Alex and their Weighted Average Cost of Capital
A Story of the MARR

By Chris Willmore
May, 2021

Alex is eligible for a design contract that pays $10,000, one year from now. The problem is that they'll need $5,000 in materials to complete the contract, and they don't have that money right now. They decide to raise the money by asking people to invest in their project for a share of the eventual pay.

The first person Alex turned to was their friend, Barbara. Barbara said, "I have $1,000 that I was going to put in my savings account. That savings account would have paid me 3% interest for the year. As long as you can at least match that, I'll let you have it, instead." Alex made a note: "Barbara's minimum acceptable rate of return is 3% per year, and they're willing to invest up to $1,000."

The second person Alex turned to was Colin, their cousin. Colin said, "I don't actually have any spare cash right now, but I could borrow up to $250 from my line of credit and pass it on to you. The line of credit charges me 6% interest per year. As long as I'm compensated for that, we're good. " Alex wrote down, "Colin's minimum acceptable rate of return is 6% a year. He's willing to invest up to $250."

The third person Alex turned to was Deborah, one of the first friends they'd made at university. Deborah said, "I just got paid $500 for a gig. I was going to use that to pay off some of my debt, but you can have it, instead, as long as the money I earn from the investment makes up for the extra interest on my debt. The bank's charging me 1.5% per month interest." Alex made a few quick calculations. If Deborah give them $500, their debt today will be $500 greater than it would have been if they'd stuck to their original plan. That extra $500 of debt will accumulate interest for 12 months, when Alex will be in a position to pay Deborah. What's the interest in percent per year? Twelve months of 1.5% interest per month would turn a debt of $100 into a debt of $100 x $(1+1.5\%)^{12}$ = $119.56, so that's equivalent to 19.56% interest for the year. Alex made a note: "Deborah is willing to invest up to $500. Her minimum acceptable rate of return is 1.5% per month, which works out to about 19.56% per year."

The fourth person Alex turned to was Edward, an investor. Edward said, "Yeah, I'll bite. As long as you make it worth my while. I have an extra $750 lying around, and I was wondering what to do with it. There's a friend of mine who's into crypto mining, and she wants to borrow money to buy GPUs, but for only one month. She'll pay me 5% interest just for that one month. Crazy, right? Thing is, after that, I have to go back to my usual stock trading, and I only get a return of about 18% for the whole year out of that. Make sure I'm at least as well off with your thing as I would have been lending to my crypto friend for a month, and then re-investing that into stocks for the other 11 months, and the $750 is yours."

Alex thought 18% per year sounded awfully high, but they decided to take Edward's statements at face value. What rate of return did Edward require for an entire year? The 5% for one month is easy enough, but what's 18% per year, for 11 months? There were a number of ways to calculate that, but Alex decided to stick to something that was clear to them, even if it

wasn't the quickest method around. If something is growing at a rate of 12% per year, it's growing at a rate of $(1 + i_{monthly})^{12}$ per year, where $i_{monthly}$ is the monthly growth rate. Just like if something is growing at a rate of 21% every two days, that works out to 10% per day, because (1+10%) x (1+10%) = 1.21. You can use that to solve for the monthly rate of growth of money poured into stocks: $(1+i_{monthly})^{12} = 18\%$, so $i_{monthly} = (1+18\%)^{1/12} - 1 = 1.388843\%$, approximately. So, if Edward had lent the money for one month at 5% per month, and then reinvested that for eleven months at about 1.39% per month, that would make the money grow by a factor of about (1+5%) x $(1+1.388843\%)^{11}$ = 1.2220, which implies a yearly growth rate of about 22.2%. Alex double-checked their calculations and made a note: "Edward is willing to invest up to $750. His minimum acceptable rate of return is about 22.2% per year."

Finally, Alex went to a bank. After looking through the information Alex had provided, including details on the financing that Barbara, Colin, Deborah and Edward had offered, the bank said: "We'll gladly lend you the rest of the money at a rate of 8% per year. One of our best clients is a large corporation that is always in need of liquidity – that means, cash on hand, in this case. They pay us just under 4% per year, but we're 100% certain that we'll be paid in full. In your case, we've determined that based on the information you've provided, there's about a 96.3% chance that you pay us in full, and about a 3.7% chance that you won't be able to pay us back and we'll have to write off the loan. We make a *lot* of these loans to people like you, and in your case we'll have to charge you twice our risk-free interest rate just to make sure that, on average, we'll be no worse than if we'd lent the money to our biggest and safest client."

"If your own accounts say I'm more than 95% likely to pay you back, why am I being charged double the interest?"

The bank's representative scribbled something on a sheet of paper and handed it to Alex. It read: "Expected payback on a $100 loan @8%: 96.3% x $108 + 3.7% x $0 = $104 + $0 = $104." In other words, just as the bank said, an 8% rate would see them earn a 4% return on average, after taking risk into account.

Alex made another note. They needed $5,000, and had promises from the other investors for $1,000 + $250 + $500 + $750 = $2,500. The bank would therefore lend them the remaining $2,500. Alex's note read: "Bank will lend $2,500. Their minimum acceptable rate of return, given risk, is 8% per year."

With enough funding secured, Alex decided to calculate their weighted average cost of capital (WACC). This is calculated just like any other weighted average: add together the values in question – in this case, the rates of return – weighted by their relative contribution to the total:

Source	Amount	% of Total	Rate	% x Rate
Barbara	$1,000	20%	3%	0.6%
Colin	$250	5%	6%	0.3%
Deborah	$500	10%	19.56%	1.956%
Edward	$750	15%	22.20%	3.33%
Bank	$2,500	50%	8%	4%
Total	$5,000		WACC	10.19%

The end result was that after all was said and done, it would cost Alex about 10.2% for the year to raise that $5,000. Put another way, they'd have to pay $1,000 x 3% + $250 x 6% + $500 x 19.56% + $750 x 22.2% + $2,500 x 8% = $509.30 interest on top of the $5,000 borrowed, leaving them with $10,000 - $5,000 - $509.30 = $4,490.70 of the contract money.

The next morning, Alex signed binding loan contracts with all the people involved (plus the bank). A few minutes later, they got a call from Fran, an engineer and an old friend. Fran said they had a great new project lined up. It would take one year, and would be very profitable, but Fran would need $10,000 up front to make it work. Alex was the first person they called about becoming a possible investor.

Before answering, Alex made a few mental calculations. Alex knew Fran was an excellent engineer with a proven track record, and if they said they had a profitable project, it was pretty much a sure thing. Alex would soon have $5,000 in the bank. They were also on the hook for paying $5,509.30 one year from now. That was true regardless of whether Alex used the $5,000 in their own project, or in Fran's. If Alex invested the money in their own project, the $5,000 would be spent on materials, and Alex would receive $10,000 one year from now. If Alex instead invested the money in Fran's project, then Fran would spend the money, and at the end of the year Alex would receive their money back, plus whatever the returns from the project were. In order to be just as well off by giving the money to Fran, as they would be with their current plan of using the money in their own project, Fran would have to pay Alex $10,000 one year from now.

"Fran," said Alex, "I have $5,000 I raised from investors that I was going to use on my own project. That project will pay out $10,000, one year from now. If you can at least match that, I'll lend you the money."

"But that's 100% interest – it's the $5,000, plus an extra $5,000. Aren't your investors charging you less than that?"

"They are," admitted Alex. "Just over 10% for the year, and I'll have to pay that, no matter what. But even if you paid me the 10%, I'd still be missing out on the $10,000 contract I was going to use the $5,000 investment for. That's what I have to be compensated for, since that's what I'd be giving up."

"So you're saying your minimum acceptable rate of return, if you lend me the $5,000…"

"Is 100% for the year. Yes. That's what it will take to make me – well, my bank account – just as well off in sending you the money as I would be, using it in my own project. And that's taking your track record and our friendship into account. I'm giving you the benefit of the doubt and assuming your project has a 100% chance of success."

"Alex, do you realize what you've just done?"

"I'm not sure I do. What have I done?"

"You've MARRed our friendship," sighed Fran. "I think I'll contact my bank, instead."

"Call disconnected," said Alex's phone. In the distance, a drummer played a rim-shot.

THE END