

“The Reliability of AUA as a Graduate Producing System”

**IE 234
RELIABILITY ENGINEERING**

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ABSTRACT

Systems are designed and constructed for a certain purpose and their activity is directed toward that goal. A system is therefore reliable if it reaches its desired target. AUA prepares specialists for Armenia, and it can be viewed as a system which produces finished products such as Industrial and Earthquake engineers or MBA graduates.

The aim of this paper is to construct a reliability model of AUA and estimate the improvement potential of each of its "elements".

THE ELEMENTS OF AUA AND THEIR PERFORMANCE ABILITY

AUA includes four colleges: Engineering, MBA, Political Science and Public Health. The steps which an applicant progresses are the same regardless of the chosen degree program. These steps are:

- Step 1: Acceptance to IEP (Intensive English Course).
- Step 2: GMAT/GRE.
- Step 3: Acceptance to Degree Program.
- Step 4: Graduation.

The time period between two consequent steps is defined as a single functioning element. Here there are three elements.

- Element 1: Acceptance to IEP- GMAT/GRE.
- Element 2: GMAT/GRE- Acceptance to Degree program.
- Element 3: Acceptance to Degree program- Graduation.

For further analysis the following assumptions are made.

1. All graduates who finish AUA are specialists with satisfactory quality. Hence if a student graduates from AUA, the goal of the system is achieved.
2. The average mental abilities of students do not fluctuate drastically. So the opportunity of each student to transfer from one step to another depends on how well AUA has created the proper environment for study.
3. The process can be considered as continuous and the performance of a student at one step does not depend on the previous step's performance directly, so the elements can be considered as independent.
4. If a student withdraws, there is not much confidence that he/she will come back and continue the study process-hence they are excluded in further calculations.

The reliability (or performance) of an element is defined simply as the number of students at the beginning and end of the element. In other words, the performance of an element is the percentage of students who have been transmitted from one step to the next one. The reliability can be calculated for each college (a series structure of three elements) and their sum gives the reliability of the entire system (a parallel structure (1-out-of-5),

because there are five major specialization: EE, IE, MBA, PS and PH). Since Political Science and Public Health Colleges have only been established recently, the calculations will be done for three specialization's: Industrial Engineering, Earthquake Engineering and Business Administration. The calculation is done in the following manner. The number of students accepted to IEP applicants (so-called raw material), say for 1992 is taken, and then their path through all steps of study up to the graduation in 1994 (finished product) is traced.

ELEMENTS' AND STRUCTURE RELIABILITY

The available data for the mentioned specialization are as follows:

1. Industrial Engineering

Year	Submitted Applications	Accepted to IEP	GRE	Degree Program	Graduation
1991	18	18	17	12	10 (1993)
1992	38	29	28	27	13 (1994)
1993	35	29	27	23	Not available
1993	64	43	35	33	Not available

2. Earthquake Engineering

Year	Submitted Applications	Accepted to IEP	GRE	Degree Program	Graduation
1991	6	6	5	5	5 (1993)
1992	16	9	9	9	3 (1994)
1993	16	8	8	8	Not available
1993	24	14	12	12	Not available

3. MBA

Year	Submitted Applications	Accepted to IEP	GRE	Degree Program	Graduation
1991	78	78	73	62	38 (1993)
1992	136	101	88	57	50 (1994)
1993	192	132	98	69	Not available
1993	175	136	118	87	Not available

In the following tables the reliability of the elements are given.

1. Industrial Engineering

Elements	1991-93	1992-94	1993-95	1994-96
Element 1	0.944	0.9665	0.931	0.814
Element 2	0.706	0.964	0.852	0.943
Element 3	0.833	0.481	Not available	Not available
Total	0.555	0.448	Not available	Not available

2. Earthquake Engineering

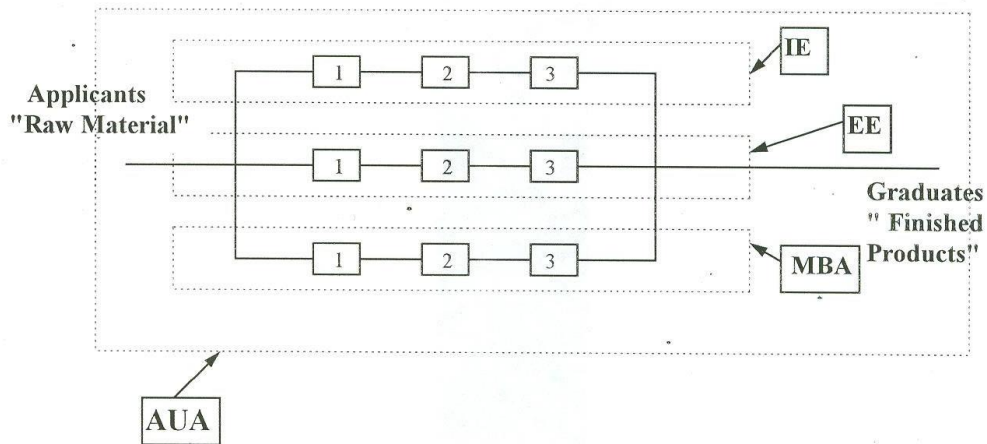
Elements	1991-93	1992-94	1993-95	1994-96
Element 1	0.833	1	1	0.857
Element 2	1	1	1	1
Element 3	1	0.333	Not available	Not available
Total	0.833	0.333	Not available	Not available

3. MBA

Elements	1991-93	1992-94	1993-95	1994-96
Element 1	0.936	0.871	0.742	0.868
Element 2	0.849	0.648	0.704	0.737
Element 3	0.613	0.877	Not available	Not available
Total	0.487	0.495	Not available	Not available

THE RELIABILITY OF AUA

It was mentioned that AUA can be represented as a system of parallel structures (colleges/degree programs) in which each branch consists of three elements (elements of study process). Here is the illustration of said approach.



For parallel structure of order 3 the system's reliability is

$$h(p(t))=1-(1-p_1)(1-p_2)(1-p_3) \quad \text{where } i=1 \text{ (IE), } 2 \text{ (EE), } 3 \text{ (MBA)}$$

$$\text{Total reliability of AUA (1991-93)}=1-(1-0.555)(1-0.833)(1-0.487)=0.962$$

$$\text{Total reliability of AUA (1992-94)}=1-(1-0.447)(1-0.333)(1-0.495)=0.82$$

It follows from the data, that the total reliability of AUA declined from 96.2% to 82% from 1991-93 to 1992-94.

AUA is designed for study in economics, engineering, political science and public health, so they all are important and the functioning of one branch can not be replaced by another result.

There are different measures for estimating the importance of a system's element. For our analysis the most convenient criteria are *Birnbaum's Measure* (BM) and *Improvement Potential* (IP). The first one shows the "weight" of an element in the given system, i.e. it allows us to determine to what extent the reliability of the given system

depends on the reliability of that particular element. The Improvement Potential describes how much the system reliability can increase, if we improve a particular element, keeping all others fixed.

The Birnbaum's Measure and Improvement Potentials of elements and colleges are the followings.

Birnbaum's measure (1991-93)

Element	IE	EE	MBA
Element 1	0.588	1	0.52
Element 2	0.786	0.83	0.574
Element 3	0.666	0.83	0.795

Birnbaum's measure (1992-94)

Element	IE	EE	MBA
Element 1	0.464	0.333	0.568
Element 2	0.465	0.333	0.764
Element 3	0.931	1	0.564

Improvement potential (1991-93)

Element	IE	EE	MBA
Element 1	0.033	0.167	0.033
Element 2	0.231	0	0.087
Element 3	0.111	0	0.308

Improvement potential (1992-94)

Element	IE	EE	MBA
Element 1	0.016	0	0.07
Element 2	0.017	0	0.269
Element 3	0.48	0.667	0.069

Of course this data isn't enough to make an accurate statistical research, which will allow long term trends in the "behavior" of AUA to be observed but even having this small quantity of data it is possible to see the changes between the first and second graduation periods. It can be seen that if we compare the IP of the elements they fluctuate from college to college. For example from the 1991-93 to 1992-94 period for IE and EE the IP of all elements have changed either in increase or decrease direction, but the most significant change occurred for element 3 (Acceptance to Degree Program- Graduation). At the same time for MBA program the elements which fluctuated the most are 2 and 3 (note that the second one has been improved).

	1991-1993			1992-1994		
	IE	EE	MBA	IE	EE	MBA
Birnbaum's measure	0.406	0.27	0.462	0.165	0.222	0.149
Improvement potential	0.18	0.045	0.237	0.09	0.148	0.075

It is obvious from this data, that the performance ability from 1991-93 to 1992-94 has been drastically decreased only for EE degree program (for IP from 0.045 to 0.148).

SUMMARY

The analysis of this paper can be used to understand AUA in terms of its system reliability.

First, for all three degree programs, there is a need to improve the reliability of the elements 2 and 3, which include the study process, beginning from GRE/GMAT up to the Graduation. This does not necessarily mean that the teaching effectiveness of degree programs is low. Here the following fact must be mentioned. The experience of previous years show that part of the applicants that are admitted to AUA are interested in enhancing their English and computer knowledge and to have an opportunity to take GRE/GMAT without any payment. Part of them earn high grades and become transferred to degree program, but they don't visit it. As a result the reliability of element three is artificially lowered. Of course it doesn't eliminate the existence of students who leave AUA as a result of low performance. To differ these issues it will be better to study the path of accepted applicants semester by semester which should allow to reveal the most critical point of entire study process.

Second point is the absence of responsibility among students, i.e. there isn't well organized policy for differentiating the good and bad students. Of course AUA has a policy to involve students with high GPA in different activities (ERC, CBRD, etc.) and to pay them but in my opinion today it isn't enough. Here the following approach can help. Beginning from the acceptance to the IEP each student must pay tuition or registration fee, but the students with high GPA, say above 3.5 should be waived from these payments. As a result the motivation for high performance will be higher and as a result the reliability of entire system will increase.

One more thing which will be very useful for enhancing the motivation of students to graduate AUA is to organize such an approach or policy, which will use the reputation of AUA and to provide after graduation the best job for the best students. Today this approach doesn't work and there isn't any difference between the good and bad graduating students.

Of course all these conclusions are based on the initial assumptions which were made and the sample of data, which is far from being sufficient, so they can seem subjective. The lack of data of course is the main drawback, but this is due to known reasons. The most important thing is that the applied approach can be implemented in future with more data.