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Performance Improvement Model of Maturity (Pi-MoM) For Optimal *Saccharum officinarum* Crop Production

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ABSTRACT

The Performance Improvement Model of Maturity (PI-MoM) is a crop product improvement model that aims at improving the performance of the crop farming. The PI-MoM objective is to present the initial structure of the framework, to measure the performance key attributes and evaluate the crop product (*Saccharum officinarum*) maturity level. The proposed framework helps to evaluate the performance improvement of the crop product (*Saccharum officinarum*) through evaluation of the final crop harvestable. Successful execution of the anticipated framework provides an optimal performance throughout the cultivation life cycle, hence it maturity.

KEY WORDS: Agricultural Product, *Saccharum officinarum* farming, farm evaluation, Performance Key Attributes, PI MoM.

1. INTRODUCTION

Saccharum officinarum is widely grown crop in India. It provides more than an Million employment opportunity directly or indirectly. It is individual of the some species of tall perennial true grasses belong to the genus Saccharum, tribe Andropogoneae which is native to the warm temperate to tropical regions of South Asia and Melanesia. The global demand for sugar is the key driver of *Saccharum officinarum* agriculture. *Saccharum officinarum* accounts for 80% of sugar produced. *Saccharum officinarum* generally grows in the tropical and subtropical regions. Other products obtained from *Saccharum officinarum* include falernum, molasses, rum, spirit, bagasse and ethanol. In various regions, community use *Saccharum officinarum* reeds to make pens, mats, screens, and thatc. Figure.1, shows the different growing stages of the *Saccharum officinarum* in the farm.

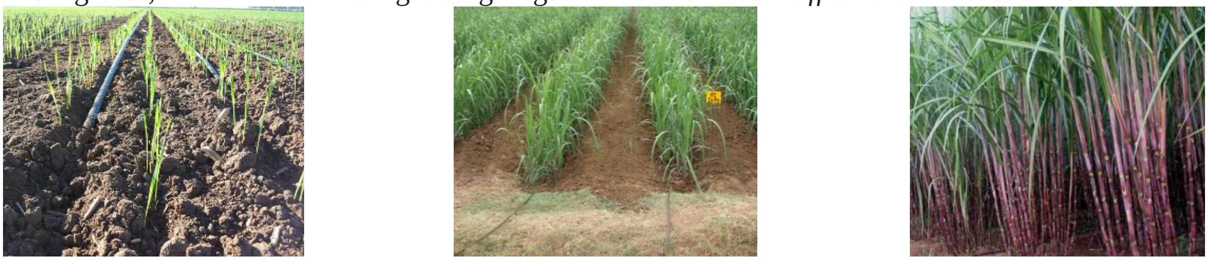

Figure.1. Different Stages of *Saccharum officinarum* Farming

The Software Engineering Institute (SEI) of Carnegie Mellon University (CMU) describes the Capability Maturity Model Integration (CMMI) as a process improvement approach that provides organization with the necessary rudiments of effective processes to improve their software development performance. The CMMI process enhancement includes identifying the organization's process strengths and weaknesses and making procedure changes to change weaknesses into strengths (Alvaro, 2007). CMMI consists of best practices that help organizations to advance their software growth effectiveness, efficiency, and quality (Golden, 2012). CMMI defines three constellations, which are compilations of best practices and procedure improvement goals that organizations use to evaluate and improve their processes. These purpose and practices are organized into different process areas.
The three constellations are:

- The CMMI for Acquisition (CMMI-ACQ): give direction to organizations that manage the supply chain to acquire products and services that meet the needs of the customer.
- The CMMI for Development (CMMI-DEV): provides process improvement guidance to organizations that develop products and services.
- The CMMI for Services (CMMI-SVC): provides guidance to organizations that set up, manage, and bring services that meet the needs of customers and end users.

CMMI aims at improving the process of the software development, however, that does not guarantee the quality of the produced software as the focus in CMMI does not wrap "product quality". Preceding research have shown that dealing with only "process quality" is not sufficient and that assessment of "product quality" is also required for the improvement of overall software quality(Golden, 2012). The proposed framework described in this paper focuses on the quality of the product instead of the process. The quality/maturity of the software product can be guaranteed through the evaluation of deliverables of the major phases of the software development lifecycle. In the proposed framework a method for technical product evaluation and quality assessment as the basis for set up the product's level of maturity. The level of product maturity measured by the degree of its compliance with the internal as well as external quality attributes defined in the stakeholders requirements. This framework is called as Technical CMMI (T-CMMI). The proposed framework along with the assessment method will:

- Enable software corporation to evaluate their software products to ensure they meet the desired quality before they release it to their clients,
- Enable customers to evaluate the quality of the product before purchasing it and
- Provide the clients with the ability to compare between the quality of different software products.

Related Work: An automatic image processing technique is proposed for the evaluation of *Saccharum officinarum* leaf area index by digital images. Everyday obtained *Saccharum officinarum* images were processed in a MATLAB setting and the different color vegetation indices were extracted from the time series digital images. (April, 2005)

Forecasting crop production has a vital role in food price predicting and justifying potential food deficiency. Crop models may need parameters from, for example, weather, crop genotype, farm management, and soil. Basis for these data are originate in extremely different places. In a proof-of-concept case study the coupling of a scalable geospatial big data platform, Physical Analytics Integrated Repository and Services (PAIRS), to the Decision Support System for Agrotechnology Transfer (DSSAT) crop model. (Alvaro, 2007)

In this section, he literature review is focused on developing maturity models and in software certification for quality assessment. A. Software Product Maturity Models Researchers projected diverse product maturity models. Al-Qutaish, (2011) proposed a software product quality maturity model (SPQMM) for review the quality of the software product. The proposed model is supported on ISO 9126, Six Sigma, and ISO 15026. This uses the characteristics, sub-characteristics, and measurements of ISO 9126. All the values are combined into a single value, which are converted to six sigma. After that, the integrity of the software product using ISO 15026 is calculated. Finally, the maturity level of the software product is identified. SPQMM is restricted to the quality attributes and metrics distinct in ISO/IEC 9126 standard.

The EuroScope consortium (Jakobsen, 1999) proposed an SCOPE Maturity Model (SMM) for software products evaluation. The model has five maturity levels: initial, repeatable, distinct, manage, and optimizing. SMM levels 2, 3, and 4 use ISO 12119, ISO/IEC 9126, and ISO 14598 principles. SMM is a measure of the quality in terms of corresponding stated specifications or requirements; tests are executed to assess the degree to which a product meets the necessary specifications. SMM requires the process to be documented to ensure the product go with the specifications. Thus, SMM does not focus on the final product quality (code). April, (2005) has proposed the Software Maintenance Maturity Model (SMMM) anyway, SMMM focuses only on maintainability. Alvaro et al. (A. Alvaro, 2005) has proposed Software Component Maturity Model (SCMM) that is based on ISO/IEC9126 and ISO/IEC 14598 standards. It contains five levels. SCMM depends mostly on the component quality model (CQM). SCMM measures only the maturity of the components that it cannot assess diverse types of product such as enterprise applications, web-services. Golden et al.(B. Golden , 2012)has proposed the Open Source Maturity Model (OSMM) which helps in assessing and comparing open source software products to recognize which one is the most excellent for a defined application. OSMM evaluates the maturity of open source products are only without evaluation the quality of these software products. OSMM is not primarily used to assess software product quality / product maturity but to help organizations execute a comparison between open source systems.

These three models above either

- Use limited set of quality attributes (Dongdong Zhang, 2016), do not focus on measuring the final software quality(Badr, 2016), or
- Therefore, the proposed model will overcome all these limitations. The proposed model is considered to be flexible to allow the assessor(s) to define their own set of quality attributes and metrics (based on the stakeholder's requirements). In addition, it is generic enough to be applicable to several type of software field, size or development method.

The proposed model can also serve in certifying software products. Software certification can be fixed for diverse types of software such as final software products (Voas, 2000) and components (Qutaish, 2011). Certification can be provided by independent agencies, which function like other quality agencies. Involving external agencies in providing the certificate increases the trust in the certification as indicated by Voas, "completely independent product certification offers the only approach that consumers can trust". Most of the certification methods are process-based (Heck, 2006), from the process they can determine the quality of the final product. However, certifying the software development process only does not guarantee the quality of the final product (Golden, 2012).

2. MATERIALS AND METHODS

In this section, the proposed *Saccharum officinarum* farming performance improvement model of maturity for Optimal Crop Production maturity evaluation framework that can be used to assess the maturity of optimal crop production products is explained. Performance is a significant feature of an agriculture product. For a agricultural product, both the natural capabilities and optimality usage of technological resources are equally important. Performance drives the success of *Saccharum officinarum* farming. Throughout the *Saccharum officinarum* Farming life cycle, the performance is ensured by continuously following the best practices of performance engineering. The adherence measure is necessary to make sure that the *Saccharum officinarum* crop cultivation process is aligned to meet the performance expectations of farmers need. In order to derive the adherence measure, an appropriate performance improvement model of maturity has to be developed. The PI-MoM based model for *Saccharum officinarum* Farming performance evaluations were done, 7 performance key areas therein it become PI value. It is analyzed that to have an optimal performance throughout the farming life cycle, recommendations on performance of maturity levels need to be provided on an appropriate manner. In order to provide appropriate maturity level recommendations on performance, a specific performance assessment tool and a reference model is essential to provide best performance engineering practices at each level throughout the *Saccharum officinarum* Farming life cycle.

Reference Model describes the common basis for the users to assess the maturity level of *Saccharum officinarum* cultivation. It also describes a scale of the maturity/capability levels of the *Saccharum officinarum* Farming based on its extent of fulfillment along with a set of quality attributes and specific metrics defined in the farmer's requirements. Performance assessment tool describe how to use the reference model in assessing the final *Saccharum officinarum* Farming artifact. It also provides guidelines and checklists that help in the assessment process and to make sure the common base of judgment. With the existing surveys of accessing methods, it is observed that there is a lack of increasing levels of performance maturity in continuous improvement to strive performance. To match these requirements, a model named performance improvement model of maturity is developed, based on the degree to which the performance engineering best practices are established.

The PMAM model is amenable with "Guidance on Performing an Assessment" ISO model (ISO 15504-3) (Morris, 20001) framework. The PI-MoM illustrated in figure 1 classifies *Saccharum officinarum* Farming performance into the following five levels:

Level 0 (Initial): Any *Saccharum officinarum* Farming for which performance management planning and activities related to performance are not carried out.

Level 1 (Basic): The performance of a *Saccharum officinarum* Farming expectations are mentioned clearly and are tested based on relevant infrastructure.

Level 2 (Performance Oriented): At level 2, the *Saccharum officinarum* Farming meets level 1 expectations and in addition, appropriate fertilizer and irrigation are altered.

Level 3 (Optimization) : At level 3, the *Saccharum officinarum* Farming meets level 2 expectations and in addition the *Saccharum officinarum* Farming is designed and altered as per the performance requirements. Furthermore, the design principles and patterns and the response time requirements related to performance, are incorporated.

Level 4 (Management Control): At level 4, the *Saccharum officinarum* Farming meets level 3 expectations and in addition, its performance is benchmarked against agricultural standards.

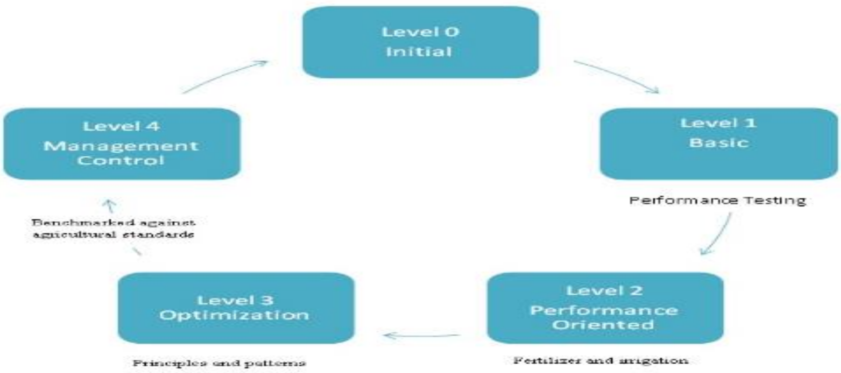

Figure.2. Performance Improvement Model of Maturity (PI-MoM)

The seven Performance Key Attributes (PKAs) illustrated in figure.3 identified for determining these five maturity levels are:

Categorization of Workload: Finding out key dealings like agricultural experts and Techniques and distributing period for each load. The categorization of workload falls under any one of the following: ad-hoc basis, based on the agricultural standards and based on work experience.

Farm design and irrigation architecture: Work experience based performance categories are included into farm architecture. The design principles and design patterns are included especially for performance.

Fertilization Optimization: At the Fertilization Optimization, the entire group is paying attention on unremitting process improvement. It has the means to identify weaknesses and strengthen the field proactively, with the goal of avert the occurrence of defects or errors. The effectiveness of the *Saccharum officinarum* Farming process is used to execute the cost benefit analysis of new technologies and proposed changes to the fertilization process. Innovations that exploit the best agricultural engineering practices are identified and are transferred throughout the farm.

Performance Testing: The *Saccharum officinarum* Farming is tested based on the specific environmental conditions. Also the performance results are analyzed with the ubiquitous performance agricultural standards.

Benchmarking against agricultural standards: The *Saccharum officinarum* Farming maturing level is decided based on the evaluation for each of these seven PKA's.

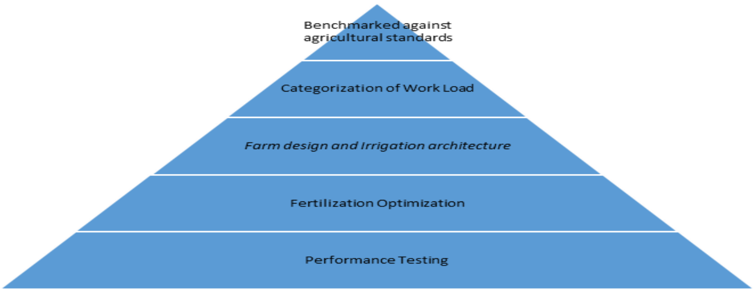

Figure.3. Performance Key Attributes (PKAs)

3. RESULTS AND DISCUSSIONS

Using PI-MoM model, the *Saccharum officinarum* Farming performance are evaluated as follows:

- Obtain the performance of the *Saccharum officinarum* Farming expectation for each of the PKA's through a pre-evaluation based questionnaire.
- Calculate the Weighted average for each of the PKA's and arrive at a specific maturity score level.
- Proper feedback is provided to *Saccharum officinarum* Farming people in order to further manage the *Saccharum officinarum* Farming performance maturity.

Figure.4, PI MOM Estimated *Saccharum officinarum* Cost of Cultivation, shows the actual cultivation cost and PI MoM estimated Cost of cultivation.

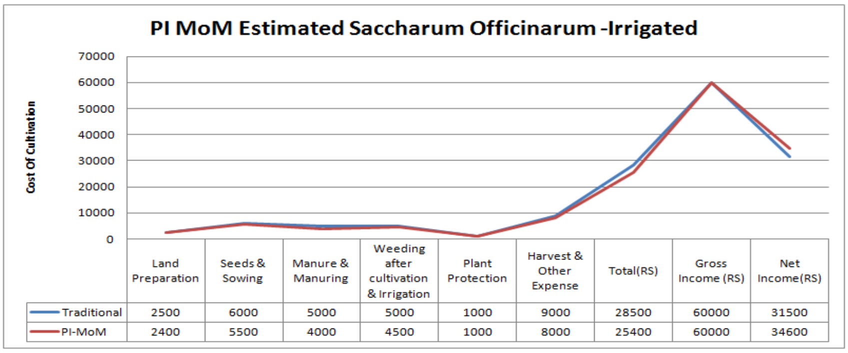

Figure.4. PI MOM Estimated *Saccharum officinarum* Cost of Cultivation

The graph clearly depict the net profit is slightly higher then the conventional method. It is also shows that operation cost is reduced the PI MoM model of farming.

4. CONCLUSION

This paper presented an approach towards developing a improving the performance of *Saccharum officinarum* Farming using maturity model. The proposed framework gives the capacity to measure the maturity of a *Saccharum officinarum* Farming of any region. It is also appropriate to all *Saccharum officinarum* Farming in spite of of the process used. The PI-MoM based model for *Saccharum officinarum* Farming performance evaluations were evaluated on performance key areas therein it become PI value. The *Saccharum officinarum* Farming performance has been measured with the usage of standardized evaluation methodology. This PI-MoM Model enables agricultural stakeholders to work together to reduce cost, and improves quality and quantity of crop production. As a scope of future work, plan in process to complete the development and evaluation of the framework. Also a website to automate the evaluation process would also be developed.

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