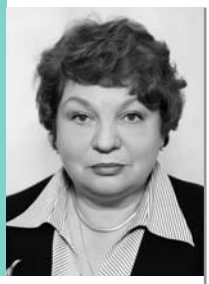
Evaluation of Graduate Qualification Works in Engineering University

Moscow State University of Radio-Engineering, Electronics and Automation, MIREA
M.V. Pokrovskaya, V.V. Sidorin



M.V. Pokrovskaya

V.V. Sidorin

Performance of graduate qualification work (GQW) is the most effective method of revealing knowledge, skills, and competences formed in the process students' training in university and presented in a concentrated form for the State Examination Board (SEB) for thesis defense. The restricted time of diploma defense, graduates' personal qualities, membership of SEB and a number of other factors decrease significantly low enough degree of objective evaluation of GQW by the expert method. In the condition of permanent growth in demand for engineering graduates on the part of employers and increase in importance of graduates' evaluation at his/her certification in the further professional activity and career development designing methods and techniques for objective evaluation is of particular significance. In this paper the technique of GQW evaluation of engineering graduates tested at specialists' and bachelors' assessment of «Design and Technology of Electronic Instrumentation» is presented.

Key words: *graduation thesis, technical university, singular quality indicator, complex quality rating indicator, measures, indicators, weighted coefficients, State Examination Board, graduate certification.*

Performance and defense of graduate qualification work (GQW) is one of the stages in assessment of an engineering university graduate to reveal his/her level of qualification and correspondence to the requirements of the Federal State Education Standard (FSES). General requirements for GQW and the procedure of certification are specified in the Regulation of Final State Certification of University Graduates of the Russian Federation approved by the order of Education Ministry of Russia of 25.03.03 № 1155. The regulation suggests the subsequent development of methodical standards in GQW evaluation by every university where specificity of each university's activity, peculiarities of provided progrmas and other aspects of students' training are to be taken into account. These standards are to include factors, indicators and criteria for GQW assessment and evaluation of graduates' training level, their preparation for professional performance. Such a standard can be the presented technique in which general regulations of final state certification of the university graduates are elaborated and indicators, criteria and the procedure of bachelors', specialists', masters' GQW evaluation are stated.

Quality assessment of GQW and evaluation of graduates' training level is performed by the State Examination Board (SEB) as a result of defense in 12 indicators (Table1). The first ten

indicators assess the work itself and its defense. In terms of each 10 indicators GQW is assessed in ten-point scale – from 1 to 10 points. The eleventh indicator includes students' performance in the process of training and is assessed in three-point scale – from 3 to 5 points. The twelfth indicator accounts for a reviewer's assessment and is evaluated in four-point scale taking the values from 2 to 5 points. Evaluation of GQW is performed by the members of SEB. Every member assesses GQW independently in terms of 10 single quality indicators presented in Table 1 and places his/her grade in the individual questionnaire.

Different significance degree of indicators is found by weighted coefficients. The magnitudes of indicator weighted coefficients include current requirements for GQW and graduates' competences from the part of the government, employers, and labour market and can be changed in some cases taking into account definite circumstances, social-political and economic conditions, priorities in GQW evaluation.

Evaluation of GQW in points using four-point scale (excellent – five points, good – four points, satisfactory – three points, unsatisfactory – two points) is performed in terms of complex criterion including:

- complex quality indicator normalized to its maximum possible magnitude: $Q\,\Sigma_{mean} / Q_{\Sigma max}$;
- every mean single indicator normalized to its maximum magnitude: $Q_{mean\ n} / Q_{n\ max.}$

Criteria for GQW evaluation using four-point scale are presented in Table 2.

Adding all grades of SEB members the complex quality indicator is calculated:

- complex quality indicator for each work normalized to its maximum magnitude: $Q_{\Sigma\ mean} / Q_{\Sigma\ max}$;
- Mean single indicators normalized to their maximum magnitudes: $Q_{mean\ n} / Q_{n\ max}$;
- Mean defining single quality indicators normalized to their maximum magnitudes: $Q_{i\ def.} / Q_{i\ def.max}$.

Table 1. Indicators and Criteria of GQW Evaluation

№	Indicator	Indicator conventional sign, Q_n	Scale Δ_{min} - Δ_{max} Of indicator value Q_n, point	Weighted coefficients, k_n	Minimal value of indicator, $Q_{n\ min}$, point	Maximum value of indicator, $Q_{n\ max}$, point
1	Correspondence of GQW to the task requirements	Q_1	1÷10	3	3	30
2	Personal contribution to the project	Q_2	1÷10	2	2	20
3	Practical significance and expected results	Q_3	1÷10	1	1	10
4	Novelty and originality of work	Q_4	1÷10	0,5	0,5	5
5	Quality of work conclusion (completeness and Correspondence to the design requirements)	Q_5	1÷10	0,5	0,5	5
6	Quality of developed materials	Q_6	1÷10	0,5	0,5	5
7	Quality of material presentation to SEB	Q_7	1÷10	0,4	0,4	4
8	Answers to the SEB members' questions	Q_8	1÷10	0,5	0,5	5
9	Quality of economic part of the work*)	Q_9	1÷10	0,3	0,3	3
10	Quality of the section devoted to ecology and labour protection*)	Q_{10}	1÷10	0,3	0,3	3
11	Mean rating score during the period of study	Q_{11}	1÷5	0,5	0,5	5
12	Reviewer's evaluation	Q_{12}	1÷5	0,5	0,5	5
	Total sum of work evaluation				$Q_{\Sigma min} = 10$	$Q_{\Sigma max} = 100$

**) Indicator is not taken at evaluation of graduate qualification papers in economic specialities.*

Final evaluation of GQW in terms of four-point scale is performed with the expert technique by expert committee using complex criterion that includes:

- complex quality indicator normalized to its maximum magnitude: $Q_{\Sigma\ mean.}/Q\Sigma_{max}$;
- mean single indicators normalized to their maximum magnitudes: $Q_{mean\ n}/Q_{n\ max.}$

Complex quality indicator normalized to its maximum possible magnitude, for each of the evaluated work is counted by the formula:

$$Q_{\Sigma\ mean}/Q_{\Sigma\ max},\ \% = \frac{1}{m}\sum_{m}\sum_{1}^{n}\frac{Q_n}{Q_{n\max}}\ , \quad (1)$$

where m – the number of members in the Board,

Qn – evaluation of work in terms of the n-th single indicator by every member m of the Examination Board,

Qn max = kn Δmax – maximum possible magnitude of the n-th single indicator,

kn – weighted coefficient of the n-th indicator.

Δmax is the maximum magnitude of the evaluation scale for the indicator Qn.

Normalized to their maximum possible magnitudes mean single quality indicators are calculated for each of the evaluated work using the formula:

$$Q_{mean\ n}/Q_{n\ max},\ \% = \frac{1}{m}\sum_{1}^{m}\frac{Q_{nm}}{Qn\max}\ , \quad (2)$$

where Q nm is evaluation of the n-th single indicator by the m-th member of the Board;

Mean defining single indicators normalized to their maximum possible magnitudes are determined similarly by the formulas presented in Table 3.

Calculated by the formulas (1), (2) GQW evaluations are matched with the numerical values of the criteria (Table 3).

The technique as a tool for GQW evaluation in terms of a vide range of indicators allows [1, 2]:

- objective gradation of university graduates' preparation for professional performance and correspondence of training to FSES requirements;
- revealing the correspondence of a graduate's professional, personal, and social competences to employers' requirements, ability to work creatively and independently, acquire knowledge, skills and readiness to solve professional and social problems;
- assessment of a graduate's professional competence rate, creative potential, ability to solve practical problems;
- increasing the role of university in students' professional orientation, training of competitive graduates being in demand at labour market, contributing to the development of students' and graduates' motivation system, encouraging their innovative and research activity;
- development of teachers' motivation and stimulation system to increase the quality of graduates' training.

Table 2. Gradations of GQW Evaluation in Four-Point Scale

Normalized to the maximum magnitude evaluation of work in terms of complex indicator, $Q_{\Sigma\ cp.}/Q_{\Sigma\ max},\ \%$	Normalized to the maximum magnitude evaluation in terms of every mean single, $Q_{cp.\ n}/Q_{n\ max},\ \%$	GQW evaluation
$Q_{\Sigma\ cp.}/Q_{\Sigma\ max} > 95$	$Q_{cp.\ n}/Q_{n\ max} > 95$	Excellent (five points)
$80 < Q_{\Sigma\ cp.}/Q_{\Sigma\ max} < 95$	$80 < Q_{cp.\ n}/Q_{n\ max} < 95$	Good (four points)
$70 < Q_{\Sigma\ cp.}/Q_{\Sigma\ max} < 80$	$70 < Q_{cp.\ n}/Q_{n\ max} < 80$	Satisfactory (three points)
$Q_{\Sigma\ cp.}/Q_{\Sigma\ max} < 70$	$Q_{cp.\ n}/Q_{n\ max} < 70$	Unsatisfactory (two points)

Typical Form of Questionnaire for Evaluation of GQW by a Member of SEB F.1

Questionnaire for Evaluation of GQW

Student _____
(Applicant's name)

The theme of work_____

Department _____

Member of SEB _____
(name and academic degree)

№	Indicator	Indicator conventional sign, Q_n	Scale A_{min}-A_{max} of indicator value Q_n, point	Weighted coefficients, k_n	Minimal value of indicator, $Q_{n\,min}$, point	Maximum value of indicator, $Q_{n\,max}$, point	Grade, Q_{nn} points	Grade normalized to its maximum magnitude, Q_n / Q_{nmax}, %
1	Correspondence of GQW to the task requirements	Q_1	1÷10	3	3	30		
2	Personal contribution to the project	Q_2	1÷10	2	2	20		
3	Practical significance and expected results	Q_3	1÷10	1	1	10		
4	Novelty and originality of work	Q_4	1÷10	0,5	0,5	5		
5	Quality of work conclusion (completeness and Correspondence to the design requirements)	Q_5	1÷10	0,5	0,5	5		
6	Quality of developed materials	Q_6	1÷10	0,5	0,5	5		
7	Quality of material presentation to SEB	Q_7	1÷10	0,4	0,4	4		
8	Answers to the SEB members' questions	Q_8	1÷10	0,5	0,5	5		
9	Quality of economic part of the work*)	Q_9	1÷10	0,3	0,3	3		
10	Quality of the section devoted to ecology and labour protection*)	Q_{10}	1÷10	0,3	0,3	3		

**) Indicator is not taken at evaluation of graduate qualification papers in economic specialities.*

Member of expert committee _____

Table 3. Calculation Formulas of Mean Defining Single Indicators.

Mean defining single indicator normalized to its maximum possible magnitude $Q_{i\ onp.}/Q_{i\ onp.max}$.	Calculation formula
$Q_{1\ onp.}/Q_{1\ onp.max}$	$Q_{1\ onp.}/Q_{1\ onp.max} = Q_{2}/Q_{2\ max}$, %
$Q_{2\ onp.}/Q_{2\ onp.max}$	$Q_{2\ onp.}/Q_{2\ onp.max} = Q_{3}/Q_{3\ max}$, %
$Q_{3\ onp.}/Q_{3\ onp.max}$	$Q_{3\ onp.}/Q_{3\ onp.max} = 1/2\ [Q_{2}/Q_{2\ max} + Q_{3}/Q_{3\ max}]$, %
$Q_{4\ onp.}/Q_{4\ onp.max}$	$Q_{4\ onp.}/Q_{4\ onp.max} = 1/2\ [Q_{2}/Q_{2\ max} + Q_{6}/Q_{6\ max}]$, %
$Q_{5\ onp.}/Q_{5\ onp.max}$	$Q_{5\ onp.}/Q_{5\ onp.max} = 1/2\ [Q_{3}/Q_{3\ max} + Q_{6}/Q_{6\ max}]$, %
$Q_{6\ onp.}/Q_{6\ onp.max}$	$Q_{6\ onp.}/Q_{6\ onp.max} = Q_{4}/Q_{4\ max}$, %
$Q_{7\ onp.}/Q_{7\ onp.max}$	$Q_{7\ onp.}/Q_{7\ onp.max} = 1/2\ [Q_{2}/Q_{2\ max} + Q_{4}/Q_{4\ max}]$, %

REFERENCES

1. Sigov A.S. Evaluation and Forecasting Competitiveness of Specialists / A.S. Sigov, A.V. Sidorin // Engineering Education Quality Management and Innovative Educational Techniques: Reports of the International Scientific-Methodical Conference, Moscow, October, 28–30, 2008: in 2 Parts. – Moscow, 2008. – P. 2. – PP. 135–138.
2. Sidorin A.V. Set of Requirements for Engineers' Quality Indicators to Provide Competitiveness of Institutions with Development Innovation Strategy // Herald of Development. – 2008. – № 1 – PP. 29–36.