CMMI process for:

APS – AutoPilot cars for roads in Serbia

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| **CMMI level** | **Project areas** | **Specific goal** | **Specific rules** | **Artefact** | **Description of applying rules in current project, possible improvements, references on other papers, …** |
| 1 | Requests  initialization |  |  | Idea of solutions | This project is about modifying autopilot software for road in Serbia. In Serbia, the driving of motor vehicles is extremely difficult due to the numerous holes on the roads, inadequate marking, road signs and poor lighting of individual sections. This greatly complicates the use of autopilot vehicles. This can provide a possibility to a large number of people to use autopilot vehicles, and also provide a possibility to people incapable of driving to use vehicles at all. This idea may also be a stimulus for other countries to follow this example. |
| 2 | Requirements  management | Requirements  management | Establish  requests agreement |  | Collect all requests from different parties of interest. Categorize based on possibilities and importance. |
| Establish obligations  according to requirements |  | Achieve all success criteria and milestones for each request accepted. |
| Requests changes  management |  | For each change in requests, try to be as flexible as possible. |
| Maintain  bidirectional mapping  of requests |  | Achieve regular and meaningful communication between all parties part of project, especially:  administration, management, project architects  and  developers, users, … |
| Identify contradictions  between  project activities  and requirements |  | Detect all contradictions between project development and requests, on time, and handle them properly. |
| Standardize management  process | Establish  organizational rules |  | Design a detailed plan for every step of project and guidelines for better following of that plan. |
| Process planning |  | Design a detailed plan of project in Trello. |
| Provide recourses | Project plan | Provide vehicles, autopilot software, equipment for developers, environment for test drives |
| Assign responsibilities | Project plan | Share responsibilities on all partners, as equal as possible, by using their expertise as guideline. |
| Train staff | Training plan  Or project plan | Improve knowledge of specifics on autopilot software we plan to modify, on all levels of developing, and some of management. |
| Manage configurations | Configuration  Management plan | Scheduling regular meetings to discuss configurations of parties based on current objectives of project. |
| Identify and include  important participants |  | Scheduling short but regular meetings that will serve as progress reports and invite all representatives of participant groups, regardless of their role in the project. Consider all ideas proposed. |
| Control and monitor  process |  | Keep track of functional demands in project, and in witch period they should be enabled. Make mini-tests that will confirm the fullfilling of them. Handle all possible problems and latency. |
| Objectively evaluate conceptual representations |  | Schedule meeting for all partners in which they will present their ideas about how the see the future project development. Consider all ideas equally. |
| Perform status revision with higher level management |  | Make progress reports regularly and present them to management.  Management must determine the validity of task success. |
| Project  planning | Determine  estimations | Define  project domain |  | Main domain is Serbia, but big picture suggest widening on all poorly developed counties of Europe. |
| Define  work product and task estimates |  | Define estimations of costs and contributions, for each part of project: tasks, products, management, |
| Define the lifetime  of the project |  | Unlimited (developing for two years, and maintaining as long as needed) |
| Define estimates of required effort  and price |  | Define estimations of costs and contribution of the entire project |
| Develop  project plan | Define  budget and schedule |  | Make a small global project fund, with certain amount used for unexpected expenses. Define budget for each phase of project. Make sure it is sufficient and returned to fund if unspent. |
| Identify  project risks |  | 1. Tesla and Korean partners declining collaboration 2. Unsafe software, doesn’t pass testing phase 3. Not enough money for all phases |
| Data management plan |  | Making database for detailed analysis of roads. Make it accessible to all relevant parties and designed to improve understanding and getting data quickly. |
| Project resources plan |  | Make plan for providing all resources described above. |
| Necessary  knowledge and skills plan |  | Make detailed plans of time and subjects of meetings, where will be performed: consulting with experts from Tesla and Korean partners |
| Plan participations |  | Make detailed plans for all project phases, about which partners will be involved and what their duties will be. |
| Establish project plan |  | Use all plans described above to make a project plan, on very high level of detailing. |
| Adhere to  the plan | Conduct revision  of the project plan |  | Make a reviewed project plan after every short meeting where ideas are discussed, that will include ways to cover those ideas, if accepted. |
| Reconcile  work activities  and  available resources |  | Make sure that all funding of the project is equally divided to all teams, scaled to needs of phase. Make sure that money is returned in global project fund if unspent. |
| Highlight obligations defined by the plan |  | Track and control all project plan activities and make sure that all are fullfilled with maximum degree. |
| Project  monitoring  and  control | Monitoring  the project  by  comparing  with the plan | Track the parameter  of the project plan |  | Keep track of project plan activities, so project plan can be changed if needed. |
| Track obligations |  | Keep tracking of every task, using Trello tool |
| Track project risks |  | Track all risks mentioned above, design possible solutions in case of issues and inform higher instances of status. |
| Track  data management |  | Maintain data base in state of consistency. |
| Track engagement of relevant participants |  | Keep track of every participants enrolment and task status in Trello |
| Conduct revisions  to estimate progress |  | Do progress reports of regular bases, design algorithms for problem handling if needed. |
| Conduct revisions  in key points |  | Do special progress reports at the end of each phase that will serve as checkpoints to establish if project plan needs to change. |
| Manage  correction  actions | Analyze problems |  | All problems detected must be documented and passed to superior as soon as possible. |
| Execute  correction actions |  | All problems during project’s life must be corrected in minimal time. |
| Manage  correction actions |  | Management must be able to quickly: analyze issue passed to him and decide who to in charge of fixing. |
| Configuration management | Determine  basics | Identify  configuration items |  | Incremental development |
| Establish a system  for configuration management |  | Coordinator: must monitor collaboration between all teams. |
| Create the basics  for publishing |  | Develop modules in each incremental phase that will be delivered for estimation. |
| Monitoring  and  controlling  changes | Track change requests |  | Coordinator must keep track of all changes and inform relevant team leaders. |
| Control configuration items |  | Coordinator will use some tool to keep the track of every detail. |
| Form  integrity | Form notes for the configuration  management |  | Design notes based on results of tool mentioned above. |
| Execute  configuration estimates |  | Do estimations of given configuration, in detail, and pass it to all teams. |
| Supplier  agreement  management | Establish  agreement | Determine the type  of procurement |  | Vehicles: import + license  Software: license, documentation  Equipment: suitable for programmers  Environment: rented car tracks |
| Choose suppliers |  | Partners (Tesla, Korean), Serbia road society |
| Establish agreement  with suppliers |  | License for import and renting. Approval of received resources. |
| Adhere to  the agreement | Make an overview  of COTS products |  | / |
| Adhere to  the agreement |  | Hire legal team. |
| Accept the delivery of the appropriate product |  | Ensure bill and confirmations needed. |
| Carry out  product transport |  | Control import of cars and equipment transport. |
| Measurement  and  analysis | Conduct activities of  measurement  and analysis | Determine  the objectives of measurement  and analysis |  | Detailed study of road conditions. |
| Precisely determine the measures |  | Damages, marking, light |
| Precisely determine the procedures for collecting data  and data storage |  | Gathering: Questioners, test drives  Storage: database |
| Precisely determine analytical procedures |  | Design measuring and statistical algorithms. |
| Provide results  of measurements | Collect  measurement results |  | Questioners, test drives |
| Analyze  measurement results |  | Size, shape of damages,  How inappropriate is the marking and lighting |
| Store  measurement results |  | database |
| Link and combine  results |  | For calculating statistical data |
| Process  and  product  Quality  assurance | Execute objective  evaluation of processes and work products | Objectively evaluate the processes |  | Processes must match ones described in project plan. |
| Objectively evaluate products and services |  | Products must match specification of demands. |
| Provide  objective insight | Connect and provide solutions to problems  which came out due to  incompatibility |  | Make progress reports on time, and handle inconsistencies in early phases of project. |
| Provide notes |  | Document every phase. |
| 3 | Risk  Management | Do preparations for  risk management | Determine risk  sources and categories |  | 1. Tesla and Korean partners declining collaboration 2. Unsafe software, doesn’t pass testing phase 3. Not enough money for all phases |
| Define risk parameter |  | 1. Success of project 2. time 3. quality |
| Define risk management strategy |  | 1. Use high level convincing techniques. 2. Small frequent tests during implementation 3. Hire an economic expert to design a good plan for spending. |
| Identify and analyze risks | Identify risks |  | 1. Project failure 2. Longer project 3. Quality decreases, project stop till money found |
| Categorize  and prioritize  risks |  | Risks are mentioned above in order based on priority. |
| Mitigate consequences  of risks | Develop  risk mitigation plan |  | 1. Plan a different contract 2. Analyze errors and make plan to fix them 3. Plan dissemination |
| Apply  risk mitigation plan |  | 1. Try to make a different contract 2. Do fixing of errors 3. Do more dissemination in order to get more investors |
| Integration  unification | Determine  team structure | Identify tasks |  | Split project into work packages, and each into tasks. |
| Identify necessary  knowledge and skills |  | Analyze expertise of each partner. |
| Identify team members |  | In charge team leader for tasks there are best to complete. |
| Manage  team work | Establish  common environment |  | Rent conference rooms for management meetings. |
| Establish  work environment |  | Rent offices for programmers. |
| Define roles  and responsibilities |  | Define responsibilities of each team. |
| Establish  working procedures |  | Define procedures that every team must follow. |
| Collaborate with interface teams |  | Ensure collaboration between front-end and back-end. |
| Integrated  supplier  management | Analyze and choose  suppliers | Analyze  potential suppliers |  | / |
| Evaluate and choose suppliers |  | Tesla and Korean partners |
| Coordination of  work with suppliers | Monitor  work activities  of selected suppliers |  | Ensure participating in regular meetings. |
| Evaluate  work products  of selected supplier |  | / |
| Review  the agreement  and relationship |  | Check all licenses and agreements. |
| Product  integration | Execute preparations for prodpuct integration | Determine  Integration flow |  | Establish time frame for implementing each module, and combining them into whole. |
| Establish a proper  integration environment |  | All resources acquired. |
| Establish integration  procedures and criteria |  | All modules must be functional and well tested before integration. |
| Provide  interface compatibility | Perform a revision of interfaces description |  | / |
| Interface management |  | Keep compatibility with Tesla |
| Complete  folding and delivery  of the product | Confirm the readiness of components  for integration |  | Testing each component individually. |
| Assemble components |  | Integration procedures followed. |
| Execute evaluation |  | Test whole integrated software. |
| Pack and deliver  the product  and components |  | Integrated software prepare for field tests. |
| Verification | Execute preparations  for verification | Select  working products  for verification |  | Whole software. |
| Set up  verification environment |  | Tracks (highways, mountain roads, city roads, …) |
| Establish  procedures and criteria  for verification |  | Driving according to traffic laws and rules. |
| Execute  professional evaluation | Prepare for professional evaluation |  | Form a team of expert drivers. |
| Conduct  professional evaluation |  | Conduct test drives |
| Analyze  professional evaluation  and data |  | Gather and analyze data from test drives. |
| execute verification of  chosen work products | Execute verification |  | Confirm success or failure of each test. |
| Analyze results  and identify  correction actions |  | Document all success/failure data and reasons (in case of failure) |
| Validation | Execute preparations  for validation | Choose  products to validate |  | Choose one model of each producer from partners. |
| Set up  validation environment |  | Form a team of expert drivers. |
| Establish validation  procedures and criteria |  | Conduct example drives that show all implemented abilities. |
| Execute verification of product  and its chosen parts | Execute validation |  | Do validation |
| Analyze  validation results |  | Document all satisfy/unsatisfied data and reasons (in case of unsatisfied) |
| Organizational  training | Determine possibilities  of organization for  conducting  training process | Determine  training needs |  | / |
| Identify needs  within the organization's competence |  | / |
| Define training plan |  | / |
| Establish  possibility of training |  | / |
| Execute  necessary training | Execute training |  | / |
| Keep training records |  | / |
| Evaluate  training effectiveness |  | / |
| Organizational  process  definition | Determine  favorable circumstances  of the process  on level of organization | Establish  standard processes |  | Dividing participants into teams and organizing internal structure of management organization. |
| Establish  model descriptions |  | Define a detailed model of management and responsibilities system. Organize hierarchy and superior-inferior communication forms. |
| Set up tailoring  criteria  and instructions |  | / |
| Establish  a set of measurements at the level of organizations |  | Define principles of good communication and relationship, and validate it during project duration. |
| Establish a library  of favorable circumstances |  | / |
| Organizational process  focus | Determine possibilities  for  process improvement | Establish the needs  of organizational processes |  | Define meeting types and number of each type needed.  Apply SCRUM methodology to our project |
| Evaluate organizational processes |  | / |
| Identify improvements |  | Document each idea elaborated on short-idea-meeting described above and process it properly. |
| Execute  planning  and implementation  of actions for  improving organizational processes | Set up plans  to take action |  | Make a detailed plan on online tools and report format used for process organization. |
| Implement plans |  | Use upper mentioned tools for organization process. |
| Use improvements  and  favorable activities |  | / |
| Embed  acquired knowledge  and improvements |  | Share experiences with other teams, in order to avoid repeating same errors. |
| Integrated  project  management | Use defined process  for project | Establish  defined process |  | Make an organization plan for management of entire project |
| Use favorable planning circumstances  for project activities |  | / |
| Integrate plans |  | Make small detailed plans to explain better parts of organization not explained detail in big organization plan. |
| Manage project  based on plans |  | Follow the plan mentioned above. |
| Improve  a set of  favorable circumstances |  | / |
| Collaboration with  important suppliers | Manage  the participation of investors |  | Keep track of all investors in project and make detailed documentation on each investment. |
| Manage dependent relationships |  | Provide some commercial to sponsors (logos, …) |
| Solve  coordination problems |  | If a problem occurs in collaboration with sponsors, detect it, analyze it and work on solving it. |
| Use  mutual understanding  for IPPR | Define context  of common understanding |  | / |
| Establish  common understanding |  | / |
| Organize  integration teams  for IPPR | Organize the team structure within the framework of project |  | / |
| Provide preliminary distribution of requests to appropriate teams |  | / |
| Establish teams |  | / |
| Decision  analysis  and  resolution | Do evaluation of  alternative solutions | Establish guidance for decision analysis |  | Design a plan to estimate properties of Tesla autopilot software. |
| Establish  evaluation criteria |  | Performances and safety. |
| Identify alternatives |  | / |
| Choose  evaluation methods |  | Testing |
| Execute evaluation |  | Make estimation of properties of Tesla autopilot software. Detect flaws. |
| Choose solutions |  | Choose parts of Tesla’s autopilot software that will be improved and adjusted to roads in Serbia. |
| Organizational  integration  environment | Provide  IPPR infrastructure | Establish  shared understanding  on organization level |  | / |
| Establish  working environment  for integration |  | / |
| Identify unique skills  as support |  | / |
| Manage people | Establish  leadership mechanisms |  | Make a management structure and define responsibilities of each lieder. |
| Establish stimulus  for integration |  | Develop strategies for motivating workers: wage bonuses, rewards for most valuable and hardworking, … |
| Establish mechanisms  for balancing responsibility |  | Develop a plan for responsibilities sharing that will be an equal burden for each participant. |
| 4 | Organizational  process  performance | Establish base lines for  performance  and models | Choose processes |  | Make a list of all processes, whose performances have greatest impact on the entire system. |
| Establishing measures  for process performance |  | Define properties that show performances of those processes and their flaws in best way. |
| Establish goals for quality  and performances of process |  | Define a frame of adequate values for performances of each of those processes. |
| Establish baseline for process performance |  | / |
| Establish  process performance models |  | / |
| Quantitative  project  management | Quantitative  project management | Establish project goals |  | Design a document that will list all goals of our project and elaborate them with details. |
| Compose  defined process |  | Make a detailed plan on how to achieve those goals. |
| Select sub processes  to which  statistical management  will be applied |  | / |
| Manage  project performance |  | Design a detailed plan of achieving and maintaining desired performances of project (management, developing, and dissemination). |
| Statistical management  of sub processes  performances | Choose techniques for analysis  and measurement |  | / |
| Apply  statistical methods  to better understand  the variations |  | / |
| Monitor performance  of the selected  sub process |  | / |
| Record specific management data |  | / |
| 5 | Causal  analysis  and  resolution | Determine  defect causes | Determine  causes of defects |  | Detect all possible defects and software flaws, by using documentation and testing. Determine causes of those failures. |
| Analyze samples |  | Analyze all causes of bad software performance and determine importance and possible avoiding techniques. |
| Address  defect causes | Implement  action suggestions |  | Implement techniques for avoiding causes of bad software performance. |
| Estimate  the effects of changes |  | Analyze impact of changes mentioned above |
| Record data |  | Make a detailed documentation on both causes, their appearance frequency and impact on software, as well as improvement level by using upper mentioned techniques. |
| Organizational  performance  management | Business performance  management | Maintain  business goals |  | Maintain and occasionally validate goals of the project and in what amount are they followed and fullfilled. |
| Identify and analyze innovations |  | Document each idea elaborated on short-idea-meeting described above and process it properly. |
| Analyze data for process performance |  | Validate performance of software. |
| Choose  improvements | Discover  suggested improvements |  | Schedule several meetings in late phases of project, in which we will discuss possible improvements of the software and dissemination techniques. If needed, few can be organized for improving management system. |
| Analyze  suggested improvements |  | Make a detailed analysis of suggestions elaborated on meetings mentioned above: through cost-benefit relations. |
| Validate  improvements |  | Confirm that those improvements do not harm desired behavior defined by gathered participant and user requests. |
| Select and implement deployment improvements |  | Choose ideas which will be implemented from the set described above, and in charge teams which will conduct it. |
| Conduct  improvements | Plan deployment |  | Make a detailed plan on organization and conducting implementation of chosen improvements. |
| Manage deployment |  | Management must guide this as well as regular implementation. All changes must be documented. |
| Estimate  improvement effects |  | Determine contribution off each improvement. Is it, at the end, bigger than its cost? |

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