EQUITY SHARES EQUATING THE RESULTS OF FCFF AND FCFE METHODS

Bartłomiej Cegłowski,[1]Błażej Podgórski[2]

Abstract

The aim of the article is to present the method of establishing equity shares in weight average cost of capital (WACC), in which the value of loan capital results from the fixed assumptions accepted in the financial plan (for example a schedule of loan repayment) and own equity is evaluated by means of a discount method. The described method causes that, regardless of whether cash flows are calculated as FCFF or FCFE, the result of the company valuation will be identical.

Introduction

Assessment of company value is a daunting task that people dealing with investment processes must face. It can be completed using various methods, which can be divided into income-based methods, assets-based methods and comparative methods. There is abundance of texts analyzing their advantages and drawbacks (Copeland, Koller and Murrin, 2000; Damodaran, 2001; Malinowska, 2001). Currently, taking into consideration the solutions used in practice, the most popular methods are those that assess free cash flows, such as Free Cash Flow to Firm (FCFF) and Free Cash Flow to Equity (FCFE). Other frequently quoted methods, such as Economic Value Added method (EVA) (Damodaran, 2001, W. Cwynar and A. Cwynar, 2002) and Adjusted Present Value (APV) (Dudycz, 2005, p. 47-56), despite their obvious benefits, are not so popular with specialists. **From the perspective of the final outcome the choice of the method is not that important, because the way of calculating should not affect the company value**. In practice though, there are situations in which analysts conducting valuations would use different results using FCFF and FCFE methods[3]. One of the reasons for this situation is the weight average cost of capital (WACC), and more specifically the way of calculating shares of particular equity sources in the whole invested equity. These shares may be determined using book or market values (Szczepankowski, 2007, p. 84). Alternatively, we can determine shares on the basis of assumed final way of financing the activity by the company, in which equity share is provided as percentage figure (A. Cwynar and W. Cwynar, 2007 p. 60). **When we rely on book values of capital, obtained results of company valuation will generally be divergent.** Specialists recommend using market shares (Rutkowski, 2007, p. 319). In this type of models, however, we often encounter the

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[1] Bartłomiej Cegłowski PhD, Koźmiński University, ul. Jagiellońska 57/59, 03-301 Warszawa, ceglos@alk.edu.pl.
[2] Błażej Podgórski MS, Koźmiński University, ul. Jagiellońska 57/59, 03-301 Warszawa, bpodgorski@alk.edu.pl.
[3] The conditional mode was used on purpose – analysts usually publish results obtained using one method, therefore, only observing the applied methodology we can assume that another method would give a different result.

problem caused by the fact that in order to determine equity's market value, we must first calculate company value, and this cannot be achieved without assessing the cost of capital. A solution could be to use in our analyses the optimum equity structure, which is not always clear for investors, and generally it does not reflect the real availability of loan capital.

This article will present formulas which will help us determine the share of own and loan capital relying on values determined on the basis of financial plan assumptions, without the necessity to assess the company value first. In our calculations we will use the assumed amounts of loan capital with appropriate interest rate, which, according to our assumptions, the valued entity should have at its disposal. The way those formulas work will be illustrated with an example, in which free cash flows will be calculated as FCFF and FCFE.

A similar solution is proposed by Patena (2010, p. 19). It is also based on a recursive approach, but it focuses on the cost of each capital. The solution presented in this article takes the cost of loan capital as information arising from agreements, focusing on determining the shares of the various sources of finance as a value consistent with the objectives of financial plans.

Free cash flow to firm (FCFF) and to equity (FCFE)

From the perspective of Value Based Management (VBM) as well as the analysis related to fundamental analysis , the present value of cash flow that a given enterprise can obtain due to operational and strategic decisions is the most important value. Therefore, in company valuation we use income-based methods, especially techniques of discounted cash flow (DCF). Within them, cash flow is most frequently determined in one of two perspectives, as:

1. free cash flow to equity (FCFE),
2. free cash flow to firm (FCFF).

On their basis, the company value is determined by means of the following formula:

$$V = \sum_{t=1}^{n} \frac{FCF_t}{(1+R)^t} + \frac{RV}{(1+R)^n} + \text{ANO} \qquad (1)$$

where: FCF – free cash flow,
   R – discount rate,
   RV – residual value,
   ANO – non-operating assets,
   t – number of the flow,
   n – last flow of analysis horizon.

FCFF covers the resources generated by an enterprise or project, which will be available to all financing parties, both owners and those who provide loan equity at appropriate interest rate. According to the assumptions of the method, further FCFF are calculated following the formula (Marciniak, 2001):

= Earnings Before Interest and Tax (EBIT)
– Income tax from EBIT
= Net Operating Profit After Tax (NOPAT)
+ Depreciation
– Change in Non-Cash Net Working Capital
– Capital Expenditure (the so-called CAPEX)
= FCFF.

In FCFE calculation, we additionally distinguish flow and expenses related to debt: interests, taking a loan capital, payment of loan capital, following the formula (Marciniak, 2001):

$$
\begin{aligned}
&= \text{Earnings Before Interest and Tax (EBIT)} \\
&\quad - \text{Interests} \\
&= \text{Profit Before Tax (PBT)} \\
&\quad - \text{Income tax} \\
&= \text{Net Income (NI)} \\
&\quad + \text{Depreciation} \\
&- \text{Change in Non-Cash Net Working Capital} \\
&\quad + \text{Acquired loan capital} \\
&\quad - \text{Paid out loan capital}[4] \\
&\quad - \text{Capital Expenditure (CAPEX)} \\
&= \text{FCFE.}
\end{aligned}
$$

Cost of capital as a discount rate for FCF

A different way of calculating cash flow from the perspective of the owner and all financing parties accounts for the fact that we should use different discount rates for discounting them. Thus, for the FCFF method we use Weight Average Cost of Capital (WACC), whereas for FCFE – cost of own equity.

In practice, taking into account recommendations on stock exchange or evaluations of profitability made by finance analysts employed by concerns, the FCFF method is used more frequently, therefore analysts must determine weight average cost of capital, which should indicate what remuneration the company should provide to all entities, which provided equity.

Weight average cost of capital reflects the cost of own equity and loan capital. It is calculated following the formula below (Rutkowski, 2007, p. 318):

$$
WACC = \sum_{k=i}^{i} U_k R_k \tag{2}
$$

where: U_k – share of capital k,
K_k – cost of capital k,
k – next source of finance,
i – number of capital sources,
other symbols as previously.

In WACC calculations we do not use all liabilities items, but only own equity and loan capital with interest rate (which constitute jointly Capital Invested – CI). After checking that the forecasts indicate the possibility of achieving profits, the cost of loan capital used for WACC calculations should be additionally adjusted, taking into account the so-called tax shield, that is the fact that interests will decrease the tax base.

The share of capital is calculated in the following way:

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[4] In some calculations it is easier to make the use of the formula: Signing-Repayment of loans, which is especially helpful l when there is only expected FCFF and FCFE calculation without the full projection of financial statements.

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$$U_{kw} = \frac{E}{E + D} \qquad (3)$$

$$U_{ko} = 1 - \frac{E}{E + D} \qquad (4)$$

where: U_{kw} – share of own equity in capital invested,
$\quad\;\;$ U_{ko} – share of loan capital in capital invested,
$\quad\;\;$ E $\quad$ – value of own equity,
$\quad\;\;$ D $\quad$ – value of loan capital with interest rate,
$\quad\;\;$ other symbols as previously.

Assuming that it is appropriate to calculate the share on the basis of market values (including the forecast ones) not balance, we suggest an alternative approach to determining the share of each type of capital. At the beginning, as with each income-based valuation, we must adopt some assumptions allowing us to calculate projected cash flows for a particular period of time, establish residual value (for example, using the liquidation value method) and the costs of capital: own equity and loan capital. However, the starting point for this proposed here method of calculating shares is the methodology of determining valuations by means of FCFF and FCFE methods (Damodaran, spreedsheets). To obtain coherent results, we use additional settlement of project/company value in line with FCFF model at the end of each year of the analysis. Thereafter, the implied debt value is established and it is used in calculating FCFE. Generally, the scheme assumes that the calculation of the project gross value starts with the last year of the project, more precisely at the very end of it. At this period of time it is assumed that the project/ company value equals its residual value. In the penultimate year it is assumed that it is the sum of all discounted elements: residual value and free cash flow for all financing parties from the last year. The above relations can be written down in the following equations:

$$V_n = RV \qquad (5)$$

$$D_n = V_n * U_{ko_n} \qquad (6)[5]$$

$$V_{n-1} = \frac{RV_n + FCFF_{n-1}}{1 + WACC_{n-1}} \qquad (7)$$

$$D_{n-1} = V_{n-1} * U_{ko_{n-1}} \qquad (8)$$

From equations 5 and 6 we can derive the following dependence:

$$U_{ko_n} = \frac{D_n}{RV} \qquad (9)$$

It will be used in calculating share of loan capital in the last year of the projection.
On the other hand, from equations 7 and 8 we will have a relation presented in equation 10.

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[5] V mark is used in a situation when we calculate the value of the whole company, in case of calculating the project value, we can use NPV interchangeably.

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$$D_{n-1} = \frac{V_n + FCFF_n}{1 + WACC_n} * U_{ko_n} \tag{10}$$

In formula 10 there is a reference to weighted average cost of capital from formula 2, which should be expanded to the following shape:

$$WACC_n = U_{kw_{n-1}} K_{kw_n} + U_{ko_{n-1}} K_{ko_n} * (1 - t) \tag{11}$$

In our considerations we assume the simplest model basing on the subject financing itself with two types of capital, whose sum should equal 1

$$U_{kw_{n-1}} + U_{ko_{n-1}} = 1 \tag{12}$$

Transforming formula 12 to the form from formula 13 and inserting it to formula 11 we obtain the formula for weighted average cost of capital basing only on the share of loan capital, which is presented in formula 14

$$U_{kw_{n-1}} = 1 - U_{ko_{n-1}} \tag{13}$$

$$WACC_n = (1 - U_{ko_{n-1}})K_{kw_n} + U_{ko_{n-1}} K_{ko_n} * (1 - t) \tag{14}$$

Formula 14 could be inserted into formula 10 and in this way we will obtain the form presented in formula 15

$$D_{n-1} = \frac{V_n + FCFF_n}{1 + [(1 - U_{ko_{n-1}})K_{kw_n} + U_{ko_{n-1}} K_{ko_n} * (1 - t)]} * U_{ko_{n-1}} \tag{15}$$

After simplifying, we will obtain the following formula

$$U_{ko_{n-1}} = \frac{1 + K_{kw_n}}{\frac{(V_n + FCFF_n)}{D_{n-1}} - [K_{ko_n} * (1 - t) - K_{kw_n}]} \tag{16}$$

Formula 9 should be used only and exclusively for the last year of the analysis, for other years we should take advantage of formula 16.

Summarizing, to use the proposed methodology correctly, we should:
1. accept the assumptions for the financial plan,
2. estimate free cash flow using the FCFF method,
3. establish residual value.

and then establish costs of capital, share of particular types of capital and company value in successive years in accordance with the following points:[6]
1. determine the estimated cost of capital from particular sources (in percentage),
2. plan balance sheet values of debt in particular periods of time,
3. calculate the share of debt in invested capital after the last year of the projection (formula 9),
4. calculate the share of debt at the end of the penultimate year of the projection in accordance with formula 16 proposed in this article,

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[6] In case when the loan balance in a given year of the analysis equals 0, we should insert hand-written 0 values as the share of loan capital.

5. calculate the share of own equity at the end and at the beginning of the last period of the forecast (formula 13),
6. calculate weighted average cost of capital for the last year (formula 2),
7. calculate company value at the end of the penultimate year of the projection (formula 7),
8. repeat operations from points 4-7 for earlier years of the analysis.

To check the correctness of the obtained results we can establish company value according to the FCFE method. We should remember to correct the residual value by the debt from the end of the period, in free cash flow we should include acquisition and payment of loan capital and as the discount rate – use only own equity.

The implementation of this method is illustrated in example 1.

Example 1

Company ABC is considering the possibility of an investment project which should generate EBIT at the level of 300,000 monetary units in the first year and growing by 5% in the successive years. Capital expenditure will be 800,000 monetary units and will be connected with the purchase of assets that are subject to 20% depreciation. The required net working capital should not exceed 20% of the EBIT. The venture will be co-financed using bank loan in the amount of 500,000 monetary units, with interest rate of 10% per year, installments to be paid annually, 5 years for 100,000 monetary units. After a period of in depth analysis of your assets, it will be cashed for the amount of 400,000 monetary units. Assuming that the company pays 19% income tax and its owners expect a 14% return rate, will the capital expenditure be justified?

Stage I – calculating free cash flow using the FCFF method and taking into account residual value

In accordance with the previous scheme, calculate FCFF in the way presented in Table 1.

**Table 1: Calculation of free cash flow using the FCFF method
and taking into account residual value**

No	Breakdown	0	n-4	n-3	n-2	n-1	n
1	EBIT		300.00	315.00	330.75	347.29	364.65
2	Income tax		57.00	59.85	62.84	65.98	69.28
3	NOPAT		243.00	255.15	267.91	281.30	295.37
4	Depreciation		160.00	160.00	160.00	160.00	160.00
5	Change in Non-Cash Net Working Capital		60.00	3.00	3.15	3.31	3.47
6	Capital Expenditure	800.00					
7	**Free cash flow to firm – FCFF**	**-800.00**	**343.00**	**412.15**	**424.76**	**438.00**	**451.90**
8	**Residual Value - RV**						**400.00**

Source: Own elaboration

Stage II – establishing costs of particular types of capital, project value in each year, nominal value of the debt, share of particular types of capital and discount rates and ratios

This is a crucial stage in the proposed method. At the beginning we should establish the cost level of particular types of capital and the debt value. In the presented example this is an easy task, as all data are provided in the content of the example. In practice, it is quite common to

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refer to the CAPM model for own equity and to take into account the tax shield effect in the cost of loan capital. The second part, namely establishing project gross value and share of each type of capital is much more complicated. The calculations start rather untypically, with the last year of the analysis. Firstly, we must determine the company value at the end of year 5. In this period, owners have residual value at their disposal (established via assets-based or income-based methods). Next we need to establish the debt share after year 5, following formula 9. The third step is to calculate the debt share at the end of year 4, according to formula 16. The fourth step is to calculate the share of own equity following formula 13. The fifth step is to calculate weighted average cost of capital for the flows in year 5. The sixth step is to calculate project gross value at the end of year 4, as a sum of project value in year 5 and free cash flow from year five discounted with WACC rate for year 5. Steps 3, 4, 5 and 6 should be repeated for the remaining years (in a spreadsheet the simplest solution will be to drag formulas to the beginning of the period under analysis). At this stage of calculation we should also establish the values of discounting ratios for FCFF and FCFE methods. In period 0 we should insert value 1, in the next years it will be the value of the first year divided respectively by the sum of one and WACC value for discounting ratio for the FCFF method or cost of own equity for the FCFE method. The effect of the above actions was presented in Table 2.

Table 2: Calculation of cost of capital, nominal value of debt, project gross value, share of particular sources of financing, weighted average cost of capital and discounting ratios

No	Breakdown	0	n–4	n–3	n–2	n–1	n
9	Cost of own equity – Kkw	14.00%	14.00%	14.00%	14.00%	14.00%	14.00%
10	Cost of loan capital – Kko	10.00%	10.00%	10.00%	10.00%	10.00%	10.00%
11	Nominal value of loan capital	500.00	400.00	300.00	200.00	100.00	0.00
12	Gross company value at the end of period	1672.52	1534.18	1313.21	1054.60	752.45	400.00
13	Share of loan capital – Uko	29.89%	26.07%	22.84%	18.96%	13.29%	0.00%
14	Share of own equity – Ukw	70.11%	73.93%	77.16%	81.04%	86.71%	100.00%
15	Weighted average cost of capital – WACC		12.24%	12.46%	12.65%	12.88%	13.22%
16	Discount ratio for FCFF	1	0.8910	0.7923	0.7033	0.6230	0.5503
17	Discount ratio for FCFE	1	0.8772	0.7695	0.6750	0.5921	0.5194

Source: Own elaboration

Stage III – calculating free cash flow using the FCFE method taking into account residual value

Following the FCFE calculation scheme, we deduct from EBIT the amount of interests (in the presented case the amount of interests is calculated on the basis of debt from the beginning of a particular period multiplied by the assumes cost of debt capital). As a result, we obtain profit before tax, on the basis of which, after deducting income tax, we calculate net income. In order to calculate free cash flow, we add the value of depreciation to net income, deduct change in non-cash net working capital and capital expenditure. Contrary to the FCFF method, we also include the taking and payment of loans. In calculations we also take into account residual value for year 5 (the product of residual value for the FCFF model and share of own equity at the end of year 5).

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The results of particular calculations for the presented case are shown in Table 3.

Table 3: Calculation of free cash flow with the FCFE method, taking into account residual value

No	Breakdown	0	n-4	n-3	n-2	n-1	n
18	EBIT		300.00	315.00	330.75	347.29	364.65
19	Interests		50.00	40.00	30.00	20.00	10.00
20	Profit before tax		250.00	275.00	300.75	327.29	354.65
21	Income tax		47.50	52.25	57.14	62.18	67.38
22	Net income		202.50	222.75	243.61	265.10	287.27
23	Depreciation		160.00	160.00	160.00	160.00	160.00
24	Change in non-cash working capital		60.00	3.00	3.15	3.31	3.47
25	Capital expenditure	800.00					
26	Taking/Paying loans	500.00	-100.00	-100.00	-100.00	-100.00	-100.00
27	**Free cash flow to equity – FCFE**	**-300.00**	**202.50**	**279.75**	**300.46**	**321.80**	**343.80**
28	**Residual value – RV**						**400.00**

Source: Own elaboration

Stage IV – calculating discounted values of FCFF, FCFE and RV and providing present value for both methods

The last stage of the calculation is to calculate discounted values of FCFF, FCFE and RV and net present value of the project.

Table 4: Discounted values of FCFF, FCFE and RV and NPV for FCFF and FCFE

No	Breakdown	0	n-4	n-3	n-2	n-1	n
29	Discounted free cash flow to firm DFCFF	-800.00	305.61	326.53	298.72	272.88	248.67
30	Discounted residual value for FCFF (DRVFCFF)						220.12
31	**NPV FCFF**	*872.52*					
32	Discounted free cash flow to equity DFCFE	-300.00	177.63	215.26	202.80	190.53	178.56
33	Discounted residual value for FCFE (DRVFCFE)						207.75
34	**NPV FCFE**	*872.52*					

Source: Own elaboration

As we can see in Table 4, the calculations made in accordance with particular stages have brought identical NPV values for both methods.

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Conclusions

The presented method of establishing market shares of different types of capital has led to the financing costs in line with the assumptions made in the financial plan. An important advantage of the method is the fact that it takes into account the amounts of planned debt capital, which makes it easier to analyze the actual availability of a given source of financing. If necessary, we can expand the model to accommodate the account of cash flow and thanks to it, via observation of planned cash resources, examine liquidity.

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Appendix 1: View formulas in Table 1

No	Breakdown	0	n-4	n-3	n-2	n-1	n
1	EBIT		300	=E3*1,05	=F3*1,05	=G3*1,05	=H3*1,05
2	Income tax		=E3*0,19	=F3*0,19	=G3*0,19	=H3*0,19	=I3*0,19
3	NOPAT		=E3-E4	=F3-F4	=G3-G4	=H3-H4	=I3-I4
4	Depreciation		=D8*0,2	=E6	=F6	=G6	=H6
5	Change in Non-Cash Net Working		=E3*0,2-D3*0,2	=F3*0,2-E3*0,2	=G3*0,2-F3*0,2	=H3*0,2-G3*0,2	=I3*0,2-H3*0,2
6	Capital Expenditure	800					
7	Free cash flow to firm – FCFF	=D5+D6-D7-D8	=E5+E6-E7-E8	=F5+F6-F7-F8	=G5+G6-G7-G8	=H5+H6-H7-H8	=I5+I6-I7-I8
8	Residual Value - RV						400

Source: Own elaboration

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Appendix 2: View formulas in Table 2

No	Breakdown	0	n-4	n-3	n-2	n-1	n
9	Cost of own equity – Kkw	0,14	0,14	0,14	0,14	0,14	0,14
10	Cost of loan capital – Kko	0,1	0,1	0,1	0,1	0,1	0,1
11	Nominal value of loan capital	600	=D15-100	=E15-100	=F15-100	=G15-100	=H15-100
12	Gross company value at the end of	=(E16+E9)/(1+E19)	=(F16+F9)/(1+F19)	=(G16+G9)/(1+G19)	=(H16+H9)/(1+H19)	=(I16+I9)/(1+I19)	=I10
13	Share of loan capital – Uko	=(1+F13)/(((F9+F16)/E15)-(F14*(1-0,19)-F13))	=(1+G13)/(((G9+G16)/F15)-(G14*(1-0,19)-G13))	=(1+H13)/(((H9+H16)/G15)-(H14*(1-0,19)-H13))	=(1+I13)/(((I9+I16)/H15)-(I14*(1-0,19)-I13))	=(1+J13)/(((J9+J16)/I15)-(J14*(1-0,19)-J13))	=I15/I16
14	Share of own equity – Ukw	=1-D17	=1-E17	=1-F17	=1-G17	=1-H17	=1-I17
15	Weighted average cost of capital - WACC		=E13*D18+E14*0,81*D17	=F13*E18+F14*0,81*E17	=G13*F18+F17*G14*0,81	=H13*G18+G17*H14*0,81	=I13*H18+H17*I14*0
16	Discount ratio for FCFF	1	=D20/(1+E19)	=E20/(1+F19)	=F20/(1+G19)	=G20/(1+H19)	=H20/(1+I19)
17	Discount ratio for FCFE	1	=D21/(1+E13)	=E21/(1+F13)	=F21/(1+G13)	=G21/(1+H13)	=H21/(1+I13)

Source: Own elaboration

Appendix 3: View formulas in Table 3

No	Breakdown	0	n-4	n-3	n-2	n-1	n
18	EBIT		=E3	=F3	=G3	=H3	=I3
19	Interests		=D15*E14	=E15*F14	=F15*G14	=G15*H14	=H15*I14
20	Profit before tax		=E24-E25	=F24-F25	=G24-G25	=H24-H25	=I24-I25
21	Income tax		=E26*0,19	=F26*0,19	=G26*0,19	=H26*0,19	=I26*0,19
22	Net income		=E26-E27	=F26-F27	=G26-G27	=H26-H27	=I26-I27
23	Depreciation		=E6	=F6	=G6	=H6	=I6
24	Change in non-cash working capital		=E7	=F7	=G7	=H7	=I7
25	Capital expenditure	=D8					
26	Taking/Paying loans	=D15	=E15-D15	=F15-E15	=G15-F15	=H15-G15	=I15-H15
27	Free cash flow to equity – FCFE	=D28+D29-D30+D32-D31	=E28+E29-E30+E32-E31	=F28+F29-F30+F32-F31	=G28+G29-G30+G32-G31	=H28+H29-H30+H32-H31	=I28+I29-I30+I32-I31
28	Residual value – RV						=I16-I15

Source: Own elaboration

Appendix 4: View formulas in Table 4

No	Breakdown	0	n-4	n-3	n-2	n-1	n
29	Discounted free cash flow to firm DFCFF	=D9*D20	=E9*E20	=F9*F20	=G9*G20	=H9*H20	=I9*I20
30	Discounted residual value for FCFF (DRVFCFF)						=I10*I20
31	NPV FCFF	=SUMA(D37:I38)					
32	Discounted free cash flow to equity DFCFE	=D33*D21	=E33*E21	=F33*F21	=G33*G21	=H33*H21	=I33*I21
33	Discounted residual value for FCFE (DRVFCFE)						=I34*I21
34	NPV FCFE	=SUMA(D40:I41)					

Source: Own elaboration

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University of Information Technology and Management
Sucharskiego 2,
35-225 Rzeszów