Transforming Milestone Trend Analysis for Utilization in Scrum: The Increment Drift Analysis

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Abstract: Existing literature provides limited insights on how project monitoring support agile product development. This article introduces the Increment Drift Analysis, a method that transforms the Milestone Trend Analysis to enhance project monitoring. The method mitigates the risk of interpretational gaps in reporting by aligning objective achievement forecasts with actual status conditions. Implementing a traffic light logic enables specific interventions by management levels when necessary. The generalized method was developed by solving real industrial problems from customer projects.

Keywords: Project Management, Design Management, Agile Product Design, Project Monitoring, Design Practice

1 Introduction

The philosophy "You cannot manage what you cannot measure" is a fundamental assumption that many managers adopt for themselves (Globerson and Shtub, 1995). Currently, effective management of agile product development projects is an important topic (van Wessel et al., 2022) to achieve competitive advantages in dynamic environments characterized by volatility, complexity, uncertainty, and ambiguity (Cooper and Fürst, 2023; Saleh and Watson, 2017). Established plan-bounded approaches of today's product development projects have proven to be limiting because these approaches assume that requirements can remain unchanged (Lévárdy and Browning, 2009). Therefore, researchers increasingly document cost and time overruns within product design projects (Flyvbjerg et al., 2022; Gardiner and Stewart, 2000; Serrador and Pinto, 2015) among other reasons being attributable to planning errors (Zwikael and Gilchrist, 2023). In addition to project planning, the project monitoring & controlling is also a critical activity within project management (Hazır, 2015; Pellerin and Perrier, 2019). Thus, planning can be understood as an activity to outline a proposed path and the required resources for achieving a defined objective (Zwikael and Gilchrist, 2023). Hence, the plan typically includes milestones for each individual phases of the product development process (Ulrich and Eppinger, 2015). Project monitoring & controlling draws on planning and serve as the foundation for project reporting (Wolf, 1989). The goal of project monitoring & controlling is to ensure the delivery of consented results according to the project plan (Conforto and Amaral, 2010). The stage-gate system according to (Cooper, 1990) has established itself as an adaptable standard in product development and can rely on simple monitoring methods such as Milestone Trend Analysis (MTA). When implementing agile approaches within companies, organizations selectively use or combine agile methods (Michalides et al., 2022; Nicklas et al., 2021). Companies preferring the application of Scrum (Nicklas et al., 2021). There are various manifestations of Scrum including its integration within established design methodologies. However, managers consistently demand reporting activities and visualized metrics, irrespective of the chosen project design. Reporting monitors adherence to the consented plan and consequently, the progress of the project (Project Management Institute, 2008). In Scrum teams, various tools like burn charts are used to visualize progress (Dinwiddle, 2009). Still, some visualizations may not fully enable management to take appropriate actions or refocus projects (Collyer and Warren, 2009). For example, several teams work together on product development projects within companies due to their complexity. Therefore, looking at just one Scrum team doesn't show the whole corporate picture. Therefore, scholars argue that milestones allow management to better monitor projects (Collyer and Warren, 2009; Cooper and Sommer, 2020). We argue that the content of milestones in product development (e.g. functional and non-functional requirements within a milestone) is crucial, as it encompasses the criteria for quality assurance and the necessary market knowledge. However, this leads to conflicting goals within agile product development projects in terms of prioritizing the achievement of milestones or the progress of product functionality in dialogue with the customer. Particularly, considering non-functional requirements is important when using Scrum in product design. Therefore, we asked ourselves how we could utilize existing methods, such as MTA, in agile design and development without constraining Scrum teams, all while aiming to meet the dynamic needs of customers. Additionally, a lack of implementation effort often reduces the acceptance of project management methods and can be increased by comprehensible method communication (Platz, 1986). The underlying idea of this article is to maintain the acceptance of milestone content as essential quality knowledge for product success but to dissolve the typical rigid structure of milestone sequences, thus making it useful in agile product development projects by implementation in the product backlog. While at the same time increasing the transparency of project progress for reporting. Therefore, our research question is:

RQ: What adaptations are necessary to implement the Milestone Trend Analysis effectively in conjunction with the application of Scrum?

To address the research question, we base our work on action research (Staron, 2020). Consequently, we reconceptualize the well-known Milestone Trend Analysis by transforming the method for Scrum managed projects. We consider the changeable Product Backlog items as well as the support for self-organization of the teams in the sequencing of tasks within Scrum. Furthermore, the adapted method should draw upon the knowledge of contemporary methods and approaches known in the industry for project monitoring & controlling. We provide the necessary fundamentals in the subsequent background section.

2 Background

2.1 Scrum

Scrum is based on lean thinking and empiricism and represents a framework for agile project management (Highsmith, 2009). In practice, the Scrum framework is generally applied by agile teams and includes associated events, roles and artefacts (Weiss et al., 2023). During set time periods called sprints, potentially deliverable increments are developed that can be validated by the customer (Sutherland and Schwaber, 2020). The continuous validation is accompanied by advantages of maintaining certain maneuverability in dynamic environments when dealing with change (Drutchas and Eppinger, 2022; Saleh and Watson, 2017; Wynn and Clarkson, 2024). The advantages result from gradually developing smaller parts (increments) of the project. These increments are presented to the customer, allowing feedback to be included in the product development process (Hannola et al., 2013). Thereby ensuring transparency and the effective allocation of resources and personnel (Sutherland and Schwaber, 2020) as the focus of planning activities concentrates on a time-boxed sprint length. Scrum defines three roles, namely the Product Owner, the Scrum Master, and the Developers, responsible for specific tasks. Moreover, Scrum teams are postulated to self-organize in designing and developing products. The Scrum Guide further defines artefacts such as the Product Backlog, the Sprint Backlog and the Increment. The Product Backlog describes the work prioritized in an emergent list. The Sprint Backlog contains the selected items of the Product Backlog that are to be processed during a sprint and correspond to the sprint goal. The sprint goal can be used as the baseline for project milestones and results (Drutchas and Eppinger, 2022). The Increment represents a concrete step towards the product or project goal and serves as a foundation for validation (Sutherland and Schwaber, 2020). Besides, the Scrum Guide also defines events linked to each other in a logical sequence. The Sprint Planning meeting initiates the sprint. Thus, the Scrum team establishes and creates the Sprint Backlog for corresponding execution during the sprint. During the sprint, the Daily Scrum serves as a routine, brief event for communicating obstacles, problems, and information to accomplish the sprint goal. The Sprint Review validates the sprint's delivered results, inviting stakeholders and communicating feedback to adapt future work. During the Product Backlog Refinement, adjustments are made to the Product Backlog based on new information and stakeholder feedback. For instance, new Product Backlog items can also be added. The Sprint Retrospective serves to increase quality and effectiveness, for example, through lessons learned. The Scrum team executes the described procedure recursively until the product or project objective is accomplished.

2.2 Project Monitoring & Controlling

Project monitoring & controlling ensures that project objectives are met while considering different parameters such as resources and time (Roock and Wolf, 2004). Subsequently, controlling ensures performance evaluation of predefined plans, taking into account the dynamics that occur during the project´s execution (Pellerin and Perrier, 2019). These processes take place at different management levels (Bukłaha, 2017). In principle, the planning process within product development projects is outcome-orientated, establishing the foundations for supporting control and monitoring processes (Wolf, 1989). Consequently, monitoring enables the identification and prediction of deviations (e.g., schedule delays and associated potential additional costs) if the risks known at the start of planning materialize or new risks arise in the course of planning (de Falco and Macchiaroli, 1998). Recognizing these deviations allows initiating appropriate feedback and control actions (de Falco and Macchiaroli, 1998; Frijns et al., 2018). However, irrespective of this consideration, a status reporting must take place. Project reporting, as an element of project monitoring & controlling, involves the transparent communication of information on the project's current status to managers of various decision-making instances (Thompson et al., 2007). Therefore, project managers are expected to provide timely and accurate reporting on, e.g., project key performance indicators, leading to a comparison between project expectations and the project's status. However, reporting material can vary and be open to interpretation. For example, project managers may act as agents for the organization's executives, but the inherent intentions are different (Kaufmann and Kock, 2023). According to (Kaufmann and Kock, 2023) this can lead to biased status reports, resulting in an over-proportionally subjective status estimate. For instance, project managers sometimes deliberately use their information advantage to prevent management from intervening because personal agendas are prioritized or personal needs still need to be satisfied (Iacovou et al., 2009). In this respect, subjective biases must always be considered and mitigated where possible. A valuable approach is the traffic light reporting system. Thus, different traffic light colors represent the statuses and thus report on the project's current status (Snow and Keil, 2002). The traffic light colors are defined according to the context and boundary conditions of the specific project. The red color typically signifies a need for top management involvement. In principle, project managers can utilize a traffic light system for the various methods and tools available and simultaneously offer the possibility for top management to remain informed about several projects by using a few initial colors (Coulter Iii, 1990).

2.3 Milestone Trend Analysis

The following section presents the Milestone Trend Analysis (MTA) project management method, which is suitable for all types of projects (Jana and Liběna, 2016). The MTA represents a specific method of project monitoring and is applied in various areas, such the automotive industry (Böhme and Meisen, 2021). In this regard, this trend analysis is based on predefined and scheduled milestones that serve as a blueprint for planning (Alam and Gühl, 2022; Lent, 2013). Milestones are fundamental 'outputs' of particular importance (Meyer and Reher, 2020) and thus differ from so-called gates (Cooper, 1990). Gates represent a test of specified criteria to support decision-making. Consequently, a decision is made on whether the project can proceed to the next stage. In industrial practice, gates often contain multifactorial checklists and therefore do not just refer to a single milestone. Furthermore, these terms are sometimes used interchangeably in practice. Nevertheless, the gates are generally linked to milestones (Cooper and Sommer, 2020). The MTA is used to monitor graphically the progress of project statuses and teams (Lucht et al., 2021). In this respect, the specific trend analysis is integral to project reporting. The MTA focuses on recognizing and forecasting schedule delays. For example, if the obstacles known at the start of planning become reality or new unknowns arise in the project´s progress. Therefore, companies use the method to check the value of the project based on milestones achieved and to monitor the corresponding metrics by implementing a traffic light indicator (Cooper and Sommer, 2020). This enables control interventions to be initiated through systematic monitoring. Basically, the MTA tracks critical key performance indicators such as the project schedule (Pellerin and Perrier, 2019) and is thus implicitly linked to the Iron Triangle. Nevertheless, every company also has additional monitoring data for its controlling purposes. There are two important preconditions for the application of a MTA: a) the individual milestones must be available in a logical, pre-planned and scheduled chain and b) the time interval between two milestones must be predefined (Alam and Gühl, 2022). Without this chaining through the schedule dependencies, future milestones could not react to the shift of the current milestone. Furthermore, no trend patterns would emerge without chaining (projection of the past). As illustrated in Figure 1, the trend patterns indicate delays or the planned adherence to milestones dates and the project target date (Lent, 2013). Figure 1 shows the Report Dates relating to the Planned Milestone Dates based on an abstracted example. The trend patterns arise from the continuous plotting of planned milestones with the corresponding reporting dates. The milestones are scheduled to be completed along the diagonal from bottom left to top right. Consequently, when the milestones intersect the diagonal line, they are achieved at the respective times. If a trendline runs horizontally, the planned milestone date is estimated in relation to the reporting date as predicted. When the trendline starts to ascend, it forecasts a temporal delay. Conversely, a downward-trending line indicates an estimated recovery of lost ground with respect to the schedule. A stagnation of project progress is visualized by a trendline running parallel to the diagonal. Various software tools support the MTA because of the method's simplicity, making it easy to automate. In multi-project management, practitioners have identified the benefit, as it allows program managers, directors and executives to quickly determine which projects require support (Coulter Iii, 1990). However, the knowledge required for the interpretation of MTA-charts includes the contained tasks in the checklists, which is not trivial. This is related to the fact that certain interlinkages of e.g. functional and non-functional requirements must be considered. We will discuss this in more detail later.

2.4 Burn Charts

Within Scrum, the burn-down chart is a common and frequently used visualization for measuring progress of teams. The visualization uses the backlog and the associated estimated values for effort or duration (e.g., story points). Thus it helps the Product Owner monitor the agreed increase in value or progress of the project (Dalton, 2019; Dinwiddle, 2009). Other variants measure the completion of the number of Product Backlog items (PBI). One frequently used chart within the Scrum application is the sprint burn-down chart (Lai et al., 2022). This chart visualizes the progress made within the sprint regarding the sprint goal of the Scrum team. Usually, the progress is discussed at the event of the daily stand-up meetings (Noor et al., 2012). The difference between a burn-down chart and a burn-up chart is that one displays the working / items remaining (burn-down), and the other one displays the work / items completed (burn-up) (Dinwiddle, 2009). Exemplary burn-down charts, as seen in (Noor et al., 2012), represent the remaining story points throughout the sprints, illustrating the concept of 'burning down' over time. Based on the assigned story points, which are intended to represent an objectively measurable state, it is possible to carry out more reliable progress measurements, as no long-term forecasts are made. Therefore, according to (Dinwiddle, 2009) it is essential to prioritize the processing of smaller tasks rather than starting larger work packages.

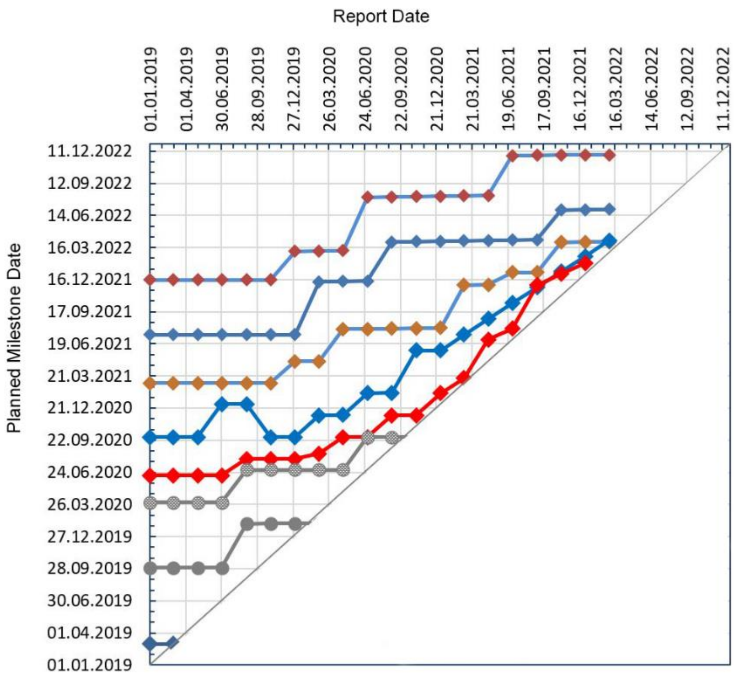

Figure 1: Example of a Milestone Trend Analysis according to (Lent, 2013), created within a product development project of a consulting project; eight milestones reported; authors are not allowed to share project data.

3 Research Approach

In the present contribution, we adapted action research and generalized the lessons learned from transformation projects, as the specific results are not the subject of the investigation. The transformation projects involved transitioning from traditional to agile project management approaches. The companies involved aimed to develop mechatronic products such as vehicle gearboxes and control units for machines or systems. However, problems arose during the transformation, which were solved by consulting projects. The consultation projects were the exchange platform for the underlying research work. Thus, the primary motivation for using action research is to support practitioners collaboratively in improving processes or products while obtaining additional research insights (Staron, 2020). In this process, various steps are followed, namely diagnosis, action planning, intervention, evaluation, and learning, to achieve the intended improvement (Davison et al., 2012). According to (Staron, 2020), these steps can be simplified into two alternating activities between the observation part (problem statement) and the intervention part (solution approach). The underlying research process is outlined in Figure 2 and described in more detail in the following.

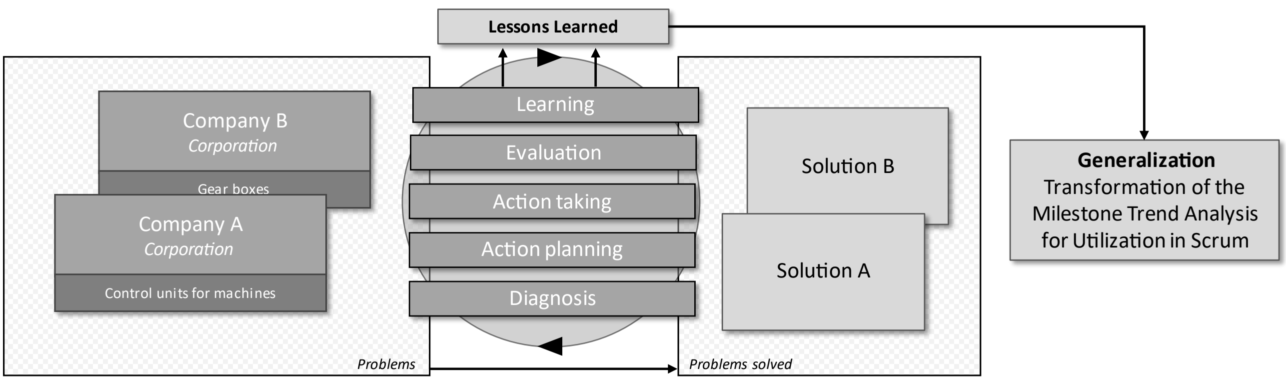

Figure 2: Research approach.

3.1 Problem Statement

In supporting transformation projects from traditional to agile project management approaches, recurring phenomena and patterns were observed among mechanical and plant engineering customers. The companies mentioned above were challenged to apply the established MTA method for project monitoring in the 'new' Scrum environment. The MTA was an established and essential project monitoring standard in all the accompanying companies to initiate focused control interventions and actions. The representations were standardized using file templates for populating project reporting, or there were IT-supported project management systems in which the MTA representation was automatically generated. Note that the milestones are linked sequentially, i.e. in practice, milestone 2 is not considered separately from milestone 1. The implementation of Scrum led to a decoupling of project planning and execution in sense of traditional project patterns by introducing backlog work, Sprint Planning, and the definition of increments. This approach does not include defining project milestones and timelines for the entire project duration. In fact, this even contradicts Scrum's methodological logic. Thus, the Scrum framework focuses on the content-related design and development work for creating product artifacts, the so-called Minimum Viable Products (MVP) which are closely related to the increments, to obtain customer feedback. This progressive approach enables agile teams to elucidate customer expectations and conceptualizations at an early stage, facilitating the ongoing validation, adjustment, or alteration of product requirements. In contrast, the tracking of predefined milestone content and its alignment with schedule targets in plan-bounded, linear progress monitoring encapsulates the inherent logic of the waterfall model. As already indicated, in the application of Scrum, the traditional fixation of requirements through fixed milestone content and associated gates throughout the entire project duration presents a contradiction. This contradiction is linked to the mentally linearized process scheme and the comprehensive planning at the beginning of the project. However, comprehensiveness and completeness are relative attributes, especially when considering dynamic environments. The MTA represents this linear planning paradigm, grounded in the assumption that all milestones and dates can be pre-defined. However, retaining the MTA as an established method or abolishing the MTA during the transition to Scrum results in effects at various levels of control: a) Within the Scrum team, the requirement for MTA reporting limits or even suppresses the desired agility in item prioritization (Product Backlog) and Sprint Planning (Sprint Backlog). The Scrum team is in constant conflict regarding its management task. b) At the management level, confusion arises when applying Scrum due to a significant increase in interim results (MVPs) compared to the typically considered number of milestones and gates. For example, in a project with a duration of 36 months, a Stage Gate approach might propose five gates, whereas in a Scrum project of the same duration, there could be 12 MVP steps spread across quarters. As a result, MTA charts can become confusing. Furthermore, the representation is no longer achievable through MVPs since the contents of MVPs are not precisely planned for the duration in the targeted contexts mentioned above. These findings raise concerns (e.g., loss of control) at the management level. Similar concerns from the industry were documented by (Michalides et al., 2022). In all cases of transformation projects, highly detailed target criteria catalogs (checklists for each milestone) were available for milestone fulfillment or gate decisions. These directives were obligatory for employees to incorporate into project planning and execution. The application of those could result from employees' habitual practices, internal quality standards, following project management standards, or complying with quality management requirements in product development. Requirements for certification and licensing procedures were also important. With these insights as a foundation for understanding the problem, the goal was to design an adaptation of the established MTA method. This adaptation aimed to preserve the acceptance of previous milestone content as relevant backlog content and avoid limiting self-organization and agility in determining sequences of design tasks.

3.2 Solution Approach

To methodically address the problem and its associated objectives we adapted the action research (Staron, 2020) and the problem-solving cycle proposed by (Ehrlenspiel and Meerkamm, 2017) involving an iterative process of analysis and synthesis. We employ analogous thinking by considering the purpose of milestone contents to make sure that the content elements (PBI) are equally addressed. Generally, thinking can be understood as an ability to engage with perceived information from the environment regarding reality and actuality (Ehrlenspiel and Meerkamm, 2017). As a result, backlog contents and milestone contents could be abstracted and compared. Following (Gurteen, 1998), creative dialogues and workshops were conducted while searching for solutions to avoid potential confrontations akin to a discourse. The aim was to listen to positions and understand associated blockades. Within this process, we discussed and reflected on different variants, which led to utilizing the MTA method in agile product development projects. This iterative process led to the specific solutions and the lessons learned within the projects. This resulted in a generic transformation algorithm that made the MTA effectively usable for the Scrum framework. The result is the Increment Drift Analysis (IDA), as illustrated in Figure 3. The transformation algorithm and the results are explained subsequently.

4 Results and Transformation Algorithm

Collaboratively analyzing the purpose of milestone content, sequences and the corresponding value-added progress for the company enabled the resolution of the contradiction and conflict. The individual criteria for each milestone and the results demanded are significant success factors and represent unique knowledge relevant to competition. In total, they constitute quality knowledge for generating customer value within the given product context. The contents of the milestones are often separated into non-functional requirements (e.g., quality list) alongside functional requirements (e.g. another lists). These requirements are rigidly linked within the milestones. This link is removed by breaking down and taking changes into account.

The initial transformation step included defining time frames with the design teams based on Sprint Planning. In this abstracted example, we set a current calendar scaled to quarters (horizontal axis, Report Date). This results in the MTA time frame aligned with quarters. Each reporting activity thus has an equal duration, establishing a fixed rhythm for the reporting. Conveniently, the duration was always a multiple of a sprint length to maintain consistency. Consequently, the example depicted in Figure 3 illustrates one increment per quarter. The vertical axis (Planned Increment-Date) is uniformly scaled, resulting in a symmetrical representation. Within a quarter, sprints could take place, allowing the Scrum team the freedom to formulate short-term plans (Sprint Backlog) from the Product Backlog. The freedom to prioritize allowed the team the maneuverability to decouple the rigid linkage between non-functional and functional requirements within milestones. As a result, this led to a constant reprioritization of sprint tasks without permanently tracking work that wasn't in process (e.g., non-functional requirements). The tracking of non-running design tasks often led to problems in specific mechatronic product development projects. Aggregately, as depicted in Figure 3, this led to a formal dissolution of milestones, ensuring that only the actual contents in development are reported on the project progress. Building upon this, the stage goals (increments) represent the prioritized items for the relevant stage (comprising multiple sprints). These items consist of the content associated with the different milestones. The team decides at which stage the milestone content is included in the process based on customer feedback. The increments (stage goals) are plotted as points on the diagonal, as shown in Figure 3. In this example, incomplete increments are visualized as red points, while completed increments are represented as green points. Generally, incomplete increments are undelivered increments in most cases. The color coding corresponds to the traffic light logic. In summary, all points on the diagonal line are connected to specific backlog states and indirectly to sprint planning.

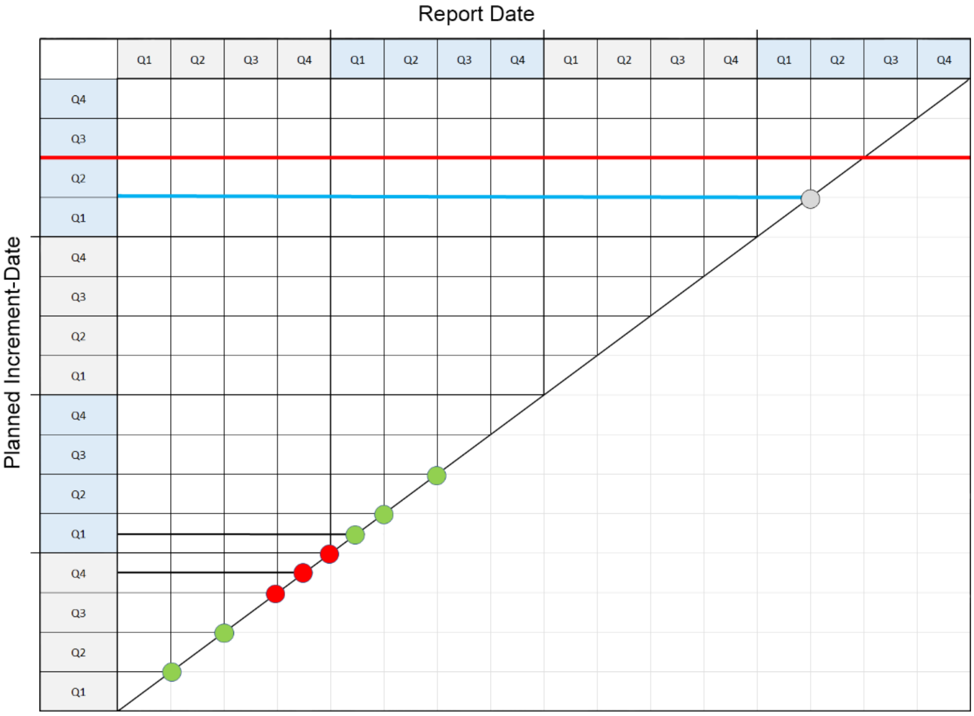

Figure 3: The Increment Drift Analysis; the planned end date is represented by the blue line; the shift in the target date is represented by the red line; the distance between the red and blue line is the drift; Milestones are resolved by separating sequence and breaking down content; stage goals (increments) are the points on the diagonal line.

However, in reality, numerous constraints exist, leading customers and stakeholders to express the desire that fixed states of the product should be achieved on specific time slots. Consequently, when needed, a staging point can be designated with a distinctive symbol, such as a diamond. Hence, an externally specified customer need, for example, after seven quarters, can also be incorporated into the diagram, as illustrated in Figure 4. In such a case, the target requirements must be aligned with the backlog contents, as implicit dependencies exist.

In addition, another practical adaptation step emerged, which is also visualized in Figure 4. By mirroring the adapted MTA representation along the horizontal axis, a descending diagonal was formed, resembling the burn-down chart. The upper-left corner in Figure 4 signifies the project's starting point, while the lower-right corner represents the project's target time. The color coding of the stage points continues to encode the completion status of the backlog and the fulfillment of Scrum team´s commitment. The control of fulfillment of commitment allows the team to evaluate a sense of their estimation accuracy as a lesson learned. In contrast to the burn-down chart, the progress of the project represented is not determined by counting the items (burn-down velocity – story points), but rather at the level of a goal-item quantity aggregated at the stage point.

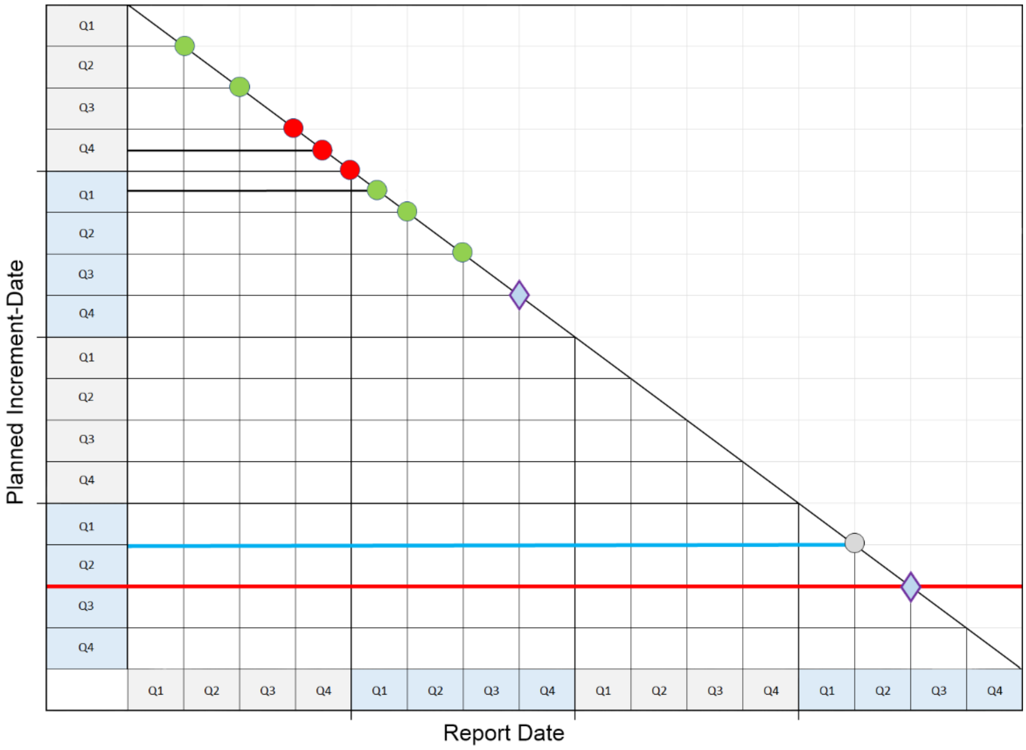

Figure 4: Increment Drift Analysis mirrored horizontally (Figure 3); customer need (diamond) added as an external constraint, need to compare target requirements and backlog content is crucial; planned end date is represented by the blue line; shift in target date is represented by the red line; the distance between the red and blue line is the drift.

4.1 Abstracted Example

Since the results are still very abstract, we will give an example. In a simplified manner, it is assumed that a vehicle is to be developed in Country A. A Quality list exists which is a part of the Milestone, containing requirements and criteria that should be met at each milestone for designing and developing the vehicle. We stress once again that in the industry are often several lists from the departments that address different contents for the product. Based on this list, decisions are made at the milestone as to whether or not the gates can be passed. It is not uncommon for the gate to be passed anyway if the degree of fulfillment of the requirements is less than 100%, resulting for example in the curves shown in Figure 1. However, it is important to note that e.g. additional requirements and criteria arise from the items on the quality list, and these may not necessarily be known. If all requirements were actually known, the agile approach would be obsolete as a plan bounded approach would probably fit better. In any case, the quality list in one milestone, for example, consists of 20 points that must be fulfilled, see Figure 5. Such a point could be the need to conduct homologation for the Asian market. For the homologation of the Asian market, there is again a checklist consisting of, for example, 30 additional check points. Note that the non-completion of one of these points already leads to the milestone not being achieved. For the transformation from MTA to IDA, these checklists must be used, decomposed and analyzed by Scrum teams. The analysis and decomposition are performed to transfer the checkpoints into appropriate product backlog items. This process eliminates the milestones while also acknowledging their content. However, this decomposition must be carried out in such a way that it fits into the logic of the backlog, for example, through user stories, tasks, or other technical specifications. Once the Product Backlog is created, individual Sprint Backlog items can be prioritized through the typical Sprint Planning process. Sprint items that could not be completed are automatically returned to the product backlog, enabling the tracking of their actual unfinished work. As a result, this mechanism means that the actual work statuses are tracked via the backlogs. This also means that the tracking of uncompleted milestone tasks is prevented if the corresponding milestone has already been passed. This mechanism is also outlined and visualized in Figure 5. It becomes evident that transparency is necessarily increased.

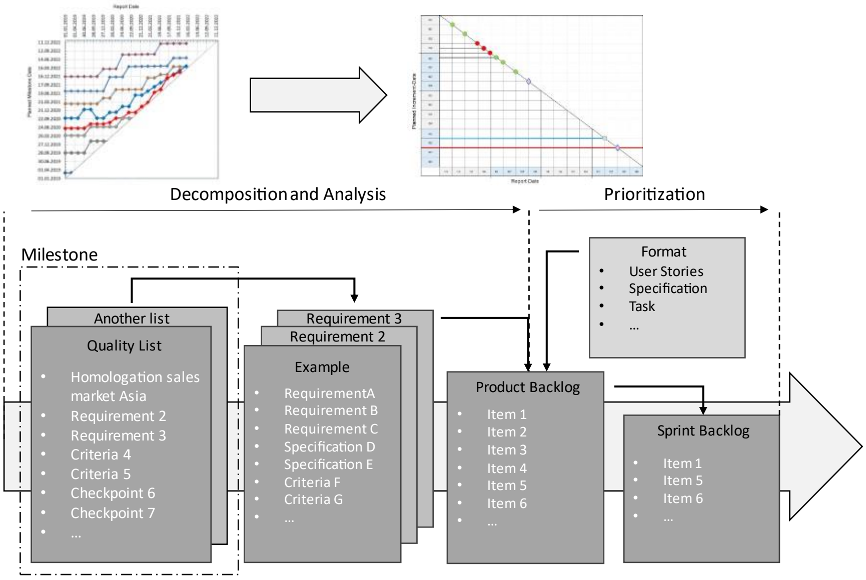

Figure 5: Example of work required for transformation; note: the industry uses a variety of terms for the milestone content.

5 Discussion

The present article transforms the well-known plan-driven MTA for practical use in combination with the Scrum framework. This contribution introduces a modified MTA referred to as Increment Drift Analysis (IDA). The name of the drift is derived from the permanent shift between the blue and red lines in practice. The described transformation steps separate the typically rigidly linked milestone contents, leading to the dissolution of the conventional milestones (see Figure 3 and Figure 5). This allows hiding the trendlines, as each increment (ideally MVPs) is associated with an implicit backlog state. However, we argue that milestone contents encompass pertinent and crucial knowledge for quality assurance and market knowledge. At this point we want to highlight, that it is self-evident that specific certification standards (non-functional requirements) must be met. Consequently, the requirements remain in the Product Backlog, but the team can actively prioritize them throughout the project within sprints and stages. In combination with the display following traffic light logic, increments are intuitively tracked and reported. In principle, each stage (increment) should correspond to an MVP so customer feedback can be collected and integrated appropriately. If a stage goal or release is at risk, it turns yellow, or red if not achieved. If a stage goal is not reached, project monitoring & controlling can implement targeted control interventions and actions. Either the next stage goal is adjusted, necessitating the reprioritization of stage contents, leading to the revision and refinement of Product Backlog items. Alternatively, the reporting frequency is increased, garnering heightened attention at the management level (promoters) for the project. Both variants of control interventions involve risks and opportunities. Control interventions carry the risk of micromanagement, potentially significantly restricting self-organization and self-accountability within teams or departments. On the other hand, there is also the opportunity, through a purposeful intervention, to adjust and sharpen the team's focus through intentional communication, which could be an expression of a new leadership behavior. The second point is a very worthy aspect to investigate. In this context, we pondered whether there might be analogies, especially those dealing with leadership and management in dynamic contexts. For instance, an intriguing analogy could be drawn from the leadership behavior of military personnel or other emergency responders. Returning to the IDA, this type of diagram is similar to the well-known MTA representations, promoting acceptance in transformation projects. In contrast to the burn-down chart, project progress is not determined by counting items (burn-down velocity) but rather at the level of a target item quantity aggregated in the staging point. Project progress is measured differently and, therefore, represents a differentiation. However, this reveals a critical ability of the team. The team's forecasting ability serves as an indicator of the most crucial success criterion: customer satisfaction. When the forecasting ability is accurate, trust can be placed in the team and the allocated resources. In cases where erroneous forecasts threaten the project, targeted control interventions and actions can be applied to guide teams without entirely relinquishing self-organization. However, this requires a leadership approach that is situationally aware, supportive, and adaptive. Furthermore, there is a need for an environment to gather experience and establish learning loops. With Increment Drift Analysis, it takes time for the original milestone contents to become apparent. This necessitates a shift in thinking and encourages stakeholder involvement in deliberating and realizing the stage goals. Practice consistently demonstrates that milestone contents deviate from the planned content with 'catch-up specifications.' These deviations lead to a mere symbolic representation of milestones that do not correspond to the actual project state. Short-cycle reporting enhances the ability to make immediate adjustments and improves the likelihood of realistically forecasting estimated project states. The traffic light symbols within the MTA can be understood quickly and intuitively, thus reducing information overflow for management. In principle, the triangular representation can be further simplified, as the vertical axis (Planned Date) grids correspond to the horizontal axis grids (Report Date). The simplification allows the illustrations shown in Figure 3 and Figure 4 to be converted into simple progress and monitoring lines (not shown in the article). Also allowing managers to access different (aggregated) 'project' lines. However, the mirroring on the horizontal provides a better analogy to the burn-down chart in agile project management or agile product development. Therefore, the illustrations have yet to be simplified. From a methodological perspective, we can demonstrate that the IDA is a generalized case of the MTA. An explanation for this lies in the MTA's fixed linkage of contents (e.g., functional and non-functional requirements). Because of the interlinking, specified requirements are established within a predefined time frame, regardless of the actual development progress or other related conditions. This logic almost inevitably leads to the non-fulfillment of milestone deadlines when the product development task is exclusively associated with searching for solutions. Conversely, this linkage proves advantageous when leveraging existing domain expertise for product development repetitions or, e.g., adaptation developments or cars, allowing project teams to narrow their focus exclusively on solution-seeking.

6 Conclusion

In this article, we proposed a transformed MTA named Increment Drift Analysis. By transforming the MTA into the foundational pattern of the burn-down chart, we obtain a tool consistent with agile project management for progress measurement and goal attainment forecasting. In this regard, the contribution complements the existing literature on agile project monitoring & controlling. The IDA uses intuitive signals of deviation (traffic light, stage, drift). As a tool, the IDA avoids the need for workarounds in interpreting actual status conditions (traffic light switches) and the associated risk of whitewashing in reporting. Additionally, we showed that Increment Drift Analysis can be considered a general case of Milestone Trend Analysis, from a methodological perspective. We believe that the IDA supports manufacturing companies in their transformation to agile product development, as the IDA is derived from a well-known established method MTA. More specifically, the IDA even replaces the MTA on monitoring those projects. Even though the emphasis was on agile mechatronic product development, there is an exciting opportunity for future research to examine additional aspects more closely. Further work could involve digitizing tools that execute transformation matrices, automatically converting objectives content with interdependencies during adaptation. Furthermore, we suggest more focused research into the prerequisites for creating an environment where a leadership culture that supports the transformed MTA (the IDA) is established. Moreover, further use cases for evaluating the method shown here would be interesting, as the generalization for developing this method represents a limitation as a higher saturation would lead to broader acceptance. Therefore, further work is required to test this method in practical application. We invite scholars and practitioners to join us in discussing and investigating these environments.

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