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CONTRIBUTION OF SOFTWARE PROCESS IMPROVEMENT APPROACHES FOR SMALL AND MEDIUM SCALE ENTERPRISES

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Abstract

A software organization regardless of their size wish to succeed on the market by providing software of high quality together with related services, support, communication with customers etc. To improve the software quality of a product in an organization, it is largely dependent on the processes that are used to create it. The software industry is a very important activity which has emerged over the last two decades. It has been seen that majority of the software industry in the world are small and medium scale enterprises. The economy of a nation is largely dependent on these small and medium scale enterprises. Software Process Improvement is an important activity which instantiates when an organization plans to enhance the capabilities of its ongoing processes. For an organization to produce a high quality product, there is a need to change the processes of the organization. This paper summarizes important SPI models and approaches those comprise of effective set of practices which can help small and medium scale enterprises to improve the quality of their products.

Preface:

The software industry is a very important activity which has emerged over the last two decades. A software organization, whether small scale or medium scale or large scale wish to succeed on the market by providing software of high quality together with related services, support, communication with customers etc. Today, the very promising small and medium scale software enterprises (SME's) are striving for standardization of their software development processes. They are carrying out improvement processes but not a proper set of processes. There is limited adoption, absorption, adaptation and assimilation of software process improvement models in SME's due to lack of know-how and available resources terms of money, time, perceived benefits, quality focus. To strengthen these small and medium scale enterprises, we need to improve the practices existing in the organization that have been adapted in accordance with their size and the type of business. It has been seen that only a few organization are able to achieve a high quality level for their development process. As most of the organizations in the world are small and medium scale enterprises, economy of a nation is greatly dependent on them. As their capacity to handle the cost of software improvement models like the CMM, P-CMM, SPICE and so forth are limited, they are not able to use in their organization for quality improvement of their products. In this paper a few approaches for software process improvement are being discussed with a hope that it will help the small and medium scale enterprises to improve the quality of their product.

Keywords:

Capability Maturity Model Integration, DMAIC, DPMO, K-Model, PRISMS, Small and Medium Scale Enterprises, Software Process Improvement

1. Capability Maturity Model Integration (CMMI):

CMMI is a process improvement model that provides a set of best practices that addresses productivity, performance, costs and stakeholder satisfaction. It is a model that consists of best practices for system and software development and maintenance and is used as a framework for appraising the process maturity of the organization. CMMI is the leading industry standard for measuring software development processes. CMMI representation can be Staged or Continuous. The continuous representation is designed to allow the user to focus on the specific processes that are considered important for the organization's immediate business objectives, or those to which the organization assigns a high degree of risk. Continuous representation suits well to SME's, where short term goals are emphasized highly.[8] There are six capability levels (CLs), five maturity levels (MLs), and 22 process areas (PAs).In CMMI there are six capability levels designated by the numbers 0 through 5.They are

- 0-Incomplete
- 1-Performed
- 2-Managed
- 3-Defined
- 4-Quantitatively Managed
- 5-Optimizing

Maturity Levels	Key Process Areas
Level 5-Optimizing	Organizational Innovation and Deployment Causal Analysis and Resolution
Level 4-Quantitatively Managed	Organizational Process Performance

	Quantitative Project Management
Level 3-Defined	Requirements Development Technical Solution Product Integration Verification Validation Organizational Process Focus Organizational Process Definition Organizational Training Integrated Project Management Integrated Supplier Management Risk Management Decision Analysis and Resolution
Level 2-Managed	Requirements Management Project Planning Project Monitoring and Control Supplier Agreement Management Measurement and Analysis Process and Product Quality Assurance Configuration Management
Level 1-Performed	

Fig 1: CMMI [10]

We can say that CMMI is a software process improvement model that is suitable for small and medium scale enterprises. [1][4]

2. Six Sigma:

Six Sigma is an approach originally developed by Motorola in 1980's to systematically improve processes by eliminating defects which will result to reduction of process variation. Six-Sigma is represented as "6σ". Its main objective is elimination of defects, waste, or quality control problems. Six Sigma is, basically, a process quality goal, where sigma is a statistical measure of variability in a process. Six Sigma is a statistical term that refers to 3.4 Defects per Million Opportunities (DPMO) (or 99.99966 percent accuracy), which is as close as anyone is likely to get to perfect. [2] The technical concept of Six Sigma is to measure current performance and to determine how many sigma's exist that can be measured from the current average until customer dissatisfaction occur. Six Sigma implies three things: statistical measurement, management strategy and quality culture. It tells us how good products, services and processes really are, through statistical measuring of quality level. [5] When customer dissatisfaction occurs, a defect results. [6] If the internal operations are not well structured, a company will find it difficult to create value and be highly competitive. Six Sigma is a good approach for small and medium scale enterprises. [7] One puzzling aspect of the "official" Six Sigma literature is that it states that a process operating at Six Sigma will produce 3.4 parts-per-million (PPM) non-conformances. Six Sigma is based on DMAIC methodology.

D-Define	Define the project and customer requirements <ul style="list-style-type: none"> • Decide the project scope and project goals • Plan project deliverables and schedule for DMAIC stages • Form the project team • Prepare a project charter • Identify the process • Document the process using SIPOC diagram • Identify, analyse and prioritise customer requirements
M-Measure	Study the process and determine the relevant metrics <ul style="list-style-type: none"> • Assess measurement systems for validity and reliability • Design and implement new measurement systems, if needed • Develop a data collection plan • Calculate the process sigma level
A-Analyse	Analyse data and discover causes of the problem <ul style="list-style-type: none"> • Use collected data to find patterns, trends and variation by using Pareto chart, cause-effect diagram, and other statistical tools
I-Improve	Investigate possible changes to the process <ul style="list-style-type: none"> • Chalk-out action plans to introduce process changes • Test the new improved methods. • Decide on ways to sustain process changes • Implement changes
C-Control	Ensure the standardisation of suggested changes <ul style="list-style-type: none"> • Address any problems with acceptance and implementation • Verify expected results and • Document effects of changes

Fig 2: Six Sigma Methodology [7]

3. Personal Software Process (PSP):

The personal software process (PSP) is developed to provide the software engineers a way to improve the quality, predictability, and productivity of their work. It is designed to address the improvement needs of individual engineers and small software organizations. The PSP process phase has three phases. They are planning, development and post mortem. [9] The PSP process areas are described in the table below along with the maturity levels.

Maturity Levels	Key Process Areas
Level 5-Optimizing	Process Change Management Technology Change Management Defect Prevention
Level 4-Managed	Quality Management Quantitative Process Management
Level 3-Defined	Peer Reviews Software Product Engineering Integrated Software Management Software Process Definition Software Process Focus
Level 2-Repeatable	Software Project Tracking and Oversight Software Project Planning
Level 1-Initial	

Fig 3: PSP [15]

4. PRISMS Project:

Process Improvement for Small to Medium enterprises (PRISMS). PRISMS is an action research project, with a team of three researchers from Leeds Metropolitan University. The model enables individual SMEs to tailor the software process improvement to the organization's business objectives. PRISMS assessment consists of an awareness and business case workshop which focuses on process improvement, cost-effectiveness, and providing a road-map for process improvement, followed by a series of assessment interviews where we meet different groups individually and collectively. [12]

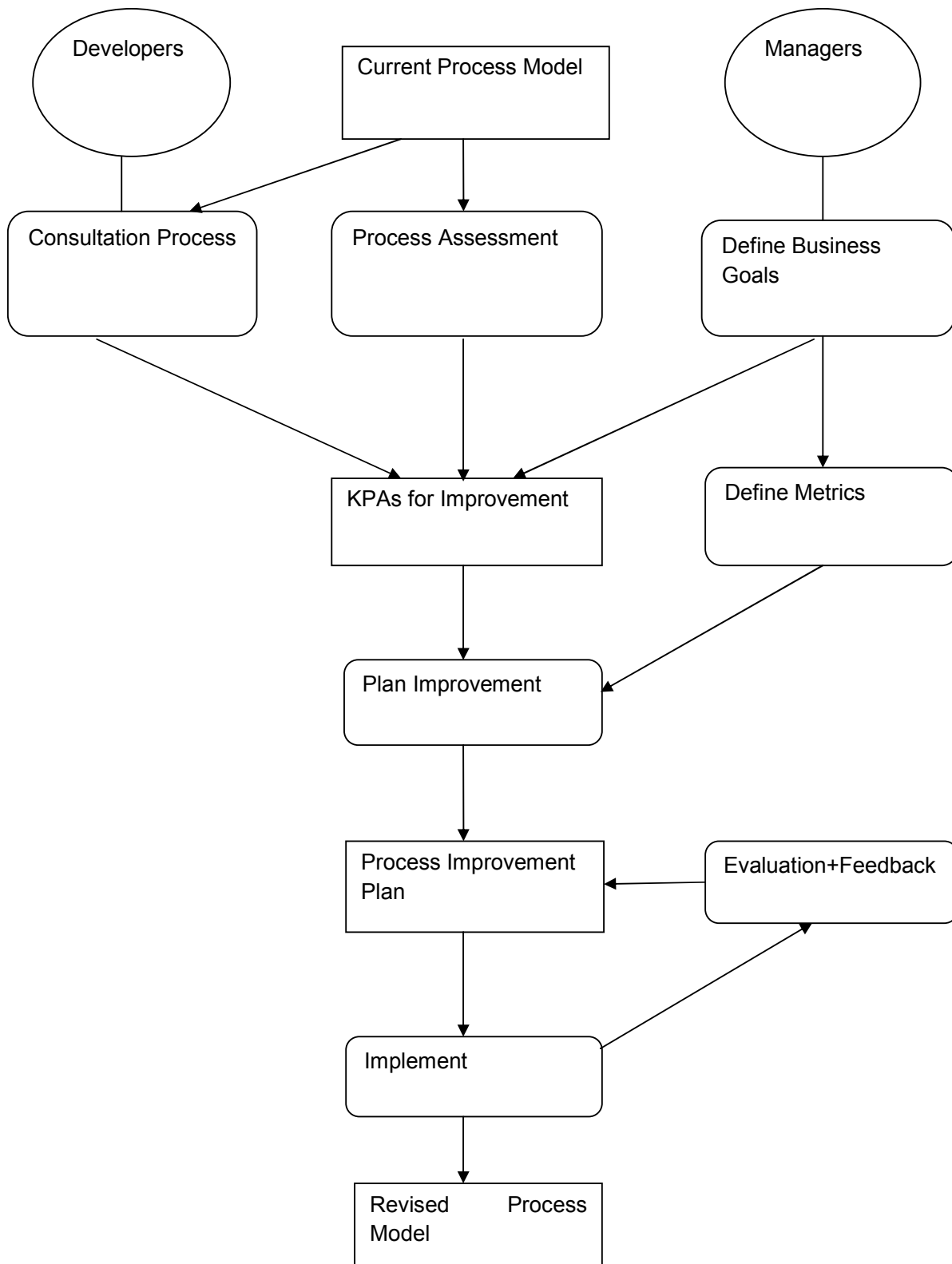


Fig 4: The PRISMS Process [12]

5. K-Model:

The guideline of software process quality certification consists of project and formation level, and it developed to satisfy the investigation of software process quality capability and improvement at the same time. There are three levels in K-model. They are Initial level (level 1), Good level (level 2) and Very Good level (level 3). [13]

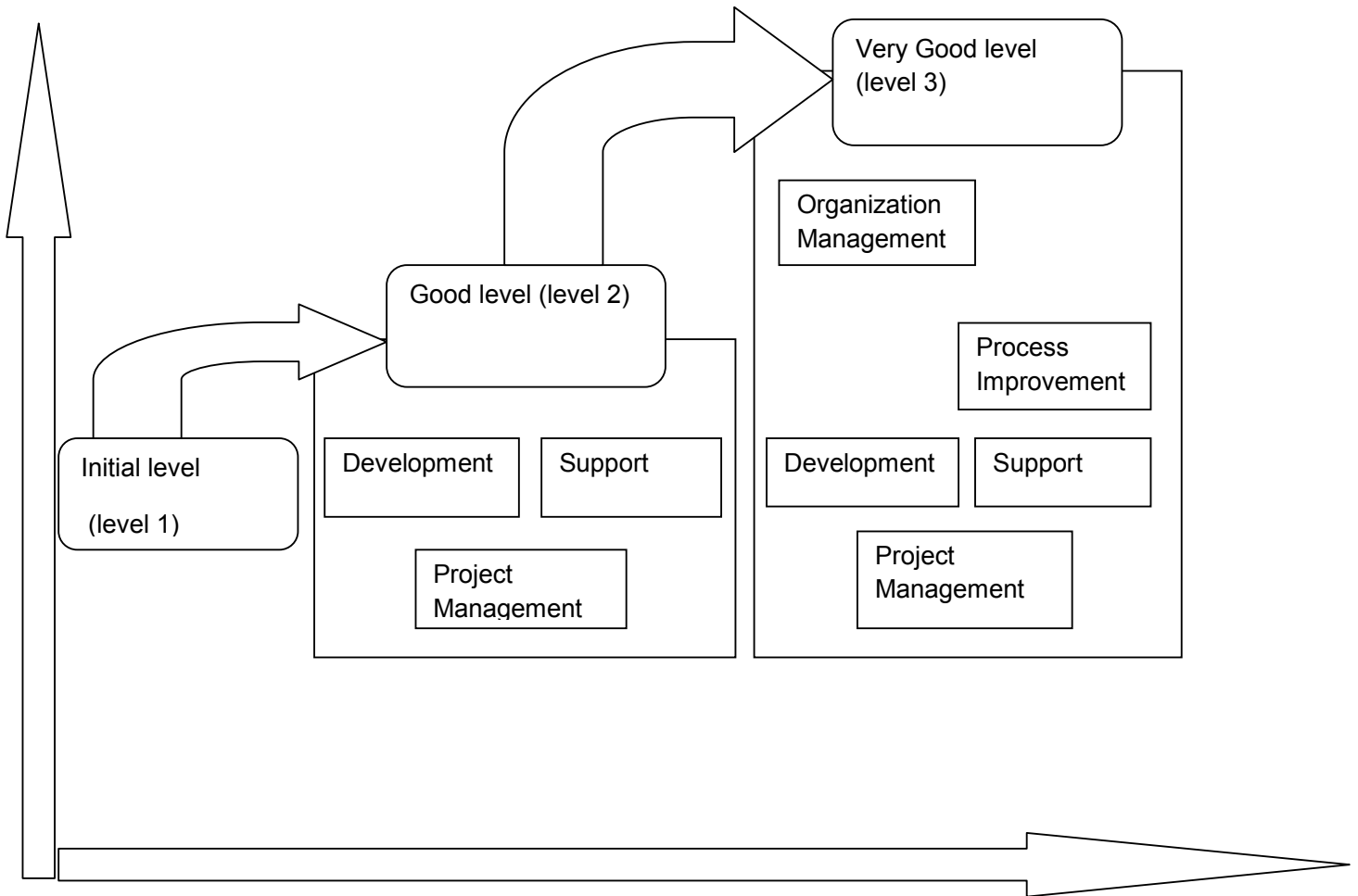


Fig 5: Steps of process quality certificate in K-model [13]

Level 1 is the basic level for improving the capability of the processes in an organization. Level 2 is concerned with developing the project and controlling it and Level 3 is concerned with improving the quality level of the projects and finding out the fundamental reason for improvement through quantitative process management. The K-model can be adapted by small and medium sized organization to improve the quality of their products. [13]

6. BOOTSTRAP:

BOOTSTRAP is a software process improvement and assessment model. It is basically developed for European industries. BOOTSTRAP methodology can be applied to small and medium size software companies or software departments within a large organization.

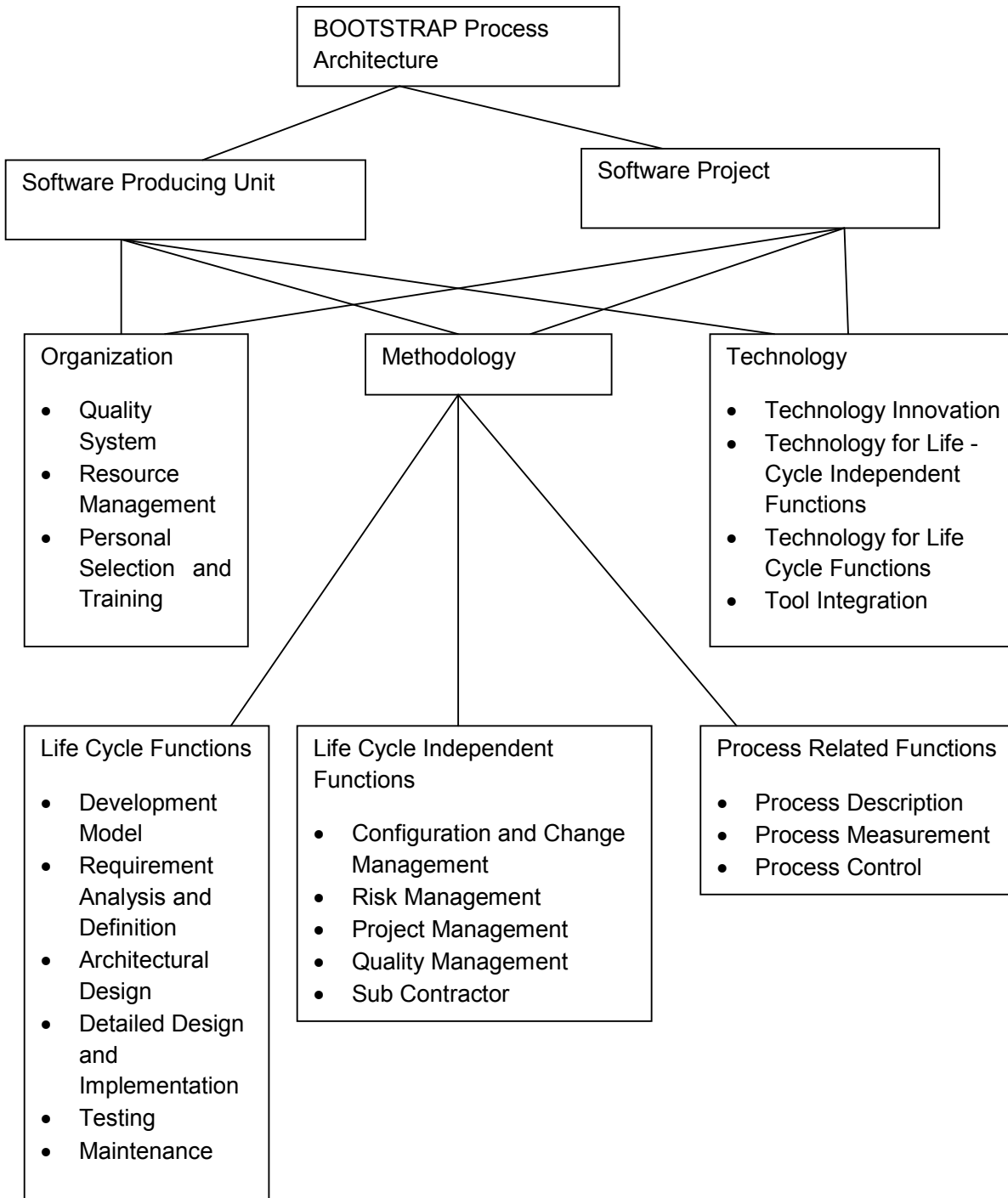


Fig 6: BOOTSTRAP Process Architecture [11]

A new release (Release 3.0) of the BOOTSTRAP methodology has been developed to assure conformance with the emerging ISO standard for software process assessment and improvement. [14] The main features of BOOTSTRAP are: Questionnaires for both site and project evaluation, Uniform procedure and mandatory assessor qualification/training, Constructive instead of a normative approach, Open questions, Immediate feedback and action planning. [3]

Conclusion:

The scope of software process improvement is very vast. As software industries are striving good software programs, there is lots of research going on software process improvement. As technology has already come a long way therefore adding process assets reusable libraries, reusable design and code components, reusable verified and validated requirements set and object orientated methods and tools is actually needed to enhance software process improvement in small and medium enterprises. This paper discusses some good software process improvement approaches that the small and medium scale enterprises are able to use to improve the practices of their organization so that quality of the product can be improved so that they can be able to compete in the market.

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