

AC 2008-2956: CONTEXT-BASED PROBLEMS AND EXERCISES FOR TEACHING ENGINEERING ECONOMY

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Context-Based Problems and Exercises for Teaching Engineering Economy

Introduction

Traditionally, methods of teaching engineering economy draw on resources such as textbooks¹⁻⁵, websites⁶ and papers⁷. Often, engineering economy courses follow the ‘given this, find that’ style of exercises to introduce and reinforce basic concepts. Developing examples and exercises that are interesting, engaging, and provide context is a challenging problem for courses with students enrolled from a variety of majors. Yet, we know that without proper context to their discipline, students will not find relevance or understand why they should care to learn engineering economy. To students it may be just another course to check off the requirements list. Further, students from disciplines other than industrial engineering (IE) often learn engineering economy as part of another required course within their discipline. For example, mechanical engineers will be introduced to engineering economy concepts in an introductory or senior course in engineering design. For this situation, non-IE students typically do not purchase a textbook in engineering economy, but rely on instructor provided materials.

When students become seniors, we expect that they will remember, integrate, synthesize and assimilate topics that have been ‘poured into their heads’ over the prior 3-4 years as they take on a capstone design project. Faculty teaching capstone design may introduce or reinforce a variety of topics, such as engineering economy, that will support the design process and other learning objectives that have not been covered earlier in the curriculum. The review of topics in preparation for the FE exam may also be a priority in the senior year.

While there are a number of excellent textbooks¹⁻⁵ on engineering economy, and authors make every effort to improve these textbooks over time with added examples and exercises and new ways of conveying concepts, these updates come every few years and do not provide a dynamic mechanism to *continuously* improve. Sharing example problems from a variety of disciplinary perspectives is limited and infrequent. Moreover, submitting suggested problems and improvements to the textbook to authors is limited compared to the size of the community. And again, there is a time delay from when suggestions are provided and when these might be included in a new edition. If student A reads the textbook but has better insight on the subject due to experience in the field, the student may be in a position to give some real life example where he found the application of the studied principles to be useful. One cannot add this example to the textbook directly. To avoid trouble of communication with the authors, student A is likely to never communicate improvements to the author. As a result of this, someone who could have benefited more by learning about A’s experience loses out on the opportunity. This lack of dynamic mechanism to continuously improve learning resources is the same for conventional websites, and other printed media such as journal and conference papers.

This paper proposes a material collection and usage method that can be used to learn or review engineering economy. A wiki framework provides the means to post instructional materials on

the fundamentals of engineering economy as well as example problems and cases from a wide variety of engineering disciplines. In the sections that follow, the basic principles of wikis are first introduced, then the main functions in this method are explained in detail with the realized system. Ultimately, with sufficient input from a variety of disciplines, it could be a national resource and basis to move beyond examples and problems that are so generalized, students do not find them relevant.

What is a Wiki?

A wiki is software that allows the user to freely create and edit web content⁸. Amongst all group communication mechanisms, a wiki is special in that it allows the organization of contributions to be edited in addition to the content itself. A wiki is ‘open’, in the sense that any user of the site (typically a member who was granted membership by the owner or administrator) can edit and add content as they see fit. One does not have the permission of deleting the pages. This helps us protect the site. A wiki is incremental, that is, the pages of the site can cite other pages. A wiki enables interaction and collaboration. This helps in forming networks and gives a solution to synergizing the effort of the whole group. A wiki finds typical application in affordable intranets and knowledge management⁸.

The main motivation behind the design of a wiki is ease in correction of mistakes and ease of updates. While wikis are ‘open’ to users, administrators monitor additions and verify the validity of the recently added pages to the wiki site. Generally, wiki sites are designed with the philosophy of tracking changes and correcting errors easily⁸. Using the recent edits page, an administrator can list the changes that have taken place in the website over any given span of time. Using the revision history, an administrator can restore the site to any of its previous states. The administrator may also choose to organize the flow and categorization of contributions.

Approach and Methods:

In preparing a Wiki site that contains information about engineering economy, the following requirements were identified:

- Any visitor can view the content of the site but cannot edit any of its content.
- A visitor should be able to request membership of the site. The right to grant membership should be reserved with the administrator.
- Members should be able to add pages and update information on the site.
- The right to delete pages should be reserved with the administrator.

Based on the requirements listed above, there are three main functions in this method, as listed below.

- User administration. It includes account application, user login and the management of editing rights of the users.
- Material browsing and editing.
- Tracking and changes, which includes searching and listing changes with the change time, version and editor as well as deleting and categorizing the changes by the administrator.

These three functions are explained with user interfaces in the following sections to show the framework of the wiki. This framework will be used as a resource of Engineering Economy

education in the future after contributions are added to the wiki that include teaching materials, example problems, industrial requirements and case studies.

User Administration:

Using wikidot, a popular website which enables users to make their own wikis, we created the site for engineering economy⁹. As shown in Figure 1, the wiki is organized so that visitors can learn about the Fundamentals of Engineering Economy or they may choose to view example problems and cases in several topics that have been posted by members.



Figure 1: Introduction page of the wiki site

Any person can view this site on the web, but only registered users can add new pages. As shown in Figures 2a and 2b, a visitor to the site can become a member by putting up an application for membership. If the person is a member of wikidot, then he/she will not need to create a new account. Upon requesting a membership and subsequently being granted, one can post examples or other content to the site and the wiki is open to contributions.

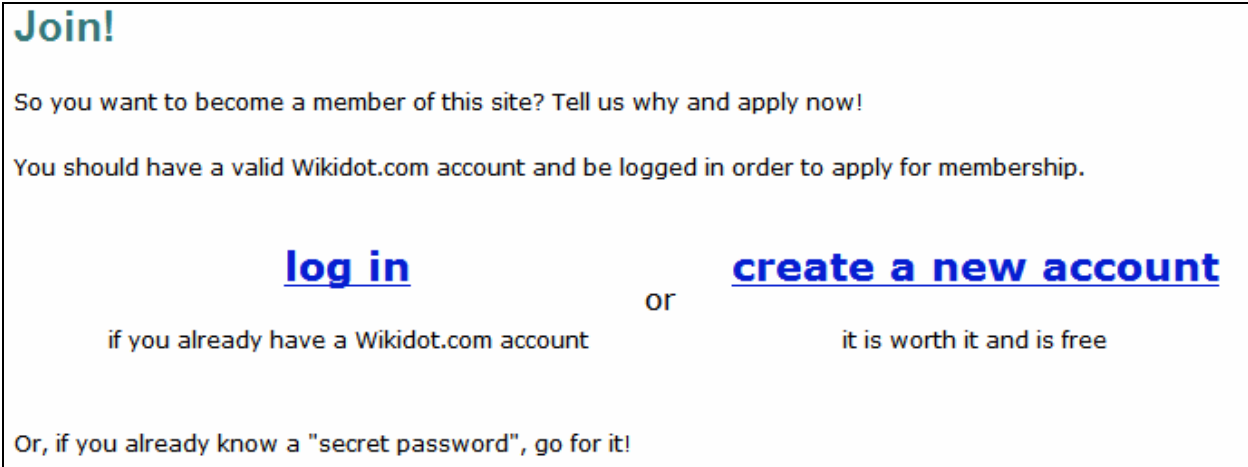


Figure 2a: Login or join the Wiki

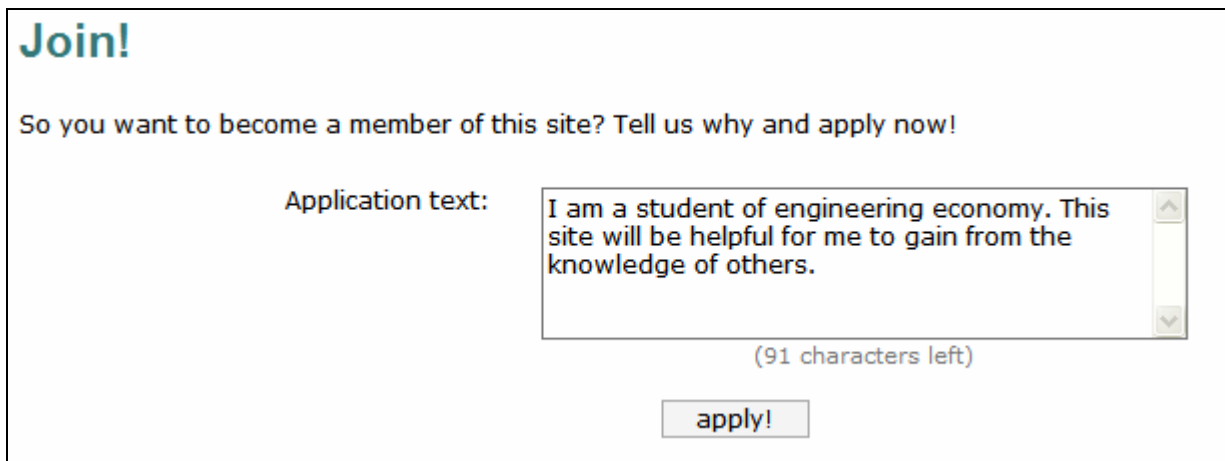


Figure 2b: Visitor putting up an application

As shown in Figure 3, after a user submits a request for membership, the administrator of the site will accept or decline it.

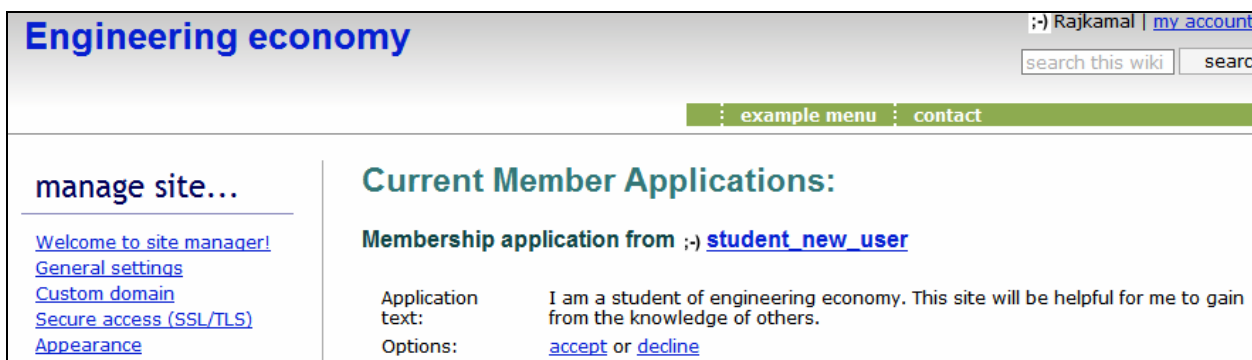


Figure 3: Administrator may accept or decline an application.

Periodically, the administrator or any moderator can scan the recent changes to the site. The administrator or moderator can then delete the content they deem irrelevant or in bad quality or

can modify the content appropriately. The administrator or moderator will also link the valuable pages to the proper topics like mechanical engineering, industrial engineering, etc.

Material Browsing and Editing:

There are several topics in the introduction page of the wiki site as shown in Figure 1, such as mechanical engineering and industrial engineering. In each topic, there are several subtitles, like industrial requirements and case studies, as shown in Figure 4. The latest requirements from industry as well as real cases and experiences related to Engineering Economy in the corresponding topics can be input into the subtitles. Since these webpages are open to all visitors of the site, the wiki can help students get in touch with the latest industrial development in the topic and help senior students be prepared with the future work after graduation.

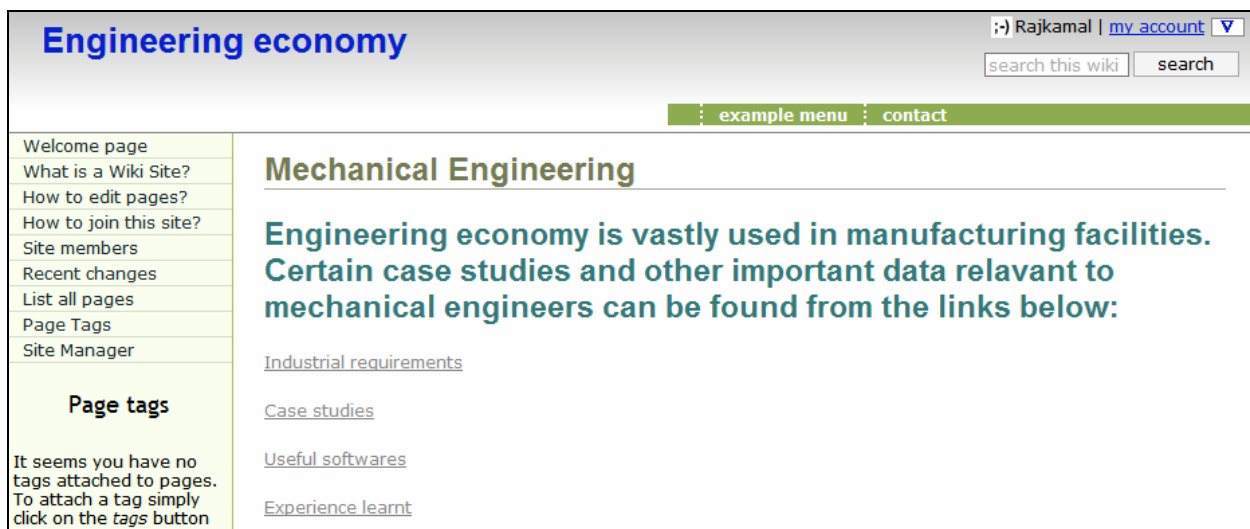


Figure 4: A topic with its subtitles

Figure 5 is an example of the teaching material that can be viewed on the website. It shows the time value of money and the comparison of alternatives.

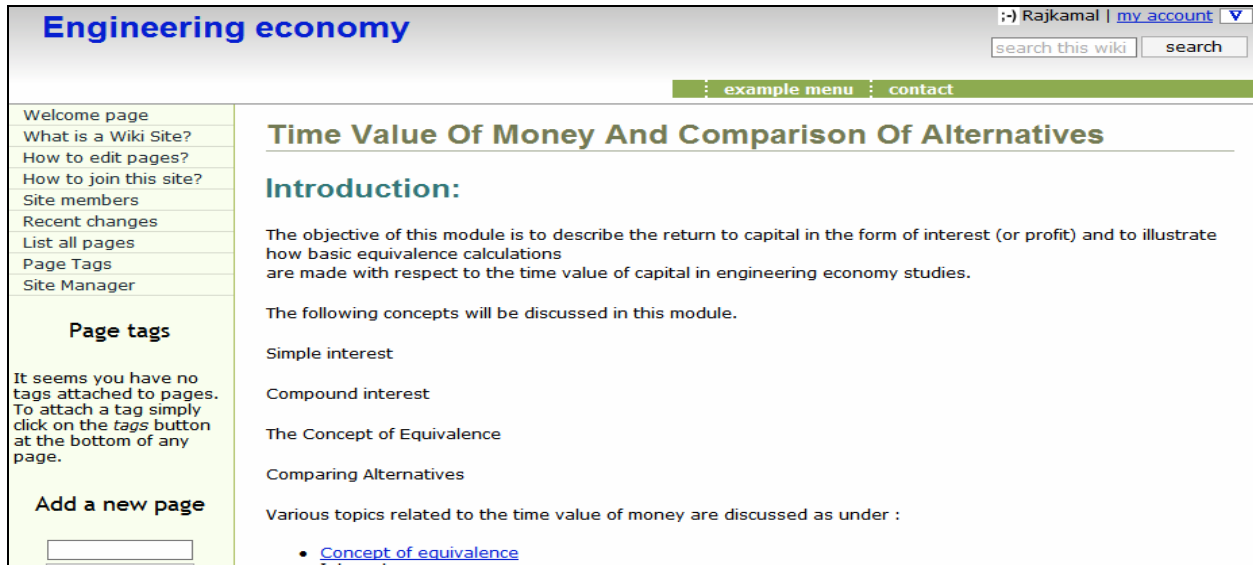


Figure 5: Visitor or member browsing through the material on the site.

Once a member (with account) feels that there is an example that can contribute to this article on the site, he/she can add a new page with his/her data and example. As shown in Figures 6a and 6b, he/she edits the page of time value of money and provides a link for the example there. This material is then available for every visitor to the site.

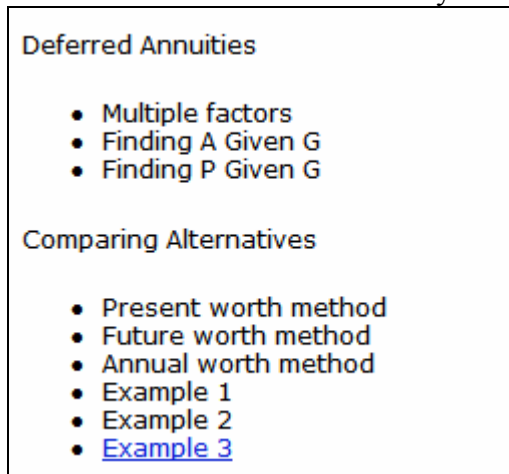


Figure 6a: A link to the new example (example 3) being provided by the member.

Engineering economy raikamal | my account

search this wiki search

example menu contact

<p>Welcome page</p> <p>What is a Wiki Site?</p> <p>How to edit pages?</p> <p>How to join this site?</p> <p>Site members</p> <p>Recent changes</p> <p>List all pages</p> <p>Page Tags</p> <p>Site Manager</p> <hr/> <p style="text-align: center;">Page tags</p> <p>It seems you have no tags attached to pages. To attach a tag simply click on the <i>tags</i> button at the bottom of any page.</p> <p style="text-align: center;">Add a new page</p>	<h2 style="margin: 0;">Example 3</h2> <p>Ex. III: Alternatives with different useful lives.</p> <p>Two possible investment alternatives are under consideration for a study period of 10 years. Given the data in the table and a MARR of 10%, which alternative would you choose? State all assumptions</p> <p>Do Nothing Invest in A Invest in B</p> <p>Initial Investment (I) 0 \$40k \$60k Annual revenues (R) 0 8k 12k Annual expenses (E) 0 2k 1.5k Salvage Value (SV) 0 10k (EOY 10) 25k (EOY 5) Useful life, in years N/A 10 5</p> <p>Solution</p> <p>In this case the useful life of Investment B is shorter than the study period of 10 years, so we can assume repeatability, we will invest in B in years 0 and 5 - repeating it twice.</p> <p>Since we are assuming repeatability, it is easiest to use the Annual Worth method to compare the alternatives. That way, we only need to compute the AW for each during its useful life.</p>
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Figure 6b: The new example added by the member.

Tracking and Managing Changes:

As shown in Figure 7, after the search requirements on the top of the webpage are specified, the changes that meet the requirements can be listed below with their change time, version and editors. The sequence of the changes listed follows the order of the time of change, with the newest change at the beginning. Through this approach, the administrator can easily track changes and delete the low quality pages in a timely manner.

Recent Changes

Revision types: ALL
 new pages
 source
 title
 move/rename
 meta data
 attachments (files)

From categories: Whole site

Revisions per page: 20

update list

page 1 of 2 1 2 next »

Time Value Of Money And Comparison Of Alternatives	<u>S</u>	16 Jan 2008 - 23:46:16	(rev. 5)	Raikamal
Time Value Of Money And Comparison Of Alternatives	<u>S</u>	16 Jan 2008 - 23:45:39	(rev. 4)	Raikamal
Example 3	<u>N</u>	16 Jan 2008 - 23:43:11	(new)	Raikamal
Introduction	<u>S</u>	16 Jan 2008 - 23:07:00	(rev. 7)	Raikamal
Introduction	<u>S</u>	15 Jan 2008 - 00:36:12	(rev. 6)	Raikamal
Time Value Of Money And Comparison Of Alternatives	<u>S</u>	14 Jan 2008 - 23:17:01	(rev. 3)	Raikamal

Figure 7: Search and track changes

Management of the Wiki:

A wiki site can be seen as a book which is continuously increasing in size. In this aspect, the administrator is in charge of checking the quality of the added pages and categorizing these pages in the proper place. A user may write a page or even a number of pages which he wants to contribute. To give the links to this page/s is a decision only at the discretion of the administrator. In addition, the administrator can provide moderator privileges to certain users. Thus, this site can be viewed as being controlled by the selected group containing the administrator and the moderators. The ultimate privilege rests with the administrator. This gives certain protection to the site from users with ill intentions. Even when any improper data is created and added to the site, periodic scanning of recent changes by the administrator and moderators can result in filtering out of such data. The administrator may even revoke the user privileges by blocking any user if he sees improper conduct of the user.

Future Work:

Future work in this area is to seek methods to grow membership of the site. Ideas from different sources should be solicited so that this resource can grow to encompass all areas dealing with engineering economy.

A wiki site is open to vandalism from its members⁸. An administrator can definitely undo any changes to the site but trust is an important factor and a roadblock to the widespread usage of wikis. Our site does provide a basic framework for the working of an open resource for the knowledge of engineering economy but stability of the site will increase with the development of wikis. In the future, more examples and content related to engineering economy are expected to be input by the system users.

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