

Review of MAX IV's project management

Report by appointed audit committee to the
Swedish Research Council, August 2018

PREFACE

The Swedish Research Council (Vetenskapsrådet) is a governmental agency with the responsibility to support basic research of the highest scientific quality in all academic disciplines. It is also part of the authority's remit to evaluate research and assess its academic quality and success. The Council for Research Infrastructure (RFI) at the Swedish Research Council has the overall responsibility to ensure that Swedish scientists have access to research infrastructures of the highest quality. Specifically, RFI assesses the needs for research infrastructures in a regularly updated roadmap, launches calls and evaluates applications, participates in international collaborations and works on monitoring and assessments. MAX IV is a synchrotron facility under construction and partial operation in Lund, Sweden, of which the Swedish Research Council/RFI is the largest funder. The laboratory is building on the success of its predecessor MAX-lab.

Upon a special request to MAX IV the Swedish Research Council have recently received a report showing significant delays in the build-up of the beamlines; these must be in place to serve the user community. In light of the seriousness of the situation presented therein, RFI has seen it necessary to quickly review the project management structure within MAX IV. To aid with this task an audit committee has been appointed and a review was performed in mid-July 2018. The expert members of the audit committee were Torbjörn S. Holmström, Thomas Allard, Jonas Modéer, Zahid Hussain and Wolfgang Drube. The Terms of Reference issued to the committee is here attached as Appendix 1 (page 8). The Swedish Research Council would like to express its sincere gratitude to the committee for devoting their time and expertise to this important task. The Swedish Research Council would also like to thank the representatives of the MAX IV laboratory for partaking in the interview sessions and the management for providing the necessary background material and giving informative presentations at the meeting with the audit committee.

Stockholm, August 2018

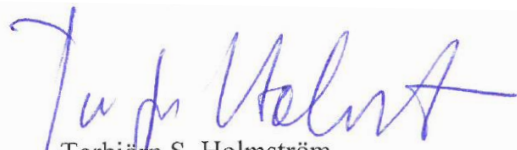


*Secretary General for
Research Infrastructures (RFI)*

TO THE SWEDISH RESEARCH COUNCIL

The present document presents the views and assessments of the audit committee members. By signing they take full responsibility for the report. The Chairman and secretary confirms that the work was conducted in accordance with the statutes of the Swedish Research Council and that it was performed in an impartial manner.

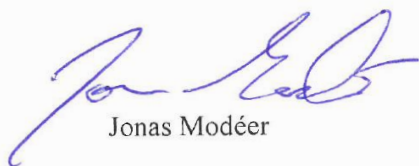
Lund, July 2018



Torbjörn S. Holmström
Chairman



Wolfgang Drube



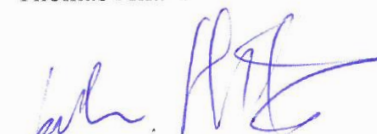
Jonas Modéer




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EXECUTIVE SUMMARY

The audit committee has identified several points of concern which it identifies as the main reasons for the significant delays in the MAX IV beamline project (2-2.5 years for several beamlines), and which it believes will continue to generate new delays if not dealt with properly. Most seriously, the organization does not employ a proper project management structure; the interactions between the line management and the project owners, with a well-defined method of allocating resources, are not properly set up. As a result, no resource-loaded work schedules have been (or can be) produced. Such schedules are key to running complex projects in a timely manner. The audit committee is concerned about the apparent lack of insight by management into these needs as well as into the complexity of the required project management procedures, and finds that management lacks the appropriate sense of urgency in view of the large delays.

Despite being asked by the Swedish Research Council, the audit committee cannot comment on the credibility of the latest timeline for beamlines produced by the lab, as such an analysis would inherently require resource-loaded schedules. Until such are produced the credibility of the newly presented timeline cannot be considered high. It is also striking that the economic follow-up systems do not allow for back-tracking of staff resources spent on delayed beamline projects. Thus, it is not currently possible for the laboratory to inform funders about how much of the spending intended for operations are in reality put into delayed projects.

Finally, the audit committee hasn't found evidence that the MAX IV board has taken appropriate action to recover the project delays. It finds that the interaction between management and its board needs to be more strict and a clear chain of command must be established.

Corrective actions must be urgently taken by MAX IV's management to complete their remaining delayed beamlines in an accelerated manner. The Committee believes that the task is difficult but not impossible and gives a number of recommendations for possible routes of action.

REPORT FROM AUDIT TEAM

Introduction

MAX IV is the first synchrotron radiation facility that has incorporated the multibend achromat concept in their storage ring design to produce near diffraction-limited emission of radiation ranging from soft to hard X-rays. The resulting small and coherent beams open the possibility of a new class of science. MAX IV, as a pioneering facility, has the opportunity to capitalize on their pioneering effort if they complete their beamlines and start the science users program in a timely manner. The rest of the world's synchrotron radiation facilities are currently copying the same novel concept and may be further refining it. These upgraded facilities will start their user program beginning around 2021 (ESRF, Grenoble), and others are coming online soon thereafter, e.g. 2023 (APS, Argonne). Therefore, there is a *small window of opportunity*, which the Committee is afraid that MAX IV may lose because of the significant delays in the beamline build-up. The build-up of several of the first 7 beamlines, i.e. the so-called Phase-I beamline package, is facing up to 2 ½ years delays and this situation could potentially worsen further. In addition, due to its facility upgrade the ESRF will not be available for the user community in 2019/20, which even more calls for an urgent start-up of the remaining MAX IV beamlines.

Despite the severity of the situation (where ~350 scientist are already are waiting to get access to the facility), there appears to be a lack of sense of urgency within management. The audit committee has found that the main problems for the laboratory to produce and follow reliable time schedules is the lack of *proper project management procedures* – this is described in more detail below.

Origins of the delays in the beamline projects at MAX IV

From discussions with management and members of the laboratory staff the audit committee got the impression that the original time-planning of the Phase-I beamline package had been presented as a way of selling the project to the funders, rather than being a realistic estimate. It was more put together as a “wish-list” rather than based on a realistic project-planning model. Furthermore, the project seems to initially have been relying on a principle of “self-organisation” rather than a proper way of dealing with projects. In a report from MAX IV to the Swedish Research Council the following statement can be noted that well describes the dangers of such an approach; “Originally there was no distinct prioritisation order between the different projects and they were handled on a ‘first come first served’ basis.”¹

Given the unrealistic scope of the original application the risks of delays were apparently already discussed within the lab from the start of the Phase-I beamline project back in 2011. A lack of some critical resources were early observed, especially within radiation safety and IT, which indeed have turned out to be severely limiting progress, and is still so to this day. In order to avoid the early-on identified resource limitations to cause delays, they should have been dealt with when they first were apparent, already back in 2012. According to the director, these issues were presented to the MAX IV board, which gave management the permission to delay the projects in order to stay within budget.

Also going further, there have not been any proper project management procedures put into place – the audit committee sees this as the main origins of the delays in the beamline projects at MAX IV. As there is no functioning structure of how line managers interact with project owners there is no clear way of how to efficiently allocate resources within the laboratory. This is still the case today, seven years into the Phase-I beamline projects, and the laboratory has still not been able to produce resource-loaded schedules which are completely crucial for managing projects of this complexity.

The prioritization mechanisms at the lab appears to have been dysfunctional for a long time. In the same report as cited above¹ one can read: “At occasions when the same specific resources were requested at the same point in time, there have been uncertainties on how to prioritise.” This is serious, especially when the boundaries of internally competing projects often are somewhat unclear. Scientists tend to be innovative/revolutionary in their thinking, which if not managed properly continuously expands the scope of the individual project. However, for

¹ “Status of beamlines at MAX IV, May 2018” – report from MAX IV to the Swedish Research Council (Dnr: STYR 2018/777)

timely completion of the project R&D effort needs to be separated and limited from the beamline and associated experimental station development – this requires effective prioritization policies to be in place.

From the interviews with management and staff it has furthermore become apparent to the audit committee that the current organisational structure shields the management from the information flow from the floor. Despite MAX IV being a relatively small organisation (235 employees) there are a large number of steps (intermediate group leaders, committees and managers) that information from beamline personal has to go through before it can reach the top management and the director. Thus, information about unsuitable consequences of the decisions by management doesn't seem to be returned to the top of the organization. MAX IV is currently structured as a fully operational facility but considering the fact that there are more beamlines under construction than operational the organisational structure does not properly support the reality on the floor.

Changes required to minimize impact of delays

A strong project management process urgently needs to be introduced at MAX IV. A professional project program manager with the highest authority within the organization needs to be installed that directly reports to the director and the MAX IV board. The line management structure furthermore needs to be revised/clarified to guarantee efficient and transparent resource allocation. In conjunction with this, proper project management tools needs to be put into place that connects the elements of time planning, resource-loading and the economic follow-up – but this cannot be done within the systems employed today. The organization should possibly also be changed in order to more clearly match the needs of the new project management structure – for example, common pooled resources (e.g. engineering, KITS, etc.) could be placed under an own umbrella and not be spread out throughout the organization.

The audit committee finds it impossible to properly answer the question whether resources are effectively used in all parts of the organization, and how they could be re-directed if this is not the case. This is because there are no systems in place to follow the real allocation of resources or the economical ramifications. This can only be mitigated with the proper tools, including the right data systems to link resources and economy.

The audit committee has concluded that the overall build-up and installation schedules are not sufficiently detailed to understand critical paths. This is a direct consequence of that work schedules are currently not resource-loaded. While it is very likely that this practice is the origin of many of the delays, it is not possible to investigate this as deviations from a resource-loaded schedule cannot be tracked. Furthermore, the audit committee notes, based on the various interviews with staff, that the perception of the scheduling and the level of project management is not consistent within the organization.

The audit committee has tried at great length to understand whether the recent steps taken at MAX IV to reprioritize resources are sufficient to deal with the issues at hand. The management has repeatedly commented that that they strongly believe they now can effectively deal with the delays. However, the audit committee could not find any evidence of any clear effects of the reprioritization, especially given the lack of resource-loaded scheduling.

The newly presented timeline for beamline projects

Given the lack of resource-loaded scheduling, resulting from improper project management procedure, the audit committee cannot properly judge the credibility of the new timeline – it is the committee's opinion that neither MAX IV's management nor its board can judge this. The only way to do so is to implement proper project management procedures, deliver resource-loaded schedules and critically evaluate them against the promised time-line.

Summary and recommendations

In summary the audit team has found several severe aspects lacking in the MAX IV organization that are required for efficient build-up of the beamline program and which it believes are the main reasons for the delays. Finally, in connection with this, the audit team would like to stress the need for broad communication in complex projects such as these. The lack thereof frustrates all stakeholders (funding agencies, universities, researchers, potential future international investors, etc.) and is particularly important when large delays are accumulating – MAX IV needs to dramatically improve its communication strategy and keep all stakeholders updated with an

increased intensity, not just providing good news but honest updates about delays so that realistic planning can be made by future users of the facility.

To sum up, the audit committee would like to put forward the following recommendations to MAX IV and its board:

- First and foremost, a professional project management structure needs to urgently be put in place, along the lines explained above.
- Proper resource-loaded schedules need to be developed. For the first 7 beamlines, where the majority of the projects are already executed, this should be done very rapidly which initially requires this to be done in a manual way. For the remaining long-term projects it should be done more thoroughly using best practices. Furthermore, weekly updates within the organisation about the various project status is essential so that management and staff share the same picture about the current state of affairs.
- When lack of resources is identified to risk causing future delays the information must be taken through a clear chain of command, i.e. via the lab's management to the MAX IV board which needs to evaluate how required funds might be allocated.
- Implement software so that the actual spending per project can be followed. Currently the Swedish Research Council cannot be properly be informed on what part of their operation support goes into the continued build-up of the delayed beamlines, which must change.
- Project (Beamline/s) management structure needs to be part of the organizational chart. Separate out operation (scientific staff, engineers, etc.) from beamlines development. Some staff may play role in both but it should be minimal and assignment for each section needs to be clearly defined.
- It is essential that specifically for all delayed beamlines there are strict control of any change in scope (of course, reducing the scope is fine if the user and stakeholder agree to it). The science continues evolving and as time passes project scientists are easily tempted to add new capabilities. This should be contained and left as future upgrades.
- All significant changes to the project scope and delays need to be effectively and timely communicated to both the funding agencies, other stakeholders, and present as well as future users.
- The board should be very active in the near future and have a mix of members that can judge the progress from both scientific and MAX IV-development point-of-view.

The audit committee suggest that the Swedish Research Council periodically follow up on the implementation of these recommendations.

APPENDIX 1: TERMS OF REFERENCE

Background

The financing of synchrotron and free electron laser sources for X-ray production occupies a large part of the budget of the Committee for Research Infrastructure (RFI, part of the Swedish Research Council). These costs amount to a minimum of 370 MSEK/year today, but are likely to increase further. Today, the largest cost in the area is by far the operation of MAX IV, the national Swedish synchrotron laboratory, of which the Swedish Research Council is the main financial contributor. The decision to fund MAX IV was made 2010 and the investments in the facility have been considerable; for the basic infrastructure and accelerator the costs amount to ~3 billion SEK and with the investments in the 16 beamlines (of which Sweden are funding 13) the total investment cost is on the order of 4.5-5 billion SEK. Furthermore, the running costs allocated to MAX IV from the Research Council is 310 MSEK/year, making it the single most costly scientific infrastructure project funded by the agency.

While the accelerator project was completed essentially within time and budget the Research Council have recently received a report from MAX IV (attached) showing significant delays in the beamline projects. While several origins of the delays have been indicated the complexity of the parallel build-up of a large number of beamlines appears to be a contributing factor.

Purpose and scope

The group should review the project management at the MAX IV facility with special attention to the beamline projects. The purpose of the review is twofold: Firstly, the Swedish Research Council needs to understand the origin of the recently reported delays at MAX IV and how they might best be addressed. Secondly, MAX IV should be given principle advice on how to rapidly restructure their project management in order to better utilize available resources.

The investigation will be led by a group of 3-4 persons and will be conducted during the period of June-July of 2018. The background material will consist of the attached report that MAX IV has submitted to the Swedish Research Council, along with a resource plan provided by the lab (to be sent to the group a couple of days ahead of the visit to MAX IV). The bulk of the work will be done at MAX IV, based on the interviews with management and other parts of the organization as the group sees fit. The findings of the group should be formulated in a brief report (maximum two A4-pages) to the Swedish Research Council and MAX IV.

Questions and perspectives

The following list of questions should be addressed by the group:

- *Origins of the delays in the beamline projects at MAX IV*
 - What are the main reasons for the delays from an organizational perspective?
 - To what extent could the delays have been foreseen and how should they then ideally have been dealt with?
- *Changes required to minimize impact of delays*
 - Are there organizational changes that need to be implemented in order to deal with the delays?
 - Should particular parts of the organization be strengthened (within existing budget)?
 - Are resources effectively used in all parts of the organization or could resources be redirected?
 - Is the overall build-up and installation schedule detailed at a sufficient level to understand critical paths? (i.e. resource needs, critical paths for each beamline as well as for the full program in full user mode, critical allocations of resources during parallel installations of beamlines)?
 - Should any projects/initiatives of the lab be reprioritized or terminated?
 - Are the recently steps taken at MAX IV to reprioritize resources suitable to deal with the issues at hand?
- *Newly presented timeline for beamline project*
 - How reliable is the new timeline given the current project management structure?
 - What procedures should be put in place in order to ensure that new timeline is kept?

APPENDIX 2: SOURCES OF INFORMATION

The conclusions drawn in this report were based on three main sources of information, namely; i) a set of documents provided by MAX IV beforehand to the audit committee, ii) presentations given by the laboratory management during the audit session with following discussions, and iii) interviews with a number of critical persons in the laboratory staff. The list of interviewees, which in part was compiled by the lab and in part by the Swedish Research Council, is:

- Christoph Quitmann, Director
- Marjolein Thunissen, New Life Science Director
- Ian McNulty, New Physical Science Director
- Katarina Jacobsson, Administrative Director
- Tomas Lundqvist, Departing Life Science Director
- Marie Andersson, Head of Finance and Office Services
- Katarina Norén, Group Manager Safety
- Darren Spruce, Head of Controls & IT
- Conny Sâthe, Group Manager Spectroscopy I and VERITAS Beamline Manager
- Thomas Ursby, MicroMAX Beamline Project Manager