Critical Thinking Module 5: Project Portfolio Evaluation

Alexander Ricciardi
Colorado State University Global

CSC501: Management for the Computer Science Professional

Dr. Brian Holbert

December 14, 2025

Critical Thinking Module 5: Project Portfolio Evaluation

Project Management, Inc. has asked our department to evaluate three project portfolios: a Metropolitan Area Network (MAN), a County School District IT overhaul, and a Housing Network Development. The evaluation was performed using both the payback period analysis and a Discounted Cash Flow (DCF) for risk-based assessment. This report recommends the County School District Network project as the most viable option for Project Management, Inc. To support this recommendation, the report details the evaluation methodology, financial analysis, and justification for the final selection.

Evaluation Methodology

Payback Period Analysis

The payback period calculation determines the length of time it takes for the investment to reach a breakeven point (VanLeeuwen, 2025). It is a metric that assesses the project's liquidity; however, it does not account for the Time Value of Money (TVM). In other words, the metric assesses the capacity of the project investment to generate cash flows sufficient to recover its initial cost (Bakić, 2025). However, it does not account for the TVM principle, stating that the value of a dollar received today is greater than the value of a dollar received in the future. The following formulas, provided by Tincher (2025), were used to calculate the payback:

The Subtraction Method is also called the uneven cash flow method:

$$Payback\ Period\ = t + \frac{|NCCF_t|}{NCF_{t+1}}$$

Where:

- t is the last period with a negative cumulative cash flow.
- $|NCCF_t|$ is the absolute value of the Negative Cumulative Cash Flow at the end of period t.

- NCF_{t+1} is the total net cash flow during the period following t (last period with a negative cumulative cash flow)

Note: It is important to understand that $NCCF_t$ are just negative CCF_t Cumulative Cash Flow.

The Discounted Cash Flow (DCF) Method

As Payback Period Analysis ignores the TVM, it is important to account for it to assess financial risks properly. The DCF method incorporates the TVM principle to estimate the value of an investment by forecasting its future cash inflows (Peace, 2023). In other words, it discounts the projected Future Cash Flow to their present value at a specific rate (TVM concept), then sums them to determine the present Equity Value of the project (Einstein, 2025). In this report, DCF is reported as a Net Present Value (NPV) using the following formula:

$$NPV = -I_0 + \sum_{t=1}^{N} \frac{NCF_t}{(1 + r_t)^t}$$

Where:

- I_0 is the initial investment at $t = 0$.
- DCF is the Discounted Cash Flow, which is the expected total Equity Value, V of the project within N total periods t.
- t is when the cash flows are expected, which is the specific period t within the N total periods.
- r_t is the discounted rate, which is the discounted rate of return for a period t within the N total periods.
- NCF_t is the net cash flow during a period t.
- N is the total number of periods t.

Note that the DCF method was particularly critical in evaluating the Housing Network Development project, where the cost of capital (interest) needed to be weighed against future income.

Project Analysis and Calculations

The analysis and calculation section evaluates the payback period, NPV, and risk of each project. As no discount rates or total number of years (project horizon) were given for the portfolio project, the DCF-related calculations were based on an assumed discount rate of 10% and a planning horizon of 5 years for projects 1 and 2, and a planning horizon of 10 years.

Option 1: Build a MAN network for the city

The information provided for this project states that the project's initial investment is 10 million dollars, the estimated monthlies are around 500 thousand dollars, and the city will collect all dues from the first year and a half for the second at the end of the second year, so the firm receives nothing in year 1 or first half of year 2. The following calculations are used to analyze cash flow, payback period, and NPV:

Analysis step 1 - converts monthly dues to annual dues:

$$Annual\ dues\ =\ \$500{,}000 *\ 12\ =\ \$6{,}000{,}000$$

Analysis step 2 - tracks years:

This analysis tracks Option 1 NCF_t and CCF_t for a period of 5 years. Note that the city collects all due for year 1 and ½ of year 2. So, the firm gets ½ of the due at the end of year 2, and gets the full due following years.

Table 1

Option 1 Annual Cash-Flow Tracking N =5 years

Year (t)	Net Cash Flow, NCF_t	Cumulative Cash Flow, CCF_t
0	-\$10,000,000 (Initial Investment)	-\$10,000,000 ($NCCF_t$)
1	\$0	-\$10,000,000 ($NCCF_t$)
2	\$3,000,000 (Annual dues / 2)	-\$7,000,000 ($NCCF_t$)
3	\$6,000,000	\$-1,000,000
4	\$6,000,000	\$5,000,000
5	\$6,000,000	\$11,000,000

Note: The table illustrates the city's collection policy, where cash inflows to the firm are delayed in Years 1–2 and shows that the cumulative cash flow becomes positive during Year 4.

Analysis Payback Period:

The last period with a negative cumulative cash flow (t) is Year $t = 3$.

$|NCCF_2| = \$1{,}000{,}000$, the cash flow in the following period ($NCF_{3+1=4}$) is \$6,000,000.

$$Payback\ Period_{option1} = 3 + \frac{|NCCF_3|}{NCF_{3+1}} = 3 + \frac{|\$-1{,}000{,}000|}{\$6{,}000{,}000} = 3 + 0.167 \approx 3.17\ years$$

Analysis DCF:

Assuming $N = 5\ years$ and $r = 10\%\ or\ 0.1\ dicount\ rate$

$$NPV_{option1} = -10{,}000{,}000 + \sum_{t=1}^{5} \frac{NCF_t}{(1+r_t)^t}$$

$$NPV_{option1} = -10{,}000{,}000 + \frac{0}{(1+0.1)^1} + \frac{3{,}000{,}000}{(1+0.1)^2} + \frac{6{,}000{,}000}{(1+0.1)^3} + \frac{6{,}000{,}000}{(1+0.1)^4} + \frac{6{,}000{,}000}{(1+0.1)^5}$$

$$NPV_{option1} = \$4{,}810{,}836.32$$

Risk assessment of the analysis results:

The payback period for Option 1 is about 3.17 years, and the NPV is about \$4,810,836.32 over a period of 5 years. This Option produces a strong positive NPV within 5 years, but it requires a very large up-front investment and depends on city policy/collection delaying cash flow in Years 1–2.

Option 2: Set up computers and networks for the County School District

The information provided for this project states that the project's initial investment is equal to $1,000,000, and the cash inflow from the contract is about $50,000 per month after the first year.

Analysis step 1 - converts the monthly cash inflow to the annual cash inflow.

$$NCF = \$50{,}000 \times 12 = \$600{,}000\ per\ year$$

Analysis step 2 - track years:

This analysis tracks Option 2 NCF_t and CCF_t for a period of 5 years.

Table 2

Option 2 Annual Cash-Flow Tracking N =5 years

Year (t)	Net Cash Flow, NCF_t	Cumulative Cash Flow, CCF_t
0	$-1,000,000 (Initial Investment)	-$1,000,000 ($NCCF_t$)
1	$0	-$1,000,000 ($NCCF_t$)
2	$600,000	-$400,000 ($NCCF_t$)
3	$600,000	$200,000
4	$600,000	$800,000
5	$600,000	$1,400,000

Note: The table illustrates that there is no cash inflow in Year 1, and the $50,000/month contract revenue begins in Year 3 (i.e., $600,000 per year).

Analysis Payback Period:

The last period with a negative cumulative cash flow (t) is Year $t = 2$.

$$Payback\ Period_{option2} = 2 + \frac{|NCCF_2|}{CF_{2+1}} = 2 + \frac{|-\$400{,}000|}{\$600{,}000} = 2 + 0.667 \approx 2.67\ years$$

Analysis DCF:

Assuming $N = 5\ years$ and $r = 10\%\ or\ 0.1\ dicount\ rate$

$$NPV_{option2} = -10{,}000{,}000 + \sum_{t=1}^{5} \frac{NCF_t}{(1+r_t)^t}$$

$$NPV_{option2} = -1{,}000{,}000 + \frac{0}{(1+0.1)^1} + \frac{600{,}000}{(1+0.1)^2} + \frac{600{,}000}{(1+0.1)^3} + \frac{600{,}000}{(1+0.1)^4} + \frac{600{,}000}{(1+0.1)^5}$$

$$NPV_{option2} = \$729{,}017.52$$

Risk assessment of the analysis results:

The payback period for Option 2 is about 2.67 years, and the NPV is about $729,017.52 over a period of 5 years. This option has the smallest initial investment and a positive NPV within five. Note that if the county school district reimburses a portion of the system assembly cost during deployment (during the first year), the $1,000,000 investment would be recovered sooner than the calculated $2.67\ years$, making this project's risks minimal.

Option 3: Build a Housing Network (12 single-family residences + 110-unit multifamily complex)

The information provided for this project states that the project's initial investment is equal to $10,000,000. Houses sell for about $450,000 each (12 total). Multifamily rent brings in about $70,000 per month after the second year. Because the firm does not have $10,000,000 in cash, borrowing at 10% per year (or a partner) is required.

Analysis step 1 - convert sales/rent figures to yearly cash flows:

$$Single\ family\ sales\ (end\ of\ Year\ 2) = 12 \times \$450{,}000 = \$5{,}400{,}000$$

$$Multifamily\ income\ (starting\ Year\ 3) = \$70{,}000\ per\ month \times 12 = \$840{,}000\ per\ year$$

Analysis step 2 - track years:

This analysis tracks Option 3 NCF_t and CCF_t for a period of 10 years. It is assumed that the sales proceeds are received at the end of Year 2 and multifamily income begins in Year 3. Note that the table calculations do not account for borrowing at 10% per year or a partner.

Table 3

Option 3 Annual Cash-Flow Tracking N =10 years

Year (t)	Net Cash Flow, NCF_t	Cumulative Cash Flow, CCF_t
0	-$10,000,000 (Initial Investment)	-$10,000,000 ($NCCF_t$)
1	$0 (Building year)	-$10,000,000 ($NCCF_t$)
2	$5,400,000 (Home sales)	-$4,600,000 ($NCCF_t$)
3	$840,000	-$3,760,000 ($NCCF_t$)
4	$840,000	-$2,920,000 ($NCCF_t$)
5	$840,000	-$2,080,000 ($NCCF_t$)
6	$840,000	-$1,240,000 ($NCCF_t$)
7	$840,000	-$400,000
8	$840,000	$440,000
9	$840,000	$1,280,000
10	$840,000	$2,120,000

Note: The table illustrates that Year 1 is a construction year with no inflow, Year 2 show the one-time home-sale ($5.4M), and the multifamily rental income begins in Year 3 ($70,000/month = $840,000/year).

Analysis Payback Period:

The last period with a negative cumulative cash flow (t) is Year $t = 7$. Note that these calculations do not account for borrowing at 10% per year or a partner.

$$Payback\ Period_{option3} = 7 + \frac{|NCCF_2|}{CF_{7+1}} = 7 + \frac{|-\$400{,}000|}{\$840{,}000} = 7 + 0.476 \approx 7.48\ years$$

Analysis DCF:

Assuming $N = 10\ years$ and $r = 10\%\ or\ 0.1\ dicount\ rate.$ Note that this calculation does not account for borrowing at 10% per year or a partner.

$$NPV_{option3} = -10{,}000{,}000 + \sum_{t=1}^{10} \frac{NCF_t}{(1+r_t)^t}$$

$$NPV_{option3} = -10{,}000{,}000 + \frac{0}{(1+0.1)^1} + \frac{5{,}400{,}000}{(1+0.1)^2} + \frac{840{,}000}{(1+0.1)^3} + \cdots + \frac{840{,}000}{(1+0.1)^{10}}$$

$$NPV_{option3} = -\$1{,}833{,}604.95$$

Risk assessment of the analysis results:

The payback period for Option 3 is about 7.48 years, and the NPV is about -$1,833,604.95 over a period of 10 years. This option remains negative NPV over 10 years. In practice, a housing/multifamily project often has a terminal (resale) value; because no sale value was provided, it is not included here, which biases NPV downward. Moreover, these calculations do not account for borrowing at 10% per year or having a partner. Note this illustrates why financing a housing development is risky, as it depends on selling units in the future and having steady cash coming in. In other words, it depends on future sales proceeds and future cash flow (OCC, 2022).

Shortest vs. Longest Payback Period

Based on the cash-flow calculation and analysis above, the option with the shortest payback period is Option 2, the setup of computers and networks for the County School District project, with a payback period of about 2.67 years. Option 1, building a MAN network for the city, with a payback period of about 3.17 years, has a medium payback period. Finally, Option 3, build a housing network (12 single-family residences + 110-unit multifamily complex) with a payback period of about 7.48 years without borrowing costs, and potentially far longer with 10% financing.

Assessment, Recommendation, and Justification

The evaluation identifies Option 2, the setup of computers and networks for the County School District, as the most viable option for Project Management, Inc. because it has the shortest payback period and the smallest up-front investment ($1 million instead of $10 million), which reduces the risk of financial damage if the estimates are off or if the project runs late. Additionally, during the integration/deployment phase, this option is easily manageable from a cost-management standpoint, allowing the purchasing of endpoints (computers), servers, and networking equipment to be planned in stages, and the deployment of these procurements can be sequenced through a pilot phased rollout. This reduces the risk of delaying the project delivery and the cost that emerges from feature rework and last-minute changes (Ucertify, n.d.a). However, the primary con for this project is the high service quality requirement, as school environments need careful management changes and substantial user training, and have many sites spread out across the city. These factors can be addressed by building within the project budget "quality funding," such as training and continuous testing across stages of the project deployment process, rather than only at the end of the process (Ucertify, n.d.b). These expenditures, which are part of the cost of quality of a project, can avoid failure costs. Overall, Option 2 is still the most viable project for Project Management, Inc., due to its payback speed, integration risk, and cost/quality governance; therefore, the County School District IT overhaul is recommended.

While Option 1 (the MAN network) has a strong NPV over 5 years and with a relatively quick return, it requires a very large $10 million up-front investment and delays early cash inflows in Years 1–2. This delay increases liquidity (cash inflow) risks, which can be accentuated if the project is not completed on time or if project scope changes occur (Ucertify, n.d.a). Additionally, large project rollouts like this one come with significant stakeholder complexity (city leadership, legal/regulatory constraints, and multiple vendors), increasing the likelihood of change requests adding financial risks. Therefore, these various risks make this project less viable than Option 1. Option 3 (the housing network) has the longest payback period and a negative NPV over ten years. Additionally, considering that the project must be funded at 10% interest (or via a partner), as the firm does not have enough funds. Furthermore, this was not accounted for in the analysis's calculations, further weakening this project's viability. Moreover, taking “a bank loan specifically to finance your project, the interest on the loan is a direct cost to the project” (Ucertify, n.d.a, p.73), will add significant additional direct expenses to the total cost. Because direct costs are considered the maximum expenses on a project, this cumulative risk makes this project significantly less viable than Option 2.

Conclusion

The evaluation of the three project portfolios shows that Option 2, the County school district IT overhaul, is the most strategic investment for Project Management, Inc. The project has a lower initial capital requirement and the shortest payback period. By prioritizing these financial metrics, the firm reduces financial risks and secures a positive Net Present Value. Additionally, the alignment with the firm’s core competencies ensures that the high service quality requirement can be easily addressed by continuous testing and user training throughout the rollout phases of the project. While Option 1 offers significant long-term growth, it needs a very large $10 million up-front investment, it also delays early cash inflows and comes with high liquidity risks due to the complexity of managing multiple vendors and city stakeholders. These compounded financial and operational/deployment risks make this project less viable than Option 2. On the other hand, Option 3 presents significant financing challenges and financial risks, making this option the least viable choice due to its negative NPV (still after 10 years) and high direct interest costs (possible loan or partner). For all these reasons, the County School District IT overhaul portfolio project is recommended.

References

Bakić, L. (2025, February 20). *Payback period in project management: Formula & examples*. Productive. https://productive.io/blog/payback-period-in-project-management/

Einstein, B. (2025, March 4). *Discounted cash flow (DCF) formula: What it is & how to use it*. Harvard Business School Online. https://online.hbs.edu/blog/post/discounted-cash-flow

OCC. (2022, March). Commercial real estate lending (Comptroller's Handbook) [PDF]. Office of the Comptroller of the Currency. https://www.occ.gov/publications-and-resources/publications/comptrollers-handbook/files/commercial-real-estate-lending/pub-ch-commercial-real-estate.pdf

Tincher, L. (2025, September 30). *Payback period: Formula and calculation examples.* SoFi Learn. https://www.sofi.com/learn/content/how-to-calculate-the-payback-period/#:~:text=Payback%20Period%20%3D%20the%20last%20year,the%20year%20after%20that%20year)

VanLeeuwen, A. (January 6, 2025). *Know the significance of payback period*. Preferred CFO. https://preferredcfo.com/insights/determining-payback-period-of-business-investment

Ucertify (n.d.a). Lesson 8: Project Cost. Project Manager Professional (PMP) Based on PMBOK7. Ucertify. ISBN: 978-1-64459-415-5

Ucertify (n.d.b). Lesson 11: Project Quality. Project Manager Professional (PMP) Based on PMBOK7. Ucertify. ISBN: 978-1-64459-415-5