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Calculating the Importance of Information Systems: The Method of Bedell Revisited

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CITER is an independent research group within the Department of Economics, University of Groningen. Our research is focused on the economics of information technologies. Our research aims at understanding and analyzing the dynamics and the processes of development, distribution and implementation of information and communications technologies and improving their efficiency and effectiveness.

We investigate particular economic issues in the economics of information technologies. For instance, the differences between 'Open' and 'proprietary' technologies, the characteristics of hardware and software commercial demand and supply and the diffusion of new technologies. We also study the efficient and effective use of those technologies, how we can improve IT management and increase the benefits of investment in information technologies.

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- Decision-support methods for implementation decisions within organizations.
- Evaluation of legacy systems.
- Innovation and technical change in ICT.
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Abstract

Various portfolio methods have been suggested to evaluate the information systems used in organizations. A characteristic method for portfolio analysis is the method of Bedell (1985). This paper provides an overview of the purpose and functioning of this method. The explanation is supported by an elaborated example.

Keywords: Information system, importance, effectiveness, portfolio management, resource allocation.

1. Introduction

Portfolio and multi criteria methods are generally accepted as being more successful than strictly financial approaches when it comes to the valuation of IS. In this report, one of these portfolio methods, Bedell's method, is revisited. As CIO of a large banking group, Bedell first published his method in 1985 in: *The computer solution: Strategies for success in the information age*. The book illustrates the battle of reducing administrative perfection and bringing more IT resources to the core business processes. Bedell's method has been improved by Van Reeken in various publications (Van Reeken, 1992; Van Reeken, 1994).

Bedell's method links business value to information systems in a systematic and transparent approach and has been successfully applied by many organizations. The technique is a classical portfolio approach, which requires limited effort, because most analysis is based on management team assessments of the current organisational setting. This implies that the method can be completed without extensive prior research. The application of this method, however, does require in-depth knowledge of the approach and because Bedell's original work is unavailable, this report provides a fresh insight into his work. The approach has also been adapted to current state-of-the-art thinking about IS management.

The remainder of the paper is composed as follows. The foundation of the method is explained in Section 2. Next, Section 3 contains in-depth information on how the method works and the variables are to be determined. To clarify the method even further, an exemplary case is included in Section 4. Finally, in Section 5, the conclusions are discussed. The original method as well as some of the work of Van Reeken is accounted for in Appendix A.

2. Foundation

The method provides decision support for IS resource allocation questions on three levels of the organization (Figure 1):

(1) Should the organization as a whole invest in IS?,

(2) On which business processes should the investments focus?, and

(3) Which concrete investments should be made? This may refer to new IS or enhancements to existing information systems.

Based on a limited amount of data, the method calculates effectiveness/ importance-portfolios for IS on these three levels. An example of a level 2 (business process) portfolio for a production process with a view of the possible activities is shown in Figure 2. It is these kind of portfolios which can be used for answering the IS resource allocation questions.

The most important principle of the method is that the level of *effectiveness* of the information systems should ideally be approximately equal to their level of *strategic importance* (the diagonal in Figure 2). For now, a system is regarded to be effective when it is cost-effective, has a high technical quality, and is functionally appropriate. And it is strategically important when the activities supported are crucial to the organization or business process in obtaining its strategic objectives (Bedell, 1985); these concepts and their determination will

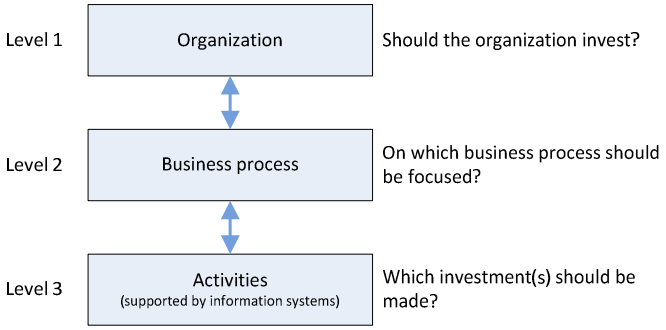

Figure 1: The three questions of Bedell

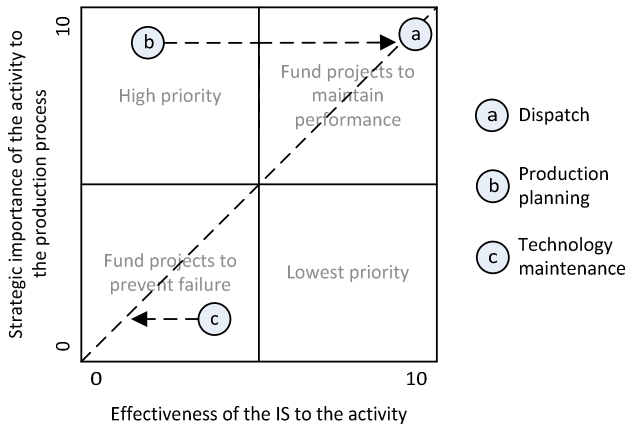

Figure 2: An effectiveness/importance portfolio for a production process

be further explained in Section 3. The effectiveness functions as the "as-is" situation, whereas importance indicates the to-be situation. This way, ineffective systems (compared to their importance) indicate areas for improvement, while outperforming ones should be kept stable, or might even receive less attention than in the current situation. The underlying assumption is that if effectiveness and importance are in line, *"we can now focus our energies on increasing information systems effectiveness, confident that, as we do so, computing support to the organization as a whole will improve"* (Bedell, 1985: 33).

An organization is viewed on three different levels of abstraction. These are determined to be (1) the entire organization, which (2) exists of a set of business processes, that (3) each of subsist of activities. In the Bedell method existing information systems are related to these activities (Figure 3). This facilitates the calculation of comparable IS effectiveness /importance numbers throughout the organization (using the equations as explained in the next section). Bottom-up, the effectiveness of the IS to the activities is step-by-step adjusted for the level of importance of IS to the intended organizational level. The results are combined into portfolios which are then assessed top-down; each step further focusing the allocation of resources on a lower organizational level. This way, the method provides an IS effectiveness/importance-portfolio for each of the three organizational levels, using only the aspects shown in Figure 3. The available portfolios and their purpose are described next.

(1) The highest level portfolio indicates the effectiveness of all information systems in the organization together reflecting the strategic importance of information systems in general to the organization (Figure 4). This portfolio provides support in assessing whether an organization should improve its IS at all. The organization in Figure 4 needs improvements to its IS as the effectiveness is severely lacking considering their importance. With the knowledge of the total rating, the organization has to determine which business processes should receive most attention.

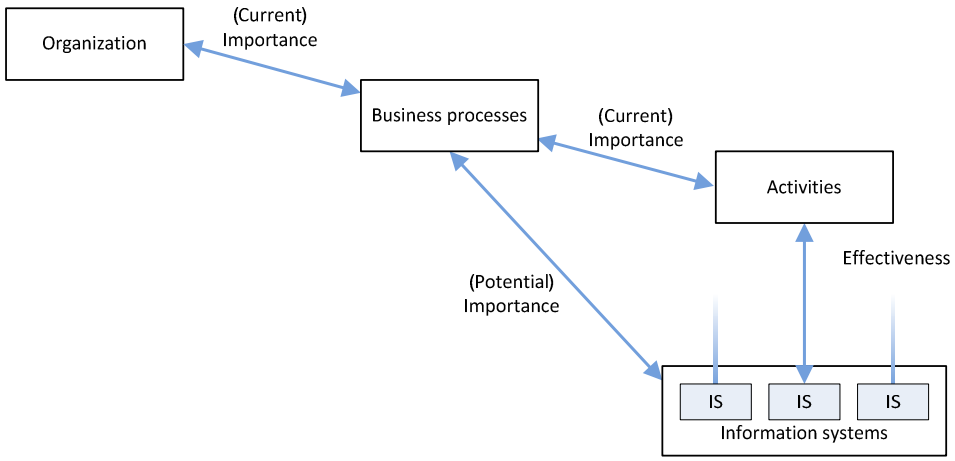

Figure 3: The key concepts (based on Bedell, 1985)

(2) The second portfolio demonstrates the effectiveness of all information systems supporting a business process together reflecting the strategic importance of the supported business process to the organization, weighted by the importance of information systems in general to the business process (Figure 5). The weights are added to prevent over prioritizing of IS resource allocation to business processes which are independent of IS. This portfolio provides support in assessing on which business processes the improvements should focus. In Figure 5, the systems supporting business processes (2) and (3) are outperforming their importance, whereas (1) and (4) are laggin. Especially the portfolio of activities in business process (1) should carefully be observed, due to the large difference and high importance rating of the business process.

(3) The last portfolio indicates effectiveness of the single information systems supporting the activities in a particular business process in reflection to the strategic importance of the supported activities to a business process (Figure 6). This figure indicates lacking activities and eventually supplies data to calculate the impact of improvements and determine which improvements should be made. In Figure 6, activity (a) is located perfectly, activity (c) doesn't need much attention. However, activities (b) and (d) are determined as underperforming

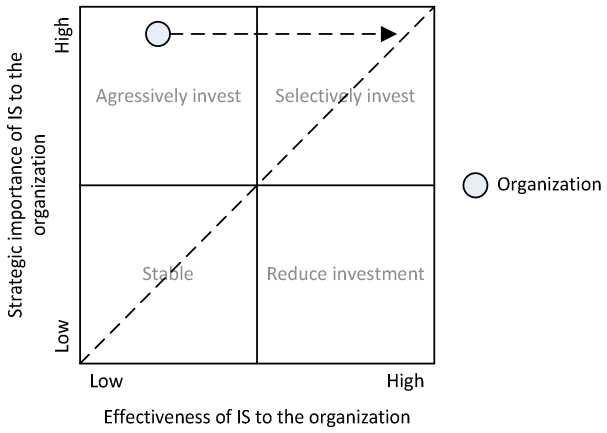

Figure 4: Organizational-level portfolio

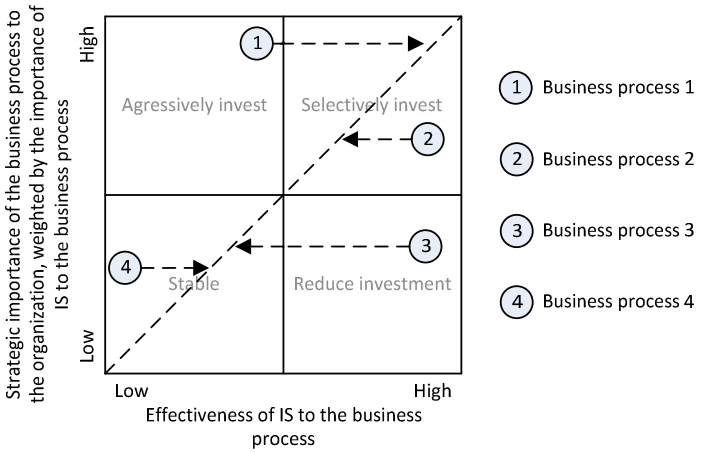

Figure 5: Business process–level portfolio

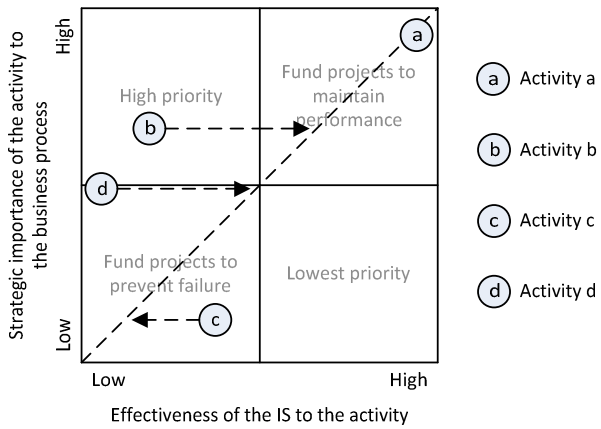

Figure 6: Activity-level portfolio

and whether these activities can be enhanced by means of information system improvement should be examined.

Knowing which activities have priority, the organization can identify change projects. For each of the projects, their impact on the performance can be established. Together with the costs and risks of the project, this delta in performance will determine the projects priority sequence. In the next section, the method is explained.

3. Operationalization

Although the portfolio analysis moves top-down regarding to the organizational levels, the calculations in the method are made bottom-up. The organization first has to establish the logical organizational, business process, and activity boundaries. Van Reeken (1992) advises the use of information strategy planning (ISP) methodology or Porter's value chain analysis if these overviews are not available. After having established the organizational design to be used, the organization has to determine the starting variables. These are the

- Current importance of each of the business processes to the organization,
  (Importance Business Process Organization, IBO)
- Current importance of each of the activities to the business processes,
  (Importance Activity Business Process, IAB)
- Potential importance of information systems in general to the business processes,
  (Importance Information Systems Business Process, IIB)
- Effectiveness of each information system to an activity.
  (Effectiveness System Activity, ESA)

The importance variables have to be determined based on the perceived importance in obtaining the strategic goals of the organization or business process. Based on these elements the processes, activities and systems are scored 0-10. In Figure 7, a diagram is presented to guide this scoring for the importance of business processes to the organization. A comparable diagram is

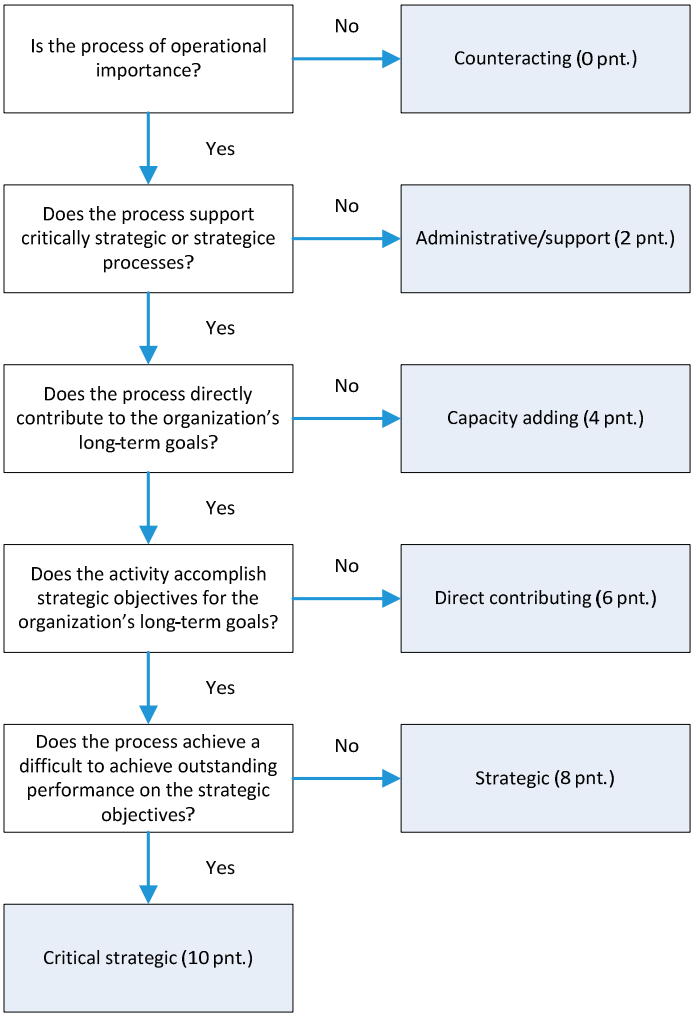

Figure 7: Determining strategic importance scores (based on Bedell, 1985)

used to value the other two importance variables. These questions could be substantiated by linking the importance to the determined business goals (Weill and Vitale, 1999).

The effectiveness of the single information systems to the activities (ESA) also has to be scaled as absent (0) to high (0-10). This is done by IS management in cooperation with the business organization based on their perception of the cost-effective, technical quality, and functional appropriateness.

With the information available, the organization can calculate the variables to be placed at the axis of the portfolios. First the organization has to calculate the effectiveness of the single information systems to the business processes (Effectiveness System Business Process, ESB), by weighting the effectiveness of the single information system to the activity (ESA) by the importance of the activity to the business process it supports (IAB) (Equation 1).

$$ESB = ESA * IAB \quad \text{Equation 1}$$

Next, the effectiveness of the single systems to the business processes (ESB) can be combined to calculated the total effectiveness of all information systems supporting a certain business process (Effectiveness Information Systems Business Process, EIB). This is calculated by dividing the total effectiveness scores of the single information systems to the business process by the total importance of the activities to the business process (Equation 2).

$$EIB = \frac{\sum(ESB)}{\sum(IAB)}$$ Equation 2

To move another level up in the three organizational levels, the effectiveness of the single systems to the organization (Effectiveness System Organization, ESO) can be calculated by weighing them by the importance of the business processes they support to the organization (Importance Business Process Organization, IBO, Equation 3).

$$\sum(ESO) = \sum(ESB * IBO)$$ Equation 3

As the single systems are related to the top level, the activities should also (Importance Activity Organization, IAO). Remember that information systems can only contribute via the activities they enhance. The activities' importance to the business process are thus also weighed against the importance of the business processes they are part of to the organization (Equation 4).

$$\sum(IAO) = \sum(IAB * IBO)$$ Equation 4

Now both the single systems as well as the activities they enhance are related to the organizational level, the effectiveness of all information systems in general to the organization can be calculated (Effectiveness Information Systems Organization, EIO, Equation 5). This provides the organization with the level for their current level of performance.

$$EIO = \frac{\sum(ESO)}{\sum(IAO)}$$ Equation 5

To reflect the numbers of the effectiveness of all IS to a certain business process to the importance of the business process to the organization, the latter have to be weighed by the importance of IS to the business process. This results in the so-called Focus Factor (FF, Equation 6).

$$FF = IBO * IIB$$ Equation 6

The final calculation before the assessment of the portfolios can then be made, the organization can determine the future potential of IS in general to the organization (Importance Information System Organization, IIO, Equation 7).

$$IIO = \frac{\sum(FF)}{\sum(IBO)}$$ Equation 7

Now the organization can create the three different portfolios as described in the previous section by selecting the needed variables. Based on these portfolios the organization can identify whether an organization has to improve their IS portfolios and if so, which areas should be focused on. To prioritize the improvements, the to-be effectiveness of a system has to be determined, so the potential added effectiveness of the improvements can be calculated (Equation 8). To provide an overall view, the added effectiveness is weighed against the cost determined for realizing and exploiting the improvement; this is called the Project Return Index (PRI, Equation 9).

$$Added = (ESA_1 - ESA_0) * IAO \qquad \text{Equation 8}$$

$$PRI = \frac{Added}{Cost} \qquad \text{Equation 9}$$

As the resources for the implementation of improvements are likely to be limited, the organization will not be able to apply them all. As the main principle of the method is to bring the effectiveness of IS to the organization to the same level as the importance of IS to the organization, the organization will be wise to select those improvements which bring the future effectiveness of the IS to the organization closest to the importance. This future effectiveness can be calculated by dividing the total of project return indexes for the chosen improvements by the total importance of the activities to the organization (Equation 10).

$$EIO_1 = EIO_0 + \frac{\sum(PRI)}{\sum(IAO)} \qquad \text{Equation 10}$$

To provide an overview of how all variables fit together the total complexity of the method is represented in Figure 8. The method is clarified with an example in the next section.

4. Example

In this Section an example is presented to illustrate Bedell's method. The example uses the steps as identified by Van Reeken (1992) and concerns an

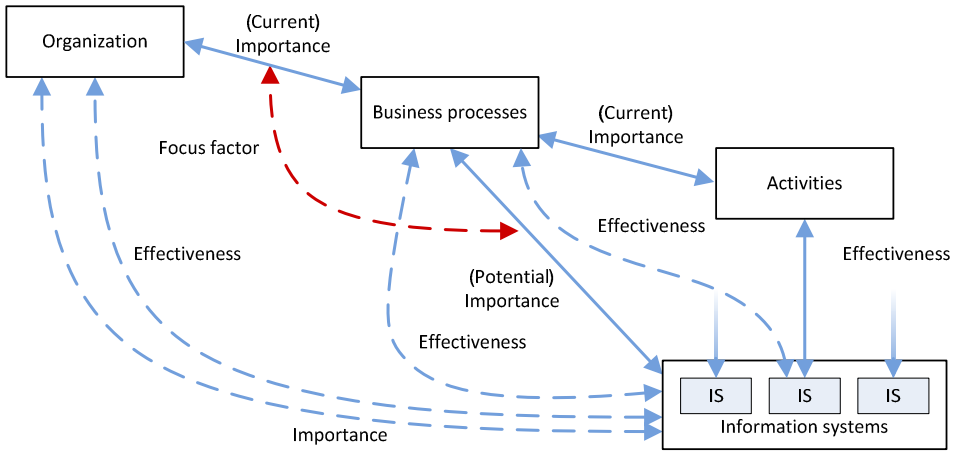

Figure 8: All aspects of the method

imaginary banking organisation called the International Banking Group (IBG). IBG is a small, simplified company which consists of only four business processes, each accommodated in a separate business unit; these are, asset management, transaction banking, retail banking, and services (Figure 9). The banking business has been rapidly changing during the last few years, especially when considering the influence of IS. The board of directors of IBG is under the impression that IBG is not coping well with these changes, and has therefore ordered an evaluation of the IS portfolio.

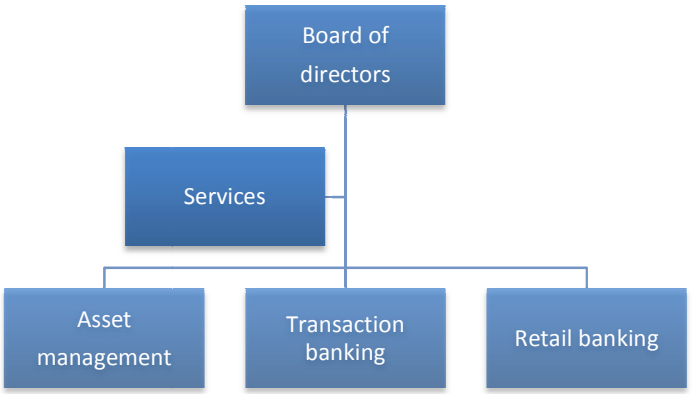

Figure 9: IBG organization chart

Step 1: Determine the importance of all organizational business processes to the organization

The importance of each of the business processes to IBG was determined in an assessment by the board of directors, the results are listed in Table 1.

Table 1: Business processes and IBO

Business process	IBO
Asset Management	10
Transaction Banking	8
Retail Banking	6
Services	2

Asset Management is seen as the core process in obtaining the organizations strategic goals. Therefore the importance of the business process to the organization (IBO) has been set at 10. Thus, if IBG is to achieve its strategic goals, Asset Management must obtain theirs. The process of Transaction Banking is determined to be strategic (8). According to the board of directors, Retail Banking is found to be contributing to the long term plans, but does not accomplish strategic objectives (6). Finally, services, are not directly contributing to the strategic objectives, but are of operational importance; therefore they are stated to be administrative (overhead, 2).

Step 2: Determine the importance of all activities executed in the business processes

Each of the business processes consists of several activities; these are listed in Table 2. The importance of the activity to the business process in obtaining its strategic goals is listed in the column IAB. The judgements are made based on

observations of the management responsible for each of the respective business processes.

Table 2: Business processes, activities, and IAB

Business process	Activities	IAB
Asset Management	Trading	5
	Mergers & Acquisitions	10
	Risk Management	10
Transaction Banking	Operations	10
	Policy & Portfolio	10
	MIS	5
Retail Banking	Private Banking	5
	Corporate Clients	10
	Bankshops	5
Services	Finance & Risk Management	1
	IT	1
	HRM	5

Step 3: Determine the effectiveness of the systems currently in place to the activities

Next, the IT management of IBG joined forces with the management of the business processes to determine the effectiveness of each of the systems to the supported activities (ESA, Table 3). It can be seen that the MIS, Private Banking, and HRM activities are maximally supported. In addition, it should be noted that the activities of Mergers & Acquisitions and Bankshops have an effectiveness rating of zero. The system supporting these activities are is thus regarded totally insufficient. There might be several reasons behind this. The activities can, for instance, be suffering from efficiency failures, lacking timeliness, or total lack of a (computerised) information system[1].

Table 3: Business processes, activities, IAB, and ESA

Business process	Activity	IAB	ESA
Asset Management	Trading	5	5
	Mergers & Acquisitions	10	0
	Risk Management	10	5
Transaction Banking	Operations	10	5
	Policy & Portfolio	10	5
	MIS	5	10
Retail Banking	Private Banking	5	10
	Corporate Clients	10	2
	Bankshops	5	0
Services	Finance & Risk Management	1	5
	IT	1	5
	HRM	5	10

Step 4: Calculate the effectiveness of the single systems and the total of information systems

The importance of the activities to the business processes and the effectiveness of the single systems in supporting the activities can now be multiplied to calculate the system's effectiveness to the business process (ESB, Table 4).

[1] The absence of computerized information does not have to results in an ESA score of zero by default; manual operations might be just as adequate in serving an activity.

Table 4: Business processes, activities, IAB, ESA, and ESB

Business process	Activity	IAB	ESA	ESB
Asset Management	Trading	5	5	25
	Mergers & Acquisitions	10	0	0
	Risk Management	10	5	50
Transaction Banking	Operations	10	5	50
	Policy & Portfolio	10	5	50
	MIS	5	10	50
Retail Banking	Private Banking	5	10	50
	Corporate Clients	10	2	20
	Bankshops	5	0	0
Services	Finance & Risk Management	1	5	5
	IT	1	5	5
	HRM	5	10	50

Next, the effect from the information systems (i.e. all systems together) to the assessed business process (EIB) is calculated by dividing the sum of all ESB scores for the business process by the sum of all its associated IAB scores (Table 5).

Table 5: Business processes, Sum(IAB), Sum(ESB), and EIB

Business process	Sum(ESB)	Sum(IAB)	EIB
Asset Management	75	25	3,0
Transaction Banking	150	25	6,0
Retail Banking	70	20	3,5
Services	60	7	8,6

To calculate the effect of the systems to the organization (ESO), the current state of the IS, first the sums of the ESB-scores have to be multiplied by the importance rate of the activities to the organization (IAO) for each of the business processes (as already determined in Step 1, Table 1). Then, the effectiveness of all information systems to the organization can be computed by dividing the total ESO-scores of all business processes weighted against their IAO-score, 2.490, by the total IAB-scores of all business processes, also weighted by the IAO, 584. This results in a current effectiveness score, EIO, for IBG of 4,3 (Table 6).

Table 6: Business processes, Sum(ESB), Sum(ESO), Sum(IAB), Sum(IAO), and EIB

Business process	Sum(ESB)	Sum(ESO)	Sum(IAB)	Sum(IAO)	EIB
Asset Management	75	750	25	250	3,0
Transaction Banking	150	1.200	25	200	6,0
Retail Banking	70	420	20	120	3,5
Services	60	120	7	14	8,6
Total		**2.490**		**584**	

EIO = 2.490 / 584 = 4,3

Step 5: Determine the potential importance of the information systems to the business processes and calculate the focus factors and the potential importance of the information systems to the organization

Based on the data from steps 1-4, with knowledge of the market (sector and technology), IBG can determine the importance of information systems to each of the business processes. Following Van Reeken (1992), IBG decided to reduce complexity by determining the importance of the information systems to the business processes (the IIB scores) by taking the maximum of the IAB-scores for each business process (Table 7).

Table 7: Business processes, IBO, and IIB

Business process	IBO	IIB
Asset Management	10	10
Transaction Banking	8	10
Retail Banking	6	10
Services	2	5

Multiplying the IIA-scores with the IBO-scores provides the focus factors (FF). In addition, the final current importance of the information systems to the organization as a whole is computed by dividing the sum of the focus factors with the sum of the IBO-scores (Table 8). The potential of information systems for IBG is thus 9,6.

Table 8: Business processes, IBO, IIB, and FF

Business process	IBO	IIB	FF
Asset Management	10	10	100
Transaction Banking	8	10	80
Retail Banking	6	10	60
Services	2	5	10
Total	**26**		**250**

IIO = 250 / 26 = 9,6

Step 6: Determine whether or not to invest in information systems as a whole

To determine whether or not to invest in information systems at all, the organizational measures of importance (IIO) and efficiency (EIO) are used. The highest level portfolio for IBG is represented in Figure 10.

The IIO is used as an indicator of what the level of support of the information systems for the organization *should* be, whereas the EIO indicates the current level. The underlying idea is that the point should be on the lower-left to upper-right diagonal. If this is the case, than the total effectiveness of the systems to the organization is equal to their importance; which is accepted as a good outcome for the portfolio. The further the horizontal amplitude from the diagonal, the worse the portfolio is matched to the wanted situation. For IBG it seems that the feeling of the board of directors was justified, the effect of the information systems is indeed too low in comparison to their importance. In line with the "aggressively invest" quadrant, it would be advisable for IBG to try to create an additional overall effectiveness of 5,3 (9,6-4,3).

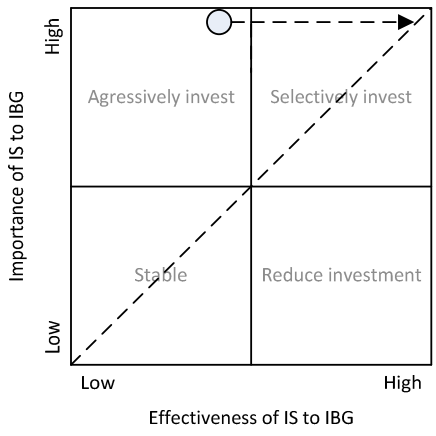

Figure 10: IBG's organizational portfolio

Step 7: Determine which business processes to make information system investments in

The next question for IBG, after having determined that investment are essential, is which business processes are most in need of improvement. To decide this, each business process is placed in Figure 11 on the coordinates of its Focus Factor and the effectiveness of its information systems to the business process (EIB). The figure provides a nuanced view of the results from step 6. It can be seen that especially the Asset Management and Services business processes diverge quite a lot from their ideal. The information systems servicing Asset Management require the most attention; developments should be considered in this area. The information systems supporting the latter process are 'overqualified' for their job; investments should not be made and resource used to manage these IS might be of better use when applied to different systems. Transaction Banking and to a lesser degree Retail Banking are close to the diagonal and hardly needs any adjustment at all.

Step 8: Determine which activity to invest in for the business process

After having found out the organization needs investments into the information systems of certain business processes, the board of directors would now like to know which activities requires most attention, so they are now assessed. For each of the business processes the effectiveness and importance of the systems and activities to the business process can be plotted. This is done for the Asset Management process in Figure 12.

The diagonal and the horizontal distance of the systems to it, is again essential to analysing the current state of the systems. It can be seen that the Finance & Risk Management systems, but most importantly, the Mergers & Acquisitions systems should be considered for enhancement. The Trading systems are found to be perfectly suitable for their purpose.

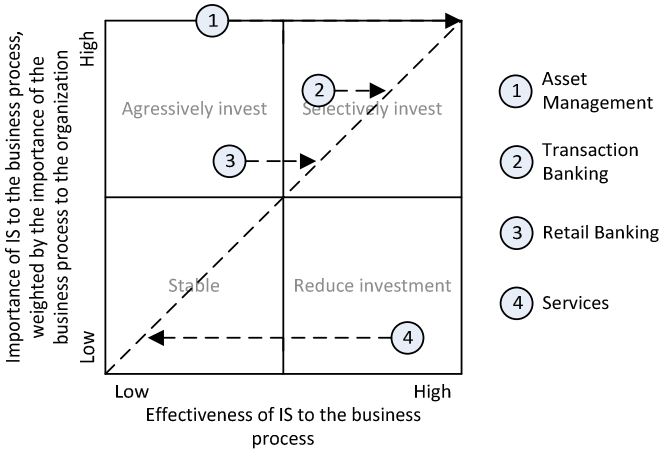

Figure 11: Business process portfolio

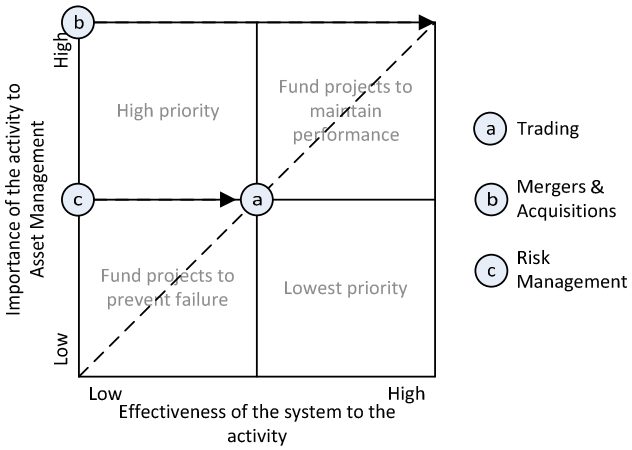

Figure 12: Research and development portfolio

Step 9: Select investment proposals

In the last phase of the portfolio management cycle, IBG is to decide which project proposals to implement (naturally, smaller changes could also be assessed). To do this, possible projects are identified and the overview as provided in Table 10 as been established. The activities lacking a "cost" attribute are not regarded in any of the project proposals. The original ESA scores are copied from Step 3 (Table 3). Additionally, the ESA' points are determined based on the to-be situation as described in the project proposals. Note that even though the Services business process is far from needing investments (Step 7, Figure 11), a project was proposed in this area.

Step 10: Prioritize investment proposals

At last, IBG can decide where to put their money. Prioritizing is based on the level of added effectiveness per invested euro. In Table 10, the improvements are weighted by the importance of the activity on to the organization (IAO, calculated by multiplying the importance of the activity to the business process, IAB from Table 1, by the importance of the business process to the organization, IBO from Table 2) are related to the size of the required investment.

Without looking at the investment sizes, the Mergers & Acquisitions project would likely be accepted. However, when assessing the Project Return Indices, the project drops considerably in prioritization. The Policy & Portfolio project will provide IBG with the most value for money.

For each project, the value in the 'added' column can be regarded as the improvement of the considered system's effectiveness to the organization (ESO). When divided by the sum of the importance of the activities to IBG (Sum(IAO), Table 6), the improvement of the total effectiveness of information systems to the organization is computed. That is, how much closer the investments bring IBG to the wanted level of importance.

Table 9: Business processes, activities, and investments

Business process	Activity	ESA	ESA'	Cost (K€)
Asset Management	Trading	5	10	100
	Mergers & Acquisitions	0	5	300
	Risk Management	5	5	-
Transaction Banking	Operations	5	5	-
	Policy & Portfolio	5	10	50
	MIS	10	10	-
Retail Banking	Private Banking	10	10	-
	Corporate Clients	2	2	-
	Bankshops	0	5	120
Services	Finance & Risk Management	5	5	-
	IT	5	10	75
	HRM	10	10	-

Table 10: Business processes, activities, improvements, investments, and relative improvements

Business process	Activity	IAO	ESA	ESA'	Added	Cost	PRI
Asset Management	Trading	50	5	10	250	100	2,50
	Mergers & Acquisitions	100	0	5	500	300	1,67
Transaction Banking	Policy & Portfolio	80	5	10	400	50	8,00
Retail Banking	Bankshops	30	0	5	150	120	1,25
Services	IT	2	5	10	10	75	0,13

If eventually, the board of directors would only approve the Trading and Policy & Portfolio projects, this would result in a EIO' of 4,3+(250+400)/584=5,4. If all projects were to be realized, the outcome would be a EIO' of 6,5. Therefore, recalling the IIO of 9,6, it might be advisable for the board to continue to look for additional projects. Also, as a project to be realized is dependent on the available resources, IBG should always keep less ambitious (ESA') and less expensive scenarios in mind; after all, they might have a better PRI.

5. Discussion and conclusions

In this paper the method of Bedell is revisited. Although the method appears to be intended for decision support for new IS investments, it can just as easily support the assessment of recourse allocation to on-going operations.

There are however some drawbacks of using the method. In its current form, the approach is, for instance, unable to cope with systems serving multiple activities and/or activities in multiple business processes. In addition, the determination of importance and effectiveness scores is neither transparent nor objective. Future research is necessary to deal with these problems.

6. References

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Appendix A: Accounting for Bedell's method

In the original method of Bedell, total nine variables are defined in order to determine the extent to which an IS supports the organization's activities; four for effectiveness issues (Table 11), and five determining importance (Table 12). Table 13 contains an explanation of the key concepts as used by Bedell; the variables themselves are further explained in Table 14. Using the variables he draws up a portfolio method to guide both the resource allocation of an (IS) organization and the setting of priorities for improvements.

To draw up the portfolio, Bedell assigns points on a 0-10 scale to the "determine" variables. An organization does not have to determine all variables, as the other variables are calculated by multiplying sets of basis variables. In general, the importance variables are based on the strategic contribution of the independent aspects to the dependent aspects of the variables; and the effectiveness is determined by a direct effectiveness rate. An overview is presented in Table 15. The composition of the portfolios has not been changed in this paper and is therefore not further included here.

In 1992 Van Reeken drew attention to the method of Bedell in The Netherlands. In this paper (Van Reeken, 1992) he refined to method. The largest change lies in emphasising that the assessment should be of the *function* which is part of a certain activity, rather than seeing a *system* as the enabler. Therefore, Van Reeken adds the layer of *function* to the method. This results in a clearer distinction between the functions executed in an activity (this includes both the computerised as the non-computerised systems; called systems by Bedell) and the computerised systems (called information systems by Bedell). This could lead to a situation in which the computerisation of formerly non-computerised function is more likely to be included in the investment proposals than when using Bedell's original terminology. In addition, Van Reeken slightly adjusted the calculation of the PRI.

Table 11: Effectiveness variables by Bedell (Source: Bedell, 1985: 35)

How effectively	does …	support the …	Variable name
How *E*ffectively	does the *S*ystem	support the *A*ctivity	ESA index
How *E*ffectively	do *I*nformation *S*ystems	support the *A*ctivity	EIA index
How *E*ffectively	does the *S*ystem	support the *O*rganization	ESO index
How *E*ffectively	do *I*nformation *S*ystems	support the *O*rganization	EIO index

Table 12: Importance variables by Bedell (Source: Bedell, 1985: 36)

How important	is …	to the …	Variable name
How *I*mportant	is the *S*ystem	to the *A*ctivity	ISA index
How *I*mportant	is the *S*ystem	to the *O*rganization	ISO index
How *I*mportant	are *I*nformation Systems	to the *A*ctivity	IIA index
How *I*mportant	are *I*nformation Systems	to the *O*rganization	IIO index
How *I*mportant	Is the *A*ctivity	to the *O*rganization	IAO index

Table 13: Concepts used by Bedell

Concept	Description
Effectiveness	The level of functional appropriateness, technical appropriateness, and cost-effectiveness
Importance	
System	One particular information system

Information systems	All information systems supporting a particular activity/organization
Activity	A function that is performed by a group or individual within the organization
Organization	

Table 14: Description of Bedell's variables (based on Bedell, 1985: 35-36)

Variable	Measures the extent to which…	Level
ESA	A particular system supports the activity it was built to support	Determine
EIA	Information systems in total support a particular activity	Determine
ESO	A particular system supports the entire organization	Calculate
EIO	Information systems in total support the entire organization	Calculate
ISA	A particular system is necessary in achieving the activity's objectives	Determine
ISO	A particular system contributes to achieving the objectives of the organization as a whole	Calculate
IIA	Information systems contribute to achieving the objectives of a specific activity	Calculate
IIO	Information systems contribute to achieving the objectives of the organization as a whole	Calculate
IAO	The activity contributes to achieving the objectives of the organization as a whole	Determine

Table 15: Determining Bedell's variables (p. 37-41, 45-47, 55-58, 66)

Variable	Determination	Points	
ESA	Highly effective	10	Functionally appropriate, technically adequate, and cost-effective. Little or no additional work required than routine maintenance.
	Moderately effective	5	Reasonable support to the activity, but substantial improvements are necessary to improve functional appropriateness, technical quality, or cost-effectiveness; however, it does not need to be replaced
	Ineffective	1	The system support the activity it was designed to support, but ineffectively. Improvements are so extensive, that, in the long term, the system will have to be replaced.
	No support	0	No system is currently installed, or it is so ineffective as to be worthless.
EIA	**=∑(ESA*ISA)/∑(ISA)**		Weighting the effectiveness of each system by its importance to the activity.
ESO	**=ESA**		Under the assumption that a system is only used by one activity. If several activities share the same system, the system's support to the organization as a whole is a function of how effectively it supports each sharing activity and how important each sharing activity is to the organization.
EIO	**=∑(ESA*ISO)/∑(ISO)**		Weighting the effectiveness of each system by its importance to the organization.
ISA	Strategic factor	10	Absolute essential in achieving significant strategic objectives of the activity.
	Major support factor	5	If it is not absolutely essential to the activity in achieving important strategic objectives, but can, or already does, play a vital role in supporting the activity; alternatives would be more costly, or cause major disruptions to install.
	Minor support factor	1	The system helps the activity achieve its strategic objectives but reasonable alternatives are available that ar not significantly more costly, less convenient, or less effective, and would not significantly disrupt operations.
	Not useful	0	The activity does not derive benefits from its use.
ISO	**=ISA*IAO**		The importance of each system to the activity by the activity's importance to the organization.
IIA	Strategic factor	10	The information systems support is absolutely essential in achieving a significant portion of the activity's strategic objectives.
	Operational support factor	5	The information systems are not absolutely essential in achieving most of the activity's strategic objects but the systems can, or already do, provide critical operational

			support for the activity; alternatives would be more costly, or cause major disruptions to install.
	Minor support factor	1	The information systems help, or could help, the activity function but strategic objectives or critical operations do not depend on computing.
	Not applicable	0	Information systems can help the activity in little or no way to achieve its objectives.
IIO	**=∑(IAO*IIA)/∑(IAO)** **=∑(FF)/ ∑(IAO)**		Weighting the importance of information systems for each activity by the activity's importance to the organization.
IAO	Critically strategic activity	10	The activity must achieve, *difficult to achieve*, outstanding performance on its strategic objectives for the organization as a whole.
	Strategic activity	8	The activity must accomplish most strategic objectives for the organization's long-term goals to be achieved.
	Contributory activity	6	The activity may directly contribute to meeting the organization's long-term goals, but the organization may still succeed even if the activity fails to achieve a substantial portion of its strategic objectives.
	Support activity	4	The activity does not directly work to achieve the organization's goals, but supports critically strategic and strategic activities in achieving their objectives; its failure will not prevent the organization from attaining its long-term goals.
	Overhead activity	2	The activity must be done but does not contribute directly to achieving the organization's long-term goals.
	Detrimental activity	0	The activity works against achieving the organization's long-term goals.
FF	**=IAO*IIA**		Determines the importance of computing in an activity to the organization as a whole.

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