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Research Article

PRS92 Monument Re-Coordination: Ensuring A United Coordinate System in Baguio City

Giovanni S. Banawa¹, Mirafe Rhoze A. De Castro¹, Ranelle S. Gabaig¹, Maureen A. Guliquey¹, Martin Angelo D. Lina¹, Le-An W. Mangsi¹, Emmanuel T. Romero¹, Criselda S. Felix²

¹Geodetic Engineering Student

²Geodetic Engineer/Professor at Baguio Central University

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*Corresponding author:

E-mail:

giovannisoliba@gmail.com

ABSTRACT

This research study looked into PRS92 Monument Re-coordination: Ensuring A United Coordinate System in Baguio City. The respondents were composed of thirty locals geodetic engineers who are duly registered with the Geodetic Engineer of the Philippines (GEP), Baguio City Chapter. The descriptive research design and descriptive survey research were the research methodology used. The questionnaire was the main data gathering instrument of the study. Based on the data gathered, the findings are the following: the objectives of re-coordination of PRS92 monuments were very much aware; the initiatives and activities of the PRS92 monument re-coordination were fully implemented, and the challenges met in the implementation of the PRS92 monument re-coordination were very much serious. The conclusions are the following: The high awareness among Geodetic Engineers in Baguio City about PRS92 monument re-coordination underscores their readiness to support the Philippine Reference System 1992 (PRS92); the programs and activities of the PRS92 are still on the process of strengthening its structures and manpower for efficient implementation; and there is a need to address the challenges met in the implementation of the Philippine Reference System 1992.

Keywords: *Geodetic control networks, Global navigation satellite system, Objectives, Initiatives and activities, Implementation, Challenges*

Introduction

The World Geodetic System 1984 (WGS84) is a widely used global geodetic datum developed and maintained by the United States National Geospatial-Intelligence Agency (NGA)

to provide precise positioning on the Earth's surface. Unlike some datums, WGS84 does not incorporate a deformation model, which leads to variations in the coordinates of fixed locations over time. These variations result from

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tectonic plate movements and changes in the Earth's internal mass distribution. As a dynamic datum, WGS84 captures these positional changes, which is crucial for geodesists aiming to define accurate latitude and longitude coordinates worldwide. For example, in tectonically active regions such as New Zealand, WGS84 coordinates continuously change and typically do not reflect a fixed position at any given moment when referenced by GPS satellite signals, highlighting the necessity of associating a time component with coordinates for precise applications, "World Geodetic System 1984 (WGS84)". Geodetic control networks play a crucial role in ensuring the precision and dependability of surveying and mapping tasks. These networks establish a system of control points with known coordinates, enabling surveyors to maintain consistency and accuracy across multiple projects. The control points act as stable references, allowing for the identification of tie points necessary for integrating data from different sources or time periods. A strong control network supports the maintenance of a unified coordinate system, minimizing discrepancies and improving measurement accuracy, which is vital for land surveying, urban development, geospatial analysis, and navigation.

The development of these networks typically involves combining advanced technologies such as GPS with traditional surveying methods to achieve high data accuracy and reliability. Overall, geodetic control networks provide the fundamental spatial framework that geodetic engineers rely on to establish a uniform coordinate system, facilitating the integration of spatial data collected over various locations and times (Celeste et al., 2024). In the Philippines, the foundation for a unified mapping and surveying system was laid between 1901 and 1946 by the United States Coast and Geodetic Survey (USCGS), which established multiple triangulation networks across the country. A significant milestone was the establishment of the Luzon Datum in 1911 at Station Balanacan, Marinduque. This station, positioned through precise astronomical observations, served as the central reference point that unified various networks into a single national system. Station Balanacan, situated near the geographic center of the Philippine archipelago,

functioned as the Primary Control Point for all geodetic surveys in the country. The geodetic calculations for this datum were based on the Clarke 1866 ellipsoid, which provided the mathematical model for the Earth's shape and size used in these surveys (Infomapper, 2021).

The Department of Environment and Natural Resources (DENR) mandated the adoption of the Philippine Reference System of 1992 (PRS92) as the official standard for all surveying and mapping activities in the country. By 1992, the modernization project was completed, and PRS92 was formally established as the national geodetic reference system through Executive Order No. 45 in 1993. Despite the upgrade, challenges remain for users who continue to rely on the older Luzon Datum, especially in integrating existing cadastral data. Regional offices responsible for natural resources and environmental management have encountered difficulties merging old survey datasets with the PRS92 framework due to inconsistencies and errors in the previous surveys, causing inconvenience in achieving a unified geospatial database (Infomapper, 2021). According to the National Mapping and Resources Information Authority (NAMRIA), the Philippine Reference System of 1992 (PRS92) is the country's official geodetic reference system for all surveying and mapping activities. It serves as the fundamental framework for the nation's spatial data infrastructure, facilitating the spatial alignment and integration of datasets used in planning and implementation across various multi-sectoral programs. PRS92 provides a consistent and unified coordinate system that supports effective data sharing and interoperability among government agencies and other stakeholders involved in development and resource management. According to DENR-CAR, the Data Integration Component of NAMRIA's PRS92 project for the city's cadastre was not fully implemented throughout the city. Geodetic engineers are still using the existing local coordinate system in isolated surveys. The lack of implementation presents a substantial barrier to local geodetic engineers, limiting their ability to use existing PRS92 references in some field surveys (Celeste et al, 2024).

As society's needs evolve, geodetic systems must also adapt to keep pace with advancing

technologies and methodologies. Traditional surveying techniques are expected to improve over time, and the standardization of coordinate systems presents significant benefits for enhancing survey accuracy and efficiency. In Baguio City, geodetic engineers and related stakeholders utilize a range of surveying technologies including total stations, real-time kinematics (RTK), and unmanned aerial vehicles (drones). Nonetheless, challenges persist due to the presence of multiple reference systems and reference monuments that are either missing or displaced. These issues cause notable discrepancies and errors in surveying work. Establishing a standardized coordinate system for Baguio City would improve the clarity and efficiency in locating and identifying geographic positions, facilitating more consistent and error-free geospatial data management. The researchers are motivated to undertake this study to re-coordinate the survey control stations within Baguio City into the Philippine Reference System of 1992 (PRS92). Their primary aim is to unify local reference stations under the PRS92 system by determining their coordinates through field surveys using GNSS receiver equipment. Additionally, the researchers assessed the degree of PRS92 integration within a specified area. The data collected from this study provided baseline information for geodetic engineers, land surveyors, and other related professionals. This information is essential for completing and maintaining a unified local geodetic network, integrating older surveys and maps into this network. Ultimately, the study supports the sustainable management and development of natural resources and aims to establish more accurate spatial positioning for infrastructure development and other activities in Baguio City.

Assumption of the Study

The study probed into the PRS92 Monument Re-Coordination: Ensuring a United Coordinate System in Baguio City. The specific problems to be answered the following questions:

1. What is the level of awareness of the objectives of re-coordination of PRS92 monuments?

2. What is the level of implementation of the initiatives and activities of the PRS92 Monument re-coordination?
3. What is the Degree of Seriousness of the challenges met in the implementation of PRS92 Monument re-coordination?

Basic Assumption

1. The level of awareness of the objectives of re-coordination of PRS92 monuments are much aware.
2. The level of implementation of the initiatives and activities of the PRS92 Monument re-coordination are moderately implemented.
3. The Degree of Seriousness of the challenges met in the implementation of PRS92 Monument re-coordination are slightly serious.

Research Design

This study employed a descriptive research design and a descriptive survey method in order to investigate the implementation of the Philippine Reference System 1992 in Baguio City. Descriptive research is designed to collect data that will describe a situation, event, or group in a point-in-time description. According to the Voxco Blog, it is applicable in answering "what" research questions, which, in this study, include determining the level at which the objectives of the PRS92 have been realized, the level at which the PRS92 has been implemented, and how grave the challenges that were encountered in implementing them are.

Meanwhile, the research adopted a descriptive survey design because the questionnaire was the major tool for data collection. As explained by Survey Planet (2022), descriptive survey research is a quantitative approach concerned with describing features or conditions of any given phenomenon instead of explaining why. This would help provide clearer insight into the subject matter and lay a foundation for future studies.

Result and Discussion

Level of Awareness of the Objectives of Re-coordination of PRS92 Monuments

Table 1 presents the Level of Awareness of the objectives of re-coordination of PRS92 monuments as observed by the respondents.

The table 1 data showed that the objectives of the Re-coordination of PRS92 monument in Baguio City were very much aware as evidenced by the obtained average weighted mean of 3.75 is a descriptive equivalent of very much aware. This means that the objectives were achieved to a certain extent. The garnered weighted means of each of the five (5) indicators and/or objectives were all rated as very much aware with ranks from the topmost to the least as follows: Rank 1 Provide Guide-

lines for completing the national geodetic control network using permanent monuments, 3.93; Rank 2 Establishes a single reference system for all surveys and mapping, 3.90; Rank 3 Integrate and unify old surveys and maps into the PRS92 coordinate system, 3.87; Rank 4.5 Maintain, recover, and preserve existing geodetic control points for accuracy and continuity and Densify the geodetic network to ensure control points are accessible at local levels such as barangays, 3.53.

Table 1. Level of Awareness of the Objectives of the Re-coordination of PRS92 Monuments

n=30

Indicators	Level of Awareness				TWP	WM	DE	R
	VMA 4	MA 3	SA 2	LA 1				
1. Provide Guidelines for completing the national geodetic control network using permanent monuments	28	2	0	0	118	3.93	VMA	1
2. Integrate and unify old surveys and maps into the PRS92 coordinate system	26	4	0	0	116	3.87	VMA	3
3. Maintain, recover, and preserve existing geodetic control points for accuracy and continuity	16	14	0	0	106	3.53	VMA	4.5
4. Densify the geodetic network to ensure control points are accessible at local levels such as barangays	16	14	0	0	106	3.53	VMA	4.5
5. Establishes a single reference system for all surveys and mapping	27	3	0	0	117	3.90	VMA	2
Ave. Weighted Mean						3.75	VMA	

Legend:

Arbitrary scale	Numerical Limits	Descriptive Equivalents	Symbols
4	3.26 – 4.00	Very much Aware	VMA
3	2.51 – 3.25	Moderately Aware	MA
2	1.76 – 2.50	Slightly Aware	SA
1	1.00 – 1.75	Least Aware	LA

The level of awareness regarding the objectives behind the re-coordination of PRS92 monuments in Baguio City is very much aware. This suggests that the Geodetic Engineers working within Baguio City possess a thorough understanding and familiarity with the ongoing efforts to unify the city’s coordinate system. Their strong awareness reflects their knowledge of the current status, goals, and importance of standardizing geodetic references through this initiative, which ultimately

ensures more accurate and consistent spatial data management across various applications within the city.

It is essential to emphasize the significance of the Philippine Reference System of 1992 (PRS92), which serves as the national standard for all surveying and mapping activities. It also forms a key foundation of the country’s spatial data infrastructure. PRS92 consists of a nationwide network of geodetic control points established through the Global Navigation Satellite

System (GNSS), and has been the official reference system for surveys and mapping since 1993. Although its objectives are few, they are broad and challenging, requiring many years to fully accomplish. Even so, the personnel and officials of the Department of Environment and Natural Resources in Baguio City continue to carry out their responsibilities with diligence and commitment to help realize the goals of PRS92.

Apart from the national goals established under the Philippine Reference System 1992, Paringit (2004) identified several specific objectives necessary for its implementation. These include: establishing a solid scientific foundation for adopting a unified national horizontal and vertical datum; evaluating the suitability of established geoid models for GNSS-based positioning; assessing existing coordinate systems used in surveying and mapping and recommending methods for converting them into a single unified system; and developing practical tools to strengthen local capabilities in accurate positioning using PRS92. Although the study did not indicate the extent to which these objectives have been achieved, it emphasized that fulfilling them is essential before the broader goals of PRS92 can be realized.

The first assumption of the study which presumed that the Objectives of the Re-coordination of PRS92 Monuments are much aware agreed with the actual findings wherein the respondents observed that the level of awareness of the Objectives of the Re-coordination of PRS92 Monuments were very much aware as confirmed by the obtained average weighted

mean of 3.75. The conformity of the assumption and the actual findings is influenced by the actual observations of the researchers and the respondents as direct implementers of the PRS92.

Level of Implementation of the Initiatives and Activities of the PRS92 Monument Re-coordination

Table 2 presents the data gathered on the level of implementation of the initiatives and activities of the PRS92 monument re-coordination in Baguio City as observed by the respondents.

The results showed that the level of the implementation of the initiatives and activities of the PRS92 monument re-coordination in Baguio City is fully based on the computed average weighted mean of 3.44. This manifests that the said initiatives and activities of the PRS92 were fully implemented.

The presented indicators (initiatives and activities) were all observed as fully implemented. The Coordination and collaboration with government agencies and private sector organizations is on the top of the list which garnered the highest weighted mean of 3.73. The coordination of the implementation PRS92 with other government agencies, private organizations and private survey practitioners are implemented to disseminate the information that only PRS92-compliant surveys shall be approved, subject to the provisions of Section 22 hereof of the revised guidelines for its implementation.

Table 2. Level of Implementation of the initiatives and activities of the PRS92 Monument re-coordination

n=30

Indicators	Level of Implementation				TWP	WM	DE	R
	FI 4	MI 3	SI 2	LI 1				
1. Coordination and collaboration with government agencies and private sector organizations	22	8	0	0	112	3.73	FI	1
2. Testing and calibration of GPS equipment and evaluation of GPS data accuracy	10	20	0	0	100	3.33	FI	4.5
3. Maintenance and preservation of geodetic control network	13	17	0	0	103	3.43	FI	2

Indicators	Level of Implementation				TWP	WM	DE	R	
	FI 4	MI 3	SI 2	LI 1					
4. Establishment and upkeep of the geodetic network information management system	11	19	0	0	101	3.37	FI	3	
5. Facilitation of control point establishment by other government agencies and private surveyors	10	20	0	0	100	3.33	FI	4.5	
Ave. Weighted Mean							3.44	FI	

Legend:

Arbitrary scale	Numerical Limits	Descriptive equivalents	Symbols
4	3.26 – 4.00	Fully Implemented	FI
3	2.51 – 3.25	Moderately Implemented	MI
2	1.76 – 2.50	Slightly Implemented	SI
1	1.00 – 1.75	Least Implemented	LI

Rank 2 in the list of fully implemented initiatives and activities is the Maintenance and preservation of geodetic control network, 3.43. This activity is specified in Article V Section 20 of the Revised guidelines for the implementation of the PRS92 provides that shall be established or undertaken to provide management and operational support to the DENR, other stakeholders and general users of the network. The GNIS shall consist of a national facility that shall have storing, updating, reporting, transformation, data analysis and security capabilities. The system shall also have online access by central and regional personnel for data sharing and efficient servicing of clients. Service fees shall be collected to recover costs.

Rank 3 Establishment and upkeep of the geodetic network information management system, 3.37. Article III Section 6 of the Revised guidelines for the implementation of the PRS92 explains that the primary geodetic network consists of interconnected and homogeneously adjusted control points which form the basic reference of all surveys and mapping activities in the country. It is comprised by first and second order control points which are nominally spaced at 50 and 10 to 25 kilometers, respectively. The secondary network consists of third and fourth order control points which shall be densified to an extent where each barangay, in the country has at least a pair of control points. The existing Bureau of Lands Location Monu-

ments (BLLMs), political boundary monuments, triangulation stations, primary stations of cadastral surveys and other similar stations shall be made part of the secondary network, provided that: These points are resurveyed or converted into PRS92 and satisfy the accuracy requirements for such points. The establishment and densification of the national geodetic network shall continue to be undertaken as described in DAO No. 2005-13 other pertinent issuances, and also the activities pertaining the conduct of information, communication education and capability building be undertaken to generate awareness and support from stakeholders and the general public and create a pool of national experts in geodesy and allied fields. Strategies shall include conduct of information campaigns and technology transfers, continuing professional education and forging of partnerships with governmental, non-governmental and private organizations.

This PRS92 activity specifies that all new surveys and maps shall be referenced to PRS92. However, the integration of old surveys and maps of a particular area into PRS92 shall proceed only after the appropriate set of local transformation parameters is determined as provided in Section 11, Article III of this Order and approved by the RTD for Lands. The NAMRIA shall pilot the process of integration and prepare procedural manuals for the guidance of all concerned.

Rank 4.5 Testing and calibration of GPS equipment and evaluation of GPS data accuracy and Facilitation of control point establishment by other government agencies and private surveyors, 3.33. The establishment of control points by other agencies and private surveyors is undertaken in cases where it is necessary for them to do so, survey teams of other government agencies and private survey practitioners shall be allowed to establish control points; provided that: said points satisfy the accuracy requirements; provided further: that in such cases, an incentive system shall be established. On the other hand, all GPS receivers shall be tested and certified by NAMRIA and registered with LMB every three (3) years.

The implication of these findings is that the fully implementation of the PRS92 in Baguio City is influenced by the numerous programs and activities to be undertaken coupled by the complexity of the procedures and processes that have to be followed. In addition, the DENR, Baguio City may only have a modest number of personnel and officials to implement or carry out the said programs and activities of the PRS92, or they are still on the process of working them out in order to improve the extent of its implementation. The programs and activities of the PRS92 are still on the process of strengthening its structures and manpower for efficient implementation. The concerned DENR officials and personnel have to make assessments on the possible factors that help achieve the PRS92 objectives at a higher level, and that functional and workable mechanisms are needed to support an improved implementation of the Philippine Reference System 1992.

The study of Paringit (2004) on the research and development in support of the implementation of the PRS92, concluded that the research and development activities undertaken to support the implementation of the PRS92 was collaborated by an academic institution and a government agency, and the rewards of the project might be reaped in full and the vision for PRS92 be realized in its entirety, the next major and logical step must be to drive the current momentum all the way to engaging other equally important stakeholders – the

industry (survey firms, mapping companies, end-users) and other beneficiaries (local government leaders, civic and non-governmental organizations, ordinary people and others.

The second assumption of the study and the actual findings of the study are in full agreement because the programs and activities of Philippine Reference System 1992 are fully implemented as confirmed by the derived average weighted mean of 3.44. This agreement of the assumption and the actual findings demonstrate the unified observation and experiences of the researcher and the respondents on the implementation of the PRS92 IN Baguio City.

Degree of Seriousness of the Challenges Met in the Implementation of PRS92 Monument Re-coordination

Table 3 present the data gathered on the degree of seriousness of the challenges met in the implementation of the PRS92 monument re-coordination in Baguio City as observed by the respondents.

Overall, the summarized data revealed that the challenges met in the implementation of the PRS92 re-coordination were very much serious as evidenced by the obtained average weighted mean of 3.42. Such result manifested that the challenges met were a little less serious and do not pose much predicament in the implementation of the Philippine Reference System 1992 in Baguio City.

The tabled results further showed that the following specific indicators were observed as very much serious: Insufficient modern equipment and technological resources to support accurate surveying; Low user confidence and acceptance of the PRS92 system; Inadequate funding to fully support and sustain the PRS92 program; and Challenges related to modernization, including the need for law amendments, deformation modeling, capacity building, and managing organizational change with weighted mean of 3.47, 3.50, 3.50 and 3.40 respectively. These challenges are in relation to educational and technical resources and update/amend laws and policies which may facilitate the implementation of PRS92.

Table 3. Degree of Seriousness of the Challenges Met in the Implementation of PRS92 monument re-coordination

n=30

Indicators	Degree of Seriousness				TWP	WM	DE	R
	VMS 4	MS 3	SS 2	LS 1				
1. Insufficient modern equipment and technological resources to support accurate surveying	14	16	0	0	104	3.47	VMS	3
2. Lack of an enabling legal framework and supporting policies to enforce full adoption	7	23	0	0	97	3.23	MS	5
3. Low user confidence and acceptance of the PRS92 system	15	15	0	0	105	3.50	VMS	1.5
4. Inadequate funding to fully support and sustain the PRS92 program	15	15	0	0	105	3.50	VMS	1.5
5. Challenges related to modernization, including the need for law amendments, deformation modeling, capacity building, and managing organizational change.	12	18	0	0	102	3.40	VMS	4
Ave. Weighted Mean						3.42	VMS	

Legend:

Arbitrary scale	Numerical Limits	Descriptive Equivalents	Symbols
4	3.26 – 4.00	Very Much Serious	VMS
3	2.51 – 3.25	Much Serious	MS
2	1.76 – 2.50	Slightly Serious	SS
1	1.00 – 1.75	Least Serious	LS

The one indicator was observed as much serious, Lack of an enabling legal framework and supporting policies to enforce full adoption with weighted means of 3.23. This challenge pertains to inadequate executive oversight, unclear implementation structures, and non-compliance by agencies, as highlighted in national PRS92 status reports.

These findings imply that the challenges met in the implementation of PRS92 should be given attention by the concerned DENR officials and personnel in order to plan out remedial measures to solve these issues so as not to hinder the smooth and fluid implementation of the programs and activities of the PRS92 in Baguio City. The concerned stakeholders are encouraged to strengthen their collaboration and linkage to ensure its successful implementation.

Similarly, Paringit (2004) aired during a stakeholders' conference a summary of issues

and concerns which posed serious backlog in densification, and integration of existing ENR maps, plans and surveys into PRS92. He likewise enumerated other problems met such: inadequate funds (less priority); inadequacies in current implementing structure, mechanisms, strategies; inadequate policies/guidelines; non-compliance by implementing units; inadequate qualified manpower complement/inadequate training; doubtful set of transformation parameters; and implications of the adoption of PRS92 to land titling and registration system. The observations and analysis of Cayapan (2016) on the status, challenges and future direction of the Philippine Geodetic Infrastructure wherein some of the challenges met were on operational aspects (communication, natural and man-made hazards, cost recovery scheme), and technical issues like PRS datum issues, modernization of the PGRS, and other modernization issues such as amendment of

law, deformation modeling, capacity building and, change management.

Additionally, the 2012 Executive Summary of the National Mapping and Resources Information Authority (NAMRIA) showed its financial and operational highlights as well as its recommendations for the improvement of its financial statements and management operations. Land Management Bureau (LMB) through the Geodetic Surveys Division (GSD), conducted a three-day Assessment cum Training-Workshop on the Transformation and Integration of Old Cadastral Surveys into PRS'92 and Evaluation of Approved Political Boundary Map and Regional Base Map. Issues and achievements were presented and discussed. Engr. Henry P. Pacis, OIC-Assistant Director, said that the Land Sector have gone a long way and achieved so much, He also stressed out that computerization of data is about to start, that the 3-D Cadastre will soon be accomplished, and that the Land Administration and Management System (LAMS) will allow the public to have access to data such as cadastral maps, approved land survey plans, public land application and titles among others. The status of PRS92 transformation activities in their respective Regions was also presented and discussed in regard to the operational, implementation issues and gaps that took place. Regions with remarkable accomplishment in the program also shared their insights and experiences for the other participants to emulate (LMB, 2016).

The third assumption of the study which states that the challenges met in the implementation of the Philippine Reference System 1992 in Baguio City disagreed with the actual findings because this study has found that the said challenges met were observed as very much serious as confirmed by the obtained average weighted mean of 3.42 and, this could be attributed by the differing observations and actual experiences by the researchers and the respondents. At times, even professionals who work with the same program or project may have different ways of perceiving things and situations.

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G.S.B.
M.R.A.D.
R.S.G.
M.A.G.
M.A.D.L.
L.W.M.
E.T.R.

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