75A) + (1 \times .5A) = 1 \rightarrow 10A = 1 \rightarrow A = .1$$

This results in the following weight categories:

Category		Relative Value
1	Significantly Above Average	.150
2	Somewhat Above Average	.125
3	Average Importance	.100
4	Somewhat Below Average	.075
5	Significantly Below Average	.050

**Table 32: Solution for Relative Value of Weight Categories**

and in the following weights for the objectives:

Objective	Category	Weight
Objective 1	2	.125
Objective 2	3	.100
Objective 3	2	.125
Objective 4	5	.050
Objective 5	3	.100
Objective 6	4	.075
Objective 7	3	.100
Objective 8	3	.100
Objective 9	1	.150
Objective 10	4	.075
<b>Total</b>		<b>1.000</b>

**Table 33: Weight Category Solution Assigned to Objectives**

Once the weightings have been established, further discrimination between objectives in the same category can be made, if desired, by trading-off weight points within the category, as in the following table:

Category	Objective	Original Weight	Modified Weight
1	Objective 9	.150	.150
2	Objective 1	.125	.128
	Objective 3	.125	.122
3	Objective 5	.100	.105
	Objective 8	.100	.105
	Objective 7	.100	.100
	Objective 2	.100	.090
4	Objective 6	.075	.075
	Objective 10	.075	.075
5	Objective 4	.050	.050
<b>Total</b>		<b>1.000</b>	<b>1.000</b>

**Table 34: Trading-Off Weight Points Within a Category**

**Example**

The following is an example of three projects rated with the BAR model. General characteristics of the three projects are as follows:

	Project 1	Project 2	Project 3
Financial Benefit	High	High	Low
Non-Financial Benefit	Low	High	High
Alignment	High	Low	High
Risk	Low	Low	High

**Table 35: Characteristics of Three Example Projects Rated with the BAR Model**

Project 1 is a low-risk project with high financial benefit, little non-financial benefit, and strong alignment with objectives. Project 2 is a low-risk project with high financial and non-financial benefits but weak alignment. Project 3 is a high-risk project with low financial but high non-financial benefit and strong alignment with objectives. The following table summarizes the BAR scores for these projects:

Category	Wts.	Weighted Scores					
		Project 1		Project 2		Project 3	
		Raw	Weighted	Raw	Weighted	Raw	Weighted
<b>Benefit:</b>			.5425		.8050		.5450
<b>Financial Benefit</b>	.65		.4550		.4550		.1950
<b>IRR</b>	.50	.8	.4000	.8	.4000	.4	.2000
<b>Payback</b>	.50	.6	.3000	.6	.3000	.2	.1000
<b>Non-Financial Benefit</b>	.35	.25	.0875	1.0	.3500	1.0	.3500
<b>Alignment:</b>			.8375		.2750		.8375
<b>Objective 1</b>	.35	1.0	.3500	.5	.1750	1.0	.3500
<b>Objective 2</b>	.25	.75	.1875	0	.0000	.75	.1875
<b>Objective 3</b>	.40	.75	.3000	.25	.1000	.75	.3000
<b>Risk:</b>			.71875		.71875		.2500
<b>Project Risk</b>	.30		.2550		.2550		.0750
<b>Risk 1</b>	.20	.75	.1500	.75	.1500	.25	.0500
<b>Risk 2</b>	.40	1.0	.4000	1.0	.4000	.25	.1000
<b>Risk 3</b>	.40	.75	.3000	.75	.3000	.25	.1000
<b>Business Risk</b>	.70		.46375		.46375		.1750
<b>Risk 4</b>	.35	.5	.1750	.5	.1750	.25	.0875
<b>Risk 5</b>	.30	.75	.2250	.75	.2250	.25	.0750
<b>Risk 6</b>	.35	.75	.2625	.75	.2625	.25	.0875
<b>BAR Score</b>			<b>52.81</b>		<b>20.95</b>		<b>33.29</b>

Table 36: Summary of BAR Score Calculations for Three Example Projects

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