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Quality assurance, safety and health assessment tool, and evaluation of the necessary parameters for irrigation projects in the Philippines

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Abstract

Irrigation is a useful crop-production method in developing countries, where water is scarce. The present study generally aims to formulate a Quality Assurance, Safety and Health Assessment Tool and evaluate the necessary parameters for irrigation projects. The study focused on irrigation projects in the province of Pampanga. At least 100 respondents were targeted, including project engineers, farmers, and IAs. Engineers who are currently or have previously worked on irrigation projects for NIA were specifically chosen. Farmers and IAs in the Municipality of Floridablanca who have directly benefited from NIA irrigation projects were also chosen as respondents. Based on the summary of findings, the study concludes that the newly developed assessment tool for irrigation projects is very useful and user-friendly as validated by the experts. The survey participants which comprised of engineers, farmers and IAs assessed the tool using different metrics or criteria and they strongly agreed that these parameters are really needed and important. Project management, quality of work and construction safety implementation as parameters of quality assurance for irrigation projects are also included in the developed assessment tool. These findings were also supported by the positive viewpoints and feedbacks from the experts during focus group discussion.

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Introduction

Irrigation is a socio-technical infrastructure for food and water security programs of many developing countries like the Philippines (Moya, 2018). As a process, it works by applying controlled amounts of water to plants at needed intervals. This helps to grow agricultural crops, maintain landscapes, and revegetate disturbed soils in dry areas and during periods of less than average rainfall.

Since then, irrigation has been a useful method in crop production particularly in developing countries. Thus, not surprisingly, it is the largest recipient of public agricultural investments in developing countries (World Bank, 1995).

In the Philippines, for example, the government has been investing heavily in irrigation development to improve crop yield (Moya, 2018). Irrigation is undoubtedly linked to significant agricultural development; hence, the government allots budget to support irrigation projects.

Moreover, according to Schoengold and Zilberman (2005), large-scale investments in irrigation projects helped contribute to agricultural development, resulting in irrigation being extended to 64 percent of potentially irrigable lands in Asia.

Evidently, irrigation is one of the answers to solve the problems in agriculture. It is useful most especially to countries whose main source of income is agriculture including the Philippines. The Philippines has about 10.3 million ha agricultural lands. Out of these, around 3.1 million ha are considered irrigable, with up to 3 percent slope, and primarily devoted to rice and corn. A study by the World Bank, however, identified more than 6.1 M ha as irrigable, including areas that are relatively more difficult to irrigate and up to 8 percent slope (https://www.nia.gov.ph). The Province of Pampanga is known as an agriculture-driven province. Agriculture is its primary sector that is why a huge portion of the province's land use consists of areas for crop production, devoted to rice and maize as well as livestock and poultry.

The National Irrigation Administration (NIA) is a government-owned and controlled corporation primarily responsible for irrigation development and management. NIA commits to provide effective and sustainable irrigation services aimed towards.

The highest satisfaction of the Filipino farmers. National Irrigation Administration Regional Office 3 (NIA-R3) stated that the potential irrigable area land use in the province is 52,475.41 hectares (58.89%); remaining area to be developed is 7,838.94 hectares (27.96%); irrigation development of 85.06%.

Table 1. Status of Irrigation Development in Region 3 as of June 30, 2020.

Province	Potential Irrigable Area (hectares)	Service area (hectares)	Irrigation Development (%)	Remaining Area to be Developed
Aurora	12,100.00	7,651.00	63.23	4,449.00
Bataan	18,577.99	8,076.23	43.47	10,501.76
Bulacan	45,703.53	30,789.63	67.37	14,913.9
Nueva Ecija	23,432.74	18,042.66	77.00	5,390.08
Pampanga	52,475.41	44,636.47	85.06	7,838.94
Tarlac	102,362.16	42,713.66	41.73	59,648.50
Zambales	29,302.70	15,190.38	51.84	14,112.32
Total	283,954.53	167,100.03	58.85	116,854.50

Irrigation development in Pampanga is high being prioritized in Central Luzon. However, irrigation projects require huge sum of money from the government. Such projects are capital intensive and long gestation. Moreover, well-trained technical personnel are needed in the planning, construction, monitoring and management of irrigation projects.

One of NIA's objectives is to develop and maintain irrigation systems in support of the agricultural program of the government. NIA rehabilitates irrigation systems which entails the reconstruction or restoration of facilities and structures. It can also include the expansion of service areas and provision of additional structures like adequate control structures, drainage systems, on-farm facilities, and service roads. Particular programs under Operations are Irrigation Systems Restoration Program and Irrigation Systems Development Program.

Table 2. F.Y. 2020 Approved Irrigation Program (GAA – R.A. No, 11465).

Region 3 Irrigation System Restoration Program				
Province	Approved Budget (P'000)			
	National Irrigation System (NIS)	Communal Irrigation System (CIS)	Other Irrigation Systems	Total per province
Aurora	30,000	15,000	--	45,000
Bataan	10,000	22,000	--	32,000
Bulacan	172,000	14,000	19,450	205,450
Nueva Ecija	--	62,000	--	62,000
Pampanga	258,000	49,961	12,000	319,961
Tarlac	219,000	103,232	43,000	365,232
Zambales	80,000	32,000	--	112,000
Total	769,010	298,193	74,450	1,141,653

Data show that the development of irrigation in Pampanga province is high (85.06%). Correspondingly, Php319,961,000.00 is the approved budget for the restoration of irrigation systems in the province, or 28.02% of Central Luzon's total irrigation system restoration program. The data thus clearly indicate that there is a problem with irrigation systems in the province of Pampanga.

The NIA Quality Management System (QMS) is a formal system that documents the structure, processes, roles, responsibilities, and procedures necessary for effective quality management in the implementation of irrigation projects. Projects should be monitored to ensure that projects are implemented in accordance with national standards and that the allocated funds are used for the intended purpose to produce quality assured projects. Quality assurance is a process that aims to eliminate defects and produce high-quality irrigation projects. The importance of safety and health during the construction of a project should not be overlooked. Occupational Safety and Health (OSH) Standards are followed in the construction industry in accordance with the Department of Labor and Employment's (DOLE) D.O. 13 series of 1998, which ensures the safety and welfare of construction workers, the protection and welfare of the general public within and around the immediate vicinity of any construction worksite as well as the promotion of harmonious employer-employee relationships in the construction industry, and after consultations with the stakeholders in the construction industry, taking into consideration industry practices and applicable government requirements.

Statement of the Problem

The budget of the NIA Irrigation Systems Restoration Program for 2020 is high (36% of the total Operations program). However, several factors like construction/ quality issues, machine irrigation system performance, lack of inter-agency cooperation, low recovery costs, maintenance and inadequate irrigation project designs lead to poor irrigation systems. Thus, the present study generally aims to formulate a Quality Assurance, Safety and Health Assessment Tool and evaluate the necessary parameters for irrigation projects. Specifically, the study intends to answer the following questions: 1) What indicators should be included in developing a new irrigation project assessment tool? 2) What are the experts' thoughts on the newly developed tool?

Materials and methods

Research Design

This study used explanatory sequential design. According to Creswell and Clark (2011), this is an approach that combines quantitative and qualitative data in phase sequences. It is the collection and analysis of quantitative data followed by a collection and analysis of qualitative data. The purpose of the explanatory research design is to increase the understanding of the researcher on a certain subject. In the present study, the specific design was used to gain a deeper understanding of the study which will allow the researcher to address subsequent research questions and significantly increase the usefulness of the conclusions of the study.

Sample and Setting

The study focused on irrigation projects in the province of Pampanga. At least 100 respondents were targeted, including project engineers, farmers, and IAs. Engineers who are currently or have previously worked on irrigation projects for NIA were specifically chosen. Farmers and IAs in the Municipality of Floridablanca who have directly benefited from NIA irrigation projects were also chosen as respondents. Purposive sampling was used in determining these respondents. According to Crossman (2019), this is a method of selecting respondents based on their

understanding and the objective of the analysis. Thus, the participants were particularly chosen because of their relevant background and experiences.

Research Iinstrument

The researcher used open and closed survey questionnaires in this study. In order to determine the most important parameters for assessing the quality management of the irrigation system, the closed survey questionnaires were in accordance with the DPWH Blue Book Specification and Standards, ASTM & PNS, and the national government's criteria for evaluating CPES. The survey is comprised of seventy-seven (77) questions divided into nine (9) sections: Respondents' Information, Project Management, Construction Safety and Health, Project Billboard, Project Personnel, Corrective Actions, Testing Requirements, Quality Control Policies, Item Descriptions, and Construction Safety Implementation Assessment (DPWH D.O. 39 series 2020).

The answers of the respondents were evaluated using Likert-scales in all rounds. A seven-point Likert scale was used because it provides less uncertain and neutral responses compared to three-point and five-point scales (Matell, 1972). In addition, greater accuracy will be provided since respondents have more options in assessing the relative importance of indicators.

Data Gathering Procedure

The researcher used both indirect and direct methods to gather the data needed for the study. Selection of respondents, questionnaire design and distribution of questionnaires are included in the survey application. The survey's respondents include NIA engineers, IAs, and farmers. The respondents for the survey include engineers who have handled irrigation projects funded by NIA and IAs and farmers who are the primary beneficiaries of NIA projects in the Municipality of Floridablanca. In order to determine the parameters to be used in the formulation of the quality assurance, safety and health assessment tool, the researcher administered survey questionnaires to the respondents. As cited in Cohen *et al.* (2000), a questionnaire is a widely used and useful instrument for collecting survey information, providing structured, often numerical data, being able to be administered without the presence of the researcher, and often being comparatively straightforward to analyze.

The questionnaire was sent via Google forms to 100 targeted participants and all of them (100%) responded. The researcher also provided three (3) NIA offices, namely NIA-PAMBAT, NIA UPRIIS and NIA BBMP-II, an official letter of request to conduct the study. Similarly, the researcher conducted closed interviews with IAs and farmers to briefly discuss the questionnaire to avoid misinterpretation and confusion. Data were collected, tabulated, analyzed and interpreted. Interviews were also conducted in support of the evaluation of the research study. The quantitative findings will be explained and interpreted based on respondents' assessments of the survey results. The researcher presented the developed assessment tool to the focus group through an online platform in a series of orientation and discussion sessions. The newly developed tool was pilot tested by the focus group on three (3) irrigation projects funded by NIA in the Central Luzon region. In addition, the information obtained from the questionnaire and the interviews were used as bases to improve the research study.

Ethical Consideration

The rights and welfare of the participants are the primary concern in the duration of the study. Before administering the questionnaires and conducting interview, a communication letter was made to ask for consent to conduct the study. Upon approval, the participants were informed about the objectives of the study and were guided accordingly to gather the needed data. The researcher asked for permission to the participants to record the whole interview. Further, the researcher made it clear that their participation is on a voluntary basis and they are free to withdraw from the study at any time. More importantly, the participants' responses and personal information, as well as the data gathered from different NIA offices particularly NIA-PAMBAT, NIA UPRIIS and NIA BBMP-II, will be used for research purposes only and

will be treated with utmost confidentiality in accordance to Data Privacy Law of 2012 and other relative existing laws.

Results and discussion

Relevance of Project Management and Its Dimensions as Parameters of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Pre-Construction Stage

Table 3 presents the respondents` evaluation of the assessment tool for irrigation projects in the pre-construction stage. Data indicate that the respondents assessed all the parameters as highly important criteria. The computed grand mean of 6.73 means that the assessment tool is very useful and relevant in terms of plans, program of works (POW), cost estimate, contract agreement, received notice to proceed, construction safety and health program, construction methodology, and quality control plan. Pre-construction documentation is a contemporary record of what really occurred in the project site.

This is quite necessary to ensure the correctness of project planning prior to implementation and to significantly improve the implementation of irrigation projects on a daily basis. Moreover, in order to avoid mishaps and delays at the construction site, each pre-construction document must be reviewed and verified by the architect/engineer concerned and by the other technical personnel involved.

Table 3. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Pre-Construction Stage.

Indicators	Mean	SD	Verbal Description
Approved Plans	6.76	0.53	Very Strongly Agree
Approved Program of Works (POW)	6.69	0.56	Very Strongly Agree
Approved Cost Estimate	6.67	0.61	Very Strongly Agree
Contract Agreement	6.76	0.51	Very Strongly Agree
Received Notice to Proceed	6.68	0.60	Very Strongly Agree
Approved Construction Safety and Health Program	6.75	0.53	Very Strongly Agree
Approved Construction Methodology	6.75	0.56	Very Strongly Agree
Approved Quality Control Plan	6.76	0.51	Very Strongly Agree
Grand Mean	6.73	0.55	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Construction Stage

Table 4 shows the respondents' evaluation of the assessment tool for irrigation projects in the construction stage. The data show that the assessment tool for irrigation projects is very relevant since the respondents are very satisfied with all the criteria such as construction schedule/ bar chart and s-curve, correspondence (minutes of meeting, contact letter, etc.), accepted as-staked plan, variation order, time extension, work suspension, work request, pouring permit, progress photos and report, project and materials logbook, weather chart, concreting works report, site instruction, inspections report and result of test. This implies that the assessment tool is very effective as supported by the computed grand mean of 6.61 interpreted as "very strongly agree". Due to the highly competitive nature of the activities carried out in the construction industry, various decisions and actions have to be taken suddenly. Such unforeseen incidents are frequently carried out by an engineer or other technical staff at the project site. These project management indicators must be present at all times during construction stage and regularly updated by technical personnel daily to prevent undesirable high loss of quality and money.

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Completion Stage

Table 5 depicts the respondents' evaluation of the assessment tool for irrigation projects in the completion stage. It indicates that the assessment tool is very relevant since the respondents are very satisfied with all the criteria specifically final inspection report,

approved as-built plans, and certificate of completion with computed means of 0.40, 0.46 and 0.42 respectively. The assessment tool is thus very effective in ensuring quality and safety as supported by the computed grand mean of 6.85 and a standard deviation of 0.43. Once the project reaches an accomplishment of ninety-five (95%) of the total contract amount, the Inspectorate Team will conduct project final inspection and submit a punch-list to the contractor in preparation for the final turnover of the project in compliance with section 7 of Annex E of the 2016 Revised IRR of RA 9184. Due to certain unavoidable problems during the construction process, the contractor brings necessary adjustments to the initial drawings which will be reflected in the as-built plan. A certificate of completion then will attest if all government standards and guidelines have been followed by the project.

Table 4. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Construction Stage.

Indicators	Mean	SD	Verbal Description
Updated Construction Schedule/ Bar Chart and S-Curve	6.70	0.55	Very Strongly Agree
Correspondence (Minutes of Meeting, Communication letter etc.)	6.58	0.61	Very Strongly Agree
Approved As-staked Plan	6.67	0.59	Very Strongly Agree
Approved Variation Order if any	6.68	0.58	Very Strongly Agree
Approved Time Extension if any	6.50	0.83	Very Strongly Agree
Approved Work Suspension if any	6.54	0.72	Very Strongly Agree
Approved Work Request if any	6.55	0.67	Very Strongly Agree
Approved Pouring Permit	6.70	0.55	Very Strongly Agree
Updated Statement of Work Accomplishment (SWA)	6.68	0.60	Very Strongly Agree
Progress Photos	6.69	0.60	Very Strongly Agree
Project Log Book	6.54	0.68	Very Strongly Agree
Materials Log Book	6.57	0.72	Very Strongly Agree
Reports on concreting works (design mix, job mix, trial mix)	6.67	0.61	Very Strongly Agree
Weather Chart	6.33	0.81	Very Strongly Agree
Site Instruction(s)	6.64	0.59	Very Strongly Agree
Inspection Reports	6.65	0.61	Very Strongly Agree
Result of Test	6.73	0.52	Very Strongly Agree
Grand Mean	6.61	0.64	Very Strongly Agree

Table 5. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects in the Completion Stage.

Indicators	Mean	SD	Verbal Description
Final inspection Report	6.87	0.40	Very Strongly Agree
Approved As-Built Plans	6.83	0.46	Very Strongly Agree
Certificate of Completion	6.85	0.42	Very Strongly Agree
Grand Mean	6.85	0.43	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety and Health Measures

Table 6 illustrates the respondents' evaluation of the quality assurance assessment tool for irrigation projects as regards construction safety and health measures. Results indicate that the respondents are very satisfied with the indicators particularly barricades and warning signs, personal productive equipment, first aid kits and traffic management with computed means of 0.42, 0.57, 0.53 and 0.60 respectively. The grand mean of 6.74 interpreted as "very strongly agree" indicates that the construction safety and health measure protocols are relevant parameters. Every construction project shall have a suitable Construction Safety and Health Program in accordance with the DOLE D.O.13 series of 1998 which ensures the protection and welfare of workers employed in the construction industry and the general public within and around the immediate vicinity of the site.

It also includes the promotion of harmonious employer-employee relationships as well as consultations with the stakeholders in the construction industry, taking into account industry practices and applicable government requirements.

Table 6. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety and Health Measures.

Indicators	Mean	SD	Verbal Description
Barricades and Warning Signs	6.82	0.42	Very Strongly Agree
Personal Protective Equipment (PPE)	6.73	0.57	Very Strongly Agree
First Aid Kit	6.70	0.53	Very Strongly Agree
Traffic Management (traffic signs, flagmen, lighting fixtures, reflectorized signages, cones, etc.)	6.70	0.60	Very Strongly Agree
Grand Mean	6.74	0.53	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Project Billboards

Table 7 exhibits the respondents' evaluation of the quality assurance assessment tool for irrigation projects as regards project billboards. Results show that the project billboards (COA) and community billboards are relevant parameters for the quality-assured irrigation project with computed means of 6.42 and 6.32, respectively. In general, the project billboards for irrigation projects are very relevant as supported by the computed grand mean of 6.37 interpreted as "very strongly agree". The result is thus compliant to COA Circular No. 2013-004 on posting of billboards/signages for projects to promote transparency and accountability; to encourage public participation therein; and to secure right of the people of information on matters of public concern at the least possible cost on public funds or most economically effective means.

Table 7. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Project Billboards.

Indicators	Mean	SD	Verbal Description
Project Billboards (COA)	6.42	0.79	Very Strongly Agree
Community Billboard	6.32	0.85	Very Strongly Agree
Grand Mean	6.37	0.82	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Project Personnel

Table 8 exhibits the respondents` evaluation of the quality assurance assessment tool for irrigation projects as regards project personnel. Result shows that the respondents assessed all the indicators under project personnel to be very highly relevant parameters as indicated by the computed grand mean of 6.73. This means that in ensuring quality irrigation projects, personnel such as project engineer, materials engineer, surveyor, foreman, safety officer, and laborer are required.

The Project Engineer is responsible for the day-to-day management of the site, supervision and monitoring of the workforce and other management related tasks.

Materials Engineer on the other hand is responsible for testing and evaluating materials and developing machinery and processes for manufacturing materials for use in products. Surveyor/Instrument Man is responsible for carrying out field surveys, drawings and maps, as well as periodic reports on irrigation schemes. Foreman assigns work schedules and keeps the construction process safe on track and manages and instructs skilled and unskilled workers on the construction site. Safety officers are responsible for planning, implementing and overseeing the safety of employees at work.

Their main duty is to ensure that the company complies with the Occupational Safety and Health (OSH) guidelines and it is important to note that their collaboration will improve the department's quality assurance program.

Table 8. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Project Personnel.

Indicators	Mean	SD	Verbal Description
Project Engineer	6.82	0.47	Very Strongly Agree
Materials Engineer	6.60	0.71	Very Strongly Agree
Surveyor/ Instrument Man	6.64	0.63	Very Strongly Agree
Foreman	6.76	0.51	Very Strongly Agree
Safety Officer	6.79	0.49	Very Strongly Agree
Laborer	6.75	0.53	Very Strongly Agree
Grand Mean	6.73	0.56	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Corrective Actions

Table 9 shows that the respondents are reasonable to assume that corrective actions should be reflected as one of the parameters of the Quality Assurance Assessment Tool for Irrigation Projects as shown by the computed mean of 6.79 and standard deviation of 0.47. Corrective action refers to any action that is undertaken which deviates from the scope, schedule, cost or quality requirements envisaged.

Table 9. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Corrective Actions.

Indicators	Mean	SD	Verbal Description
Corrective Actions	6.79	0.47	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Testing Requirements

Table 10 shows the respondents' evaluation of the relevance of the testing requirement indicator as parameter of the quality assurance assessment tool. It can be seen on the table that the respondents are very satisfied with the minimum testing requirements based on the latest SWA with a mean of 6.73 interpreted as "very strongly agree". This indicator will avoid problems that may arise as a result of improper quality control. In order to ensure high-quality irrigation projects, the minimum requirements for the testing of all construction materials as set out in the SWA shall be complied with.

Table 10. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Testing Requirements.

Indicators	Mean	SD	Verbal Description
Minimum Testing Requirements based on Latest SWA	6.73	0.55	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Adherence to Quality Control Policies

Table 11 presents the respondents' evaluation of the relevance of indicators for adherence to quality control policies. Results show that the respondents rated the indicators very high which means that the assessment tool adheres to quality control policies such as provision of minimum testing equipment, availability of the required construction equipment to be provided by the contractor, proof of accreditation of contractor`s Materials Engineer and accreditation of Safety Officer. The computed grand mean of 6.45 interpreted as "very strongly agree" is in accordance with DPWH D.O. Series No.11 of 2017 titled 'Inclusion of Minimum Materials Testing Equipment in the Technical Component of the Bid' and section 25.2.b of the Revised IRR requirement of RA 9184.

Table 11. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Adherence to Quality Control Policies.

Indicators	Mean	SD	Verbal Description
Provision of minimum testing equipment (DPWH DO # 11, series of 2017)	6.64	0.63	Very Strongly Agree
Availability of the required construction equipment to be provided by the contractor	6.64	0.63	Very Strongly Agree
Proof of Accreditation of Contractor's Materials Engineer (DPWH DO # 98, series of 2016)	6.65	0.61	Very Strongly Agree
Proof of Accreditation of Safety Officer	6.65	0.63	Very Strongly Agree
Grand Mean	6.45	0.63	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Items to be Considered

Table 12 presents the respondents' evaluation of the quality assurance assessment tool as regards to items to be considered. As can be seen on the table, all indicators were regarded as highly relevant parameters such as general requirements, site development works and others. Only two (2) indicators (filtration tank and treatment facility) did not receive the highest ratings with computed means of 5.92 and 6.00 respectively both interpreted as "strongly agree". In general, the indicators are very relevant as supported by the

computed grand mean of 6.31 interpreted as "very strongly agree". All the tasks and operations performed in the site are thus very relevant and effective. Item Descriptions are contained in DPWH Blue Book Volume II (2012) - Standard Specifications for Public Works and Highways, Bridges and Airports and Special Works Items (SPL). Also in DPWH D.O. 136 series adaptation entitled 'DPWH Standard Volume IV Project Quality Assurance Specifications.

Table 12. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Items to be Considered.

Indicators	Mean	SD	Verbal Description
General Requirements	6.67	0.57	Very Strongly Agree
Site Development Works	6.64	0.57	Very Strongly Agree
Well Source Development	6.20	0.88	Very Strongly Agree
Spring Source Development	6.17	0.89	Very Strongly Agree
Surface Water Source Development	6.31	0.79	Very Strongly Agree
Pipelines and Related Civil Works	6.54	0.67	Very Strongly Agree
Filtration Tank	5.92	1.08	Strongly Agree
Treatment Facility	6.00	1.15	Strongly Agree
Concrete Reservoir	6.45	0.77	Very Strongly Agree
Steel Ground Reservoirs	6.19	0.94	Very Strongly Agree
Steel Elevated Reservoirs	6.25	1.04	Very Strongly Agree
Pump House	6.20	0.98	Very Strongly Agree
Perimeter Fence	6.43	0.85	Very Strongly Agree
Masonry Works	6.55	0.65	Very Strongly Agree
Electrical Works	6.18	0.91	Very Strongly Agree
Public Tapstands/Stub Outs/Water Meters	6.18	1.04	Very Strongly Agree
Grand Mean	6.31	0.86	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety Implementation

Table 13 shows the evaluation of the assessment tool as regards construction safety implementation. The respondents are very satisfied with all the indicators such as list of personnel, medical certificates, etc. as indicated by the grand mean of 6.61 interpreted as "very strongly agree'. This is pursuant to the DPWH D.O. 39 series 2020 titled 'Construction of Safety Guidelines for implementation of Infrastructure Projects during COVID-19 Public Health Crisis' as stated in the IATF-issued Revised Omnibus Guidelines dated May 15, 2020.

Table 13. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety Implementation.

Indicators	Mean	SD	Verbal Description
List of Personnel (Annex B of DO 39 s. 2020)	6.63	0.58	Very Strongly Agree
Medical Certificates of Personnel	6.61	0.60	Very Strongly Agree
Construction Quarantine Pass for the Personnel (Annex A of DO 39 s. 2020)	6.57	0.65	Very Strongly Agree
Board and Lodging (For Stay-In Personnel)	6.56	0.70	Very Strongly Agree
Presence of Disinfection Facilities	6.62	0.62	Very Strongly Agree
Sanitary	6.64	0.59	Very Strongly Agree
Washing	6.61	0.64	Very Strongly Agree
Grand Mean	6.61	0.63	Very Strongly Agree

Evaluation of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety during Deployment of Personnel

Table 14 shows the respondents' evaluation of construction safety indicators prior to the implementation of the irrigation project. The grand mean of 6.68 indicates that the indicators such as work plan/schedule, adequate supply of PPEs, presence of

safety policies, penalties and penalties for violating the construction safety and health program, and manner of disposal of waste arising from construction are highly relevant parameters for the formulation of the Quality Assurance Safety and Health Assessment Tool. Respondents strongly agreed that these indicators are required during deployment which will help the Project Manager to ensure quality irrigation project. This is pursuant to the DPWH D.O. 39 series 2020 titled 'Construction of Safety Guidelines for implementation of Infrastructure Projects during COVID-19 Public Health Crisis' as stated in the IATF-issued Revised Omnibus Guidelines dated May 15, 2020 for allowed government and private construction projects in areas under Enhanced Community Quarantine, Modified Enhanced Community Quarantine, General Community Quarantine, and Modified General Community Quarantine.

Table 14. Descriptive Analysis of the Quality Assurance, Safety and Health Assessment Tool for Irrigation Projects as regards Construction Safety during Deployment of Personnel.

Indicators	Mean	SD	Verbal Description
Work Plan/ Work Schedule	6.71	0.53	Very Strongly Agree
For Entry and Exit of Workers (daily logbook)	6.70	0.53	Very Strongly Agree
For Pre and Post Work Health conditions of Workers (Annex C of DO 39 s. 2020) (daily logbook)	6.69	0.54	Very Strongly Agree
Adequate supply of PPEs, disinfectants and hand soaps	6.69	0.54	Very Strongly Agree
Presence of safety policies (posted in the construction site) (Compliance with DOLE DO No. 13 s. 1998)	6.68	0.58	Very Strongly Agree
Penalties and sanction for violating Construction Safety and Health Program (CSHP)	6.54	0.68	Very Strongly Agree
Manner of disposing waste arising from the construction	6.73	0.52	Very Strongly Agree
Grand Mean	6.68	0.56	Very Strongly Agree

Validation of the Developed Assessment Tool

The researcher conducted a dry run of the developed assessment tool. Following the dry run, there was an open forum for expert questions. After the dry run and clarification of the queries, the experts unanimously expressed their approval of the developed assessment tool. They determined that the tool is user-friendly and understandable for project inspectors to use during project monitoring.

They share similar perspectives on the utility of the assessment tool and the key parameters that are taken into account. They stated that the project management and quality of work parameters are important, and that the safety and health measures during the COVID-19 pandemic are very timely. The advanced and systematic-programmed Excel file format of the tool, which instantly provides recommendations for every defect found in accordance with national government standards and other international references, was praised by NIA Engineers. Representatives from the IA are optimistic about the tool, stating that it will be beneficial if used. DENR-EMB representative stated that the developed assessment tool has a lot of potential for use in other infrastructure projects like horizontal, vertical, and water projects. Contractor representatives expressed their gratitude for being a part of the focus group, and they also mentioned that these parameters, particularly in project management, are already being implemented by them to ensure quality irrigation projects. They all agreed that if the NIA office uses the tool properly, it will have a significant impact on the monitoring of irrigation projects to ensure high quality projects. They also suggested that the tool be reviewed by other experts for improvement before being adopted by the office.

The developed assessment tool was pilot tested for three (3) projects by the NIA UPRIIS office. In terms of risk assessment, the three (3) projects with final ratings of 93.21%, 95.65%, and 97.34 % are all low risk. During the COVID-19 Public Health Crisis, however, the final ratings for the three (3) projects on safety and health measures were all the same, with a risk level of "Non-compliant." The tool was said to be understandable and user-friendly by the project engineers. Minor errors were observed at first, but

the pilot testing was completely successful during project inspection.

Table 15. Pilot Testing of the Developed Assessment Tool (Quality and Timeliness).

Project Title	Final Rating	Risk Level
Construction of CHB lining @ Lateral H	93.21%	Low
Repair of Sub-Lateral N-5a(Sta. 1+043.30 - Sta. +095.50), Sub-Lateral N-5a-1(Sta. 1+444.50 - Sta. 2+483.79) and Sub-Lateral N-5a-1a (Sta. 0+967.20 - Sta. 1+745.65)	95.65%	Low
Construction of slope protection at Sta. 47+540 - Sta. 47+730 and Sta. 51+810 - Sta. 51+930.66	97.34%	Low

Table 16. Pilot Testing of the Developed Assessment Tool (Safety and Health during COVID-19 Public Health Crisis).

Project Title	Rating	Risk Level
Construction of CHB lining @ Lateral H	35%	Non-compliant
Repair of Sub-Lateral N-5a(Sta. 1+043.30 - Sta. +095.50), Sub-Lateral N-5a-1(Sta. 1+444.50 - Sta. 2+483.79) and Sub-Lateral N-5a-1a (Sta. 0+967.20 - Sta. 1+745.65)	35%	Non-compliant
Construction of slope protection at Sta. 47+540 - Sta. 47+730 and Sta. 51+810 - Sta. 51+930.66	75%	Non-compliant

Conclusion

Based on the summary of findings, the study concludes that the newly developed assessment tool for irrigation projects is very useful and user-friendly as validated by the experts. The survey participants which comprised of engineers, farmers and IAs assessed the tool using different metrics or criteria and they strongly agreed that these parameters are really needed and important. Project management, quality of work and construction safety implementation as parameters of quality assurance for irrigation projects are also included in the developed assessment tool. These findings were also supported by the positive viewpoints and feedbacks from the experts during focus group discussion.

Recommendations

Based on the conclusions drawn, it is recommended to utilize the developed assessment tool since all the experts strongly agreed to the importance and relevance of its parameters. With the positive viewpoints of the experts regarding the contribution and impact of the assessment tool, the tool is endorsed for utilization in irrigation projects. Finally, though the tool was found to be very useful, the experts recommend that future researchers should continue conducting studies to add insights and to improve the tool as different needs may arise as time goes by.

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