

## **Development of a Case Study Problem in Engineering Economics Based on a Telephone Replacement Undertaking at UW -Platteville**

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### **Abstract**

General Engineering 2820 (GE 2820) is a course offered to all undergraduate students at the College of Engineering, Mathematics, and Science (EMS), University of Wisconsin –Platteville. A constant exercise for the instructors in this course is to update the course material with interesting case study problems which are then solved by students as an assignment. In recent days, the University of Wisconsin –Platteville, is contemplating replacement of its current Voice over IP (VoIP) phone service (catered by the local utility company “Century Link”) with a “Unified Communications” service. Current services cost the university \$18,900 per month. With the new system being contemplated and the since the university has necessary infrastructure in place, the cost for the university is estimated to be approximately \$7000 per month. Therefore, a breakeven analysis was undertaken for studying the economic feasibility of this undertaking by the students in this course. Part of this case study involved – defining the problem correctly, processing the interest rate data so as to calculate an appropriate effective annual rate, processing the financial data related to the phone services, and finally performing a breakeven study using the annual worth computation. Based on student performances, such case study problems have benefited the students in understanding the concepts of time value of money and various method of analysis in engineering economy.

### **Introduction**



The University of Wisconsin –Platteville (of the UW -system) is a 4 –year undergraduate institution. Engineering Economics (GE 2820) is a requirement in the curriculum of almost all engineering programs at the College of Engineering, Mathematics, and Science (EMS).

Engineering Economics is the study of the viability of an engineering project from a financial point-of-view. There are numerous approaches to decide on the viability of a project, namely –valuation analysis, break-even analysis, and benefit-cost analysis among many others<sup>1</sup>. Any critical thinking in understanding these concepts should include the students being able to - (i) recognize reliable financial data from relevant literature, (ii) decide on a suitable approach for the analysis, (iii) process the data for the analysis, (iv) undertake the analysis, and (v) process the results for decision making.

One of the major drawbacks is that most of the problems in many of the standard textbooks are oversimplified and often neglect the uncertainty inherent in financial analysis. This discourages in depth thinking of the topic. Therefore it has been a constant exercise to develop case study problems in this course. One such case study problem recently developed was based on the

phone replacement project currently being undertaken at UW –Platteville. The project provides the students a complex and more realistic problem that required them to consider uncertainty in their analysis. The project is also a service learning opportunity<sup>2</sup>, which should help increase the students’ motivation and ultimately improve learning.

In the following sections, we shall first introduce the data for the phone systems and the prevailing interest rates. This shall be followed by a brief description of the analysis undertaken. We shall conclude with the results we obtained in terms of students understanding the concepts.

### The Financial Data for the Phone Systems



The university is currently using a Voice over IP (VoIP) phone system installed in 2007. This system is owned by CenturyLink and is jointly managed by UW –Platteville telecommunications staff and CenturyLink. University staff is responsible for day-to-day management, while CenturyLink is responsible for hardware and software maintenance, and licensing. Under the current model the university spends approximately \$18,900 monthly on basic telephone service. Early cost models suggest the university could save at least \$56,000 annually and increase service by implementing and managing its own telecommunications infrastructure such as the Unified Communications System.



While the current VoIP implementation system serves the university well, the university seeks an extended VoIP system, ie., the “Unified Communications Sytem” with the potential to integrate with existing communication systems including e-mail, security systems, and emergency communications systems. With an increasing number of mobile professionals, the university also requires the system provide mobility solutions using

single-number reach and softphones installed on mobile devices and laptop computers. Other highly desired features include video, collaboration and conferencing tools, and instant messaging.

All relevant financial data<sup>3</sup> for the existing and the proposed system is described in Appendix 1.

## The Financial Data on the Interest Rates

The interest rates (or the bond rates) are specified for the UW –system by the state. These rates fluctuate from month-to-month. Appendix 1 also specifies the interest rates from July 1, 2010 to October 1, 2013.

## Plan for Analysis



Since the interest rates are monthly, it is convenient to work with an effective annual rate. The first task for the students is to find a way to compute this annual rate. Next, the economic study is undertaken using breakeven analysis. For this, students need to determine the number of years it would take when a

breakeven in cost is achieved between the two phone systems before the campus starts saving money. The expenses for the two phone systems is annualized over a period of 10 years and the net annual expense for the two systems is equated to compute the breakeven period. The actual breakeven period computed between the two systems is 4.6 years. The assignment is included as Appendix 1.

## Results and Conclusions

The designing of case study problems is an ongoing exercise in improving the learning by the students through appealing to their critical thinking. Obviously the outcome of this entire exercise would be quantifying the learning objectives. Although no formal procedure is adopted, one measure that is employed is the improvement in weekly quiz scores over the entire semester. In this regard, students doing well in such case study problems excel in quizzes and exams.

## Bibliography

1. WHITE, J.A., CASE, K.E., and PRATT, D.B., "Principles of Engineering Economic Analysis", 5<sup>th</sup> edition, John Wiley & Sons, Inc., 2010.
2. EYLER, J., GILES, D.E., and ASTIN, A.W., "Where's the Learning in Service-Learning?", Jossey-Bass, 1999.
3. <http://www.cisco.com/c/en/us/products/unified-communications/service-listing.html>

## Appendix 1

The problem statement and the required financial data:

The University of Wisconsin –Platteville is contemplating replacing its current Voice over IP (VoIP) phone system with a Unified Communications System which has the potential to integrate with existing communication systems including e-mail, security systems, and emergency communications systems. Determine the financial feasibility of this project by doing an appropriate economic analysis. Below are the required financial data for the two phone systems and the interest rates for borrowing.

Financial data for the existing VoIP system:

	Qty	VoIP Rate	VoIP (Monthly)	Annual
Standard Phone	1200	\$ 15.75	\$ 18,900.00	\$ 226,800.00
Soft Phone Only	0	\$ 15.75		
Advanced Phone	100	\$ 15.75	\$ 1,575.00	\$ 18,900.00
Staff (Salaries)				\$ 94,900.00
VoIP Monthly Est.			\$ 20,475.00	
VoIP Annual (inc Staff)				\$ 340,600.00

Financial data for the proposed unified communications system:

	Life	qty	Unit Cost	Total(up front)	
Hardware	5yrs	1	\$ 38,372.10	\$ 38,372.10	one-time payment, yr 0
Support and Maintenance	Annual	1	\$ 874.00	\$ 874.00	Annual payment starting yr 0
Conference Phone	10 yrs	30	\$ 823.05	\$ 24,691.50	one-time payment, yr 0
License		30	\$ 88.50	\$ 2,655.00	one-time payment, yr 0
Support and Maintenance	Annual	30	\$ 7.24	\$ 217.20	Annual payment starting yr 0
Standard Phone	10 yrs	1200	\$ 309.75	\$ 371,700.00	one-time payment, yr 0
License		1200	\$ 191.75	\$ 230,100.00	one-time payment, yr 0
Support and Maintenance	Annual	1200	\$ 23.97	\$ 28,764.00	Annual payment starting yr 0
Soft Phone Only		0	\$ -	\$ -	
License		0	\$ 191.75	\$ -	one-time payment, yr 0
Support and Maintenance	Annual	0	\$ 23.97	\$ -	Annual payment starting yr 0
Advanced Phone	10 yrs	100	\$ 572.30	\$ 57,230.00	one-time payment, yr 0

	Life	qty	Unit Cost	Total(up front)	
License		100	\$ 295.00	\$ 29,500.00	one-time payment, yr 0
Support and Maintenance	Annual	100	\$ 44.00	\$ 4,400.00	Annual payment starting yr 0
Professional Services (Installation)		1	\$ 95,000.00	\$ 95,000.00	one-time payment, yr 0
Staff (Salaries)	Annual		\$ 94,900.00		
Up front cost				\$ 883,503.80	

Interest Rate data:

Month	Interest Rate	Month	Interest Rate	Month	Interest Rate	Month	Interest Rate
7/2010	0.2308005%	7/2011	0.1205660%	7/2012	0.1503893%	7/2013	0.0723840%
8/2010	0.2294765%	8/2011	0.1136921%	8/2012	0.1549388%	8/2013	0.0766900%
9/2010	0.2370547%	9/2011	0.1182716%	9/2012	0.1755830%	9/2013	0.0686347%
10/2010	0.2322484%	10/2011	0.1461920%	10/2012	0.1999993%	10/2013	0.0952012%
11/2010	0.2309554%	11/2011	0.1477573%	11/2012	0.1976050%		
12/2010	0.2057810%	12/2011	0.1476153%	12/2012	0.1910734%		
1/2011	0.1974885%	1/2012	0.1384161%	1/2013	0.1354274%		
2/2011	0.1795710%	2/2012	0.1424556%	2/2013	0.1418443%		
3/2011	0.1705448%	3/2012	0.1583100%	3/2013	0.1562416%		
4/2011	0.1511422%	4/2012	0.1485758%	4/2013	0.1470559%		
5/2011	0.1316993%	5/2012	0.1563873%	5/2013	0.0965062%		
6/2011	0.1195966%	6/2012	0.1671826%	6/2013	0.0848065%		