

National Aeronautics and
Space Administration
Goddard Space Flight Center
Greenbelt, MD 20771



Reply to Attn of:

910

September 9, 1998

Mr. Douglas E. Forsyth
Deputy Director
1313 Halley Circle
Norman, OK 73069

Dear Doug:

Please find enclosed a copy of our final report. I hope you will find it useful. It was a pleasure working with the Panel members and all of you.

Best wishes.

Sincerely,

A handwritten signature in cursive script, appearing to read "Franco".

Franco Einaudi, Chief
Laboratory for Atmospheres

Enclosure

Report
On the
Norman Consolidation Building Project
By the
Independent Review Panel

August 5-7, 1998

Panel members:
Franco Einaudi, NASA/Goddard, *Franco Einaudi*
Steve Nelson, NSF
Colonel Jack Hayes, USAF

September 8, 1998

1. Background

Four organizations of the National Oceanic and Atmospheric Administration (NOAA) are formulating a plan to address critical facility deficiencies and to modernize and consolidate their facilities in Norman, Oklahoma. These organizations are: the National Severe Storms Laboratory (NSSL), the Storm Prediction Center (SPC), the Operational Support Facility (OSF), and the Weather Forecast Office (WFO). NOAA directives require that major construction projects follow the NOAA Project Development, Approval, and Management (PDAM) process. One of the steps in the process is a review of the program, functional, and facility requirements by an independent panel. The focus of the Independent Review Panel is on the rationale and logic of the programmatic and facility requirements as they relate to the mission and plans of NOAA. The review is required toward the end of phase one, planning, and before the beginning of phase two, scoping.

2. On the Process

The Independent Review Panel (hereafter, referred to as "the Panel") met for two and one half days, starting on the afternoon of August 5, 1998. The Panel received on July 14, 1998, background material that goes back to the report on the Norman Consolidation Workshop that was held in Norman, January 10-12, 1995. Appendix A is the list of items received prior to the

visit. Additional material was provided during the presentations or was requested by the Panel during the visit.

During the afternoon of August 5, 1998, Doug Forsyth and Don Raynor outlined the purpose of the visit and the charge to the Panel. Jeff Kimpel, Joe Schaefer, and Jim Belville described the mission and planning history for NSSL, SPC, and OSF, respectively. Ken Crawford of OU took the Panel for a tour of the proposed sites. During the morning of August 6, Dennis McCarthy described the mission and planning history of the Weather Forecast Office. The Panel then toured NSSL and SPC. In the afternoon, the Panel toured OSF and WFO and heard presentations by Kelvin Droegemeier, Dave Stapleton and Robyn Tower of the University of Oklahoma (OU).

Kelvin Droegemeier, director of the Center for Analysis and Prediction of Storms (CAPS), discussed the significance of creating the Oklahoma Weather Center on the South Campus of OU. Such a center would include the following components of the College of Geosciences: School of Meteorology, Department of Geography, Center for Computational Geosciences, Cooperative Institute for Mesoscale Meteorology (CIMMS), CAPS, and Oklahoma Climatological Survey. It would also include, if NOAA so chooses, NSSL, SPC, WFO, and the Applications and Training branches of OSF.

Dave Stapleton of the Office of Architectural and Engineering Services of OU described the status of the South Campus project and showed architectural drawings for a building that would house all of the OU units and, optionally, the NOAA organizations also. Additionally, Dave Stapleton discussed the possible construction, to the South Campus, of a distance learning/teleconferencing center and library.

Robyn Tower of the Development Department of OU described OU's plans for seeking \$ 15M from the Reynolds Foundation in Tulsa, OK, to create the Donald W. Reynolds Center for Meteorology and Scientific Research. The Center would serve as the cornerstone for the South Campus Education and Research Park.

The Panel spent the morning of August 7, 1998, going over the material received, and the presentations and discussions that took place during the visit. The Panel prepared the outline for the report and for the briefing provided to Don Raynor, Doug Forsyth, and the Heads of the NOAA organizations in the early afternoon.

3. Observations

The assessments of the Panel members are based upon the written materials provided, the tours of the facilities, and the specific presentations by the project team and the other speakers.

The Panel's focus was upon the rationale and logic of the programmatic and facility requirements as they relate to the mission and plans of the agency. Although the focus was not on detailed space allocations or costs, we first review below the staffing and facility requirements and other factors for each organization.

A. National Severe Storms Laboratory (NSSL):

1. Staffing Requirements: the NSSL briefing indicated nearly level staffing for the foreseeable future. Current staffing is 118; projected staffing in 2003 is 120. No further increases were indicated during our visit.
2. Facility Requirements: the NSSL briefing indicated growth in space requirements from 32,378 gross square feet (gsf) to 49,656 gsf. We were unable to determine from the materials provided whether or not the "current space required" figure included temporary office space (i.e., trailer space). Consequently, we were unable to determine how much real growth exists in the projected total space requirement.
3. Other Factors: the NSSL briefing indicated that there was no requirement to move the Cimmaron dual-polar Doppler radar as part of the Norman Consolidation project.
4. Observations:
 - a. The leased warehouse on public property (east of railroad tracks) is deficient in a number of areas.
 - i) Available space is not sufficient to store all research vehicles and equipment. Four vehicles were present on site, and it did not appear that there is room for the additional 2-3 vehicles, the mobile labs, and the Doppler on Wheels equipment that also must be accommodated. Equipment and cartons are being stored on top of an office area inside the warehouse--clearly, this area was filled to capacity.
 - ii) Environment within the warehouse is deficient. The building lacks air conditioning, which will make it difficult for staff to do the equipment work that must be done inside the warehouse during summer months. D. Rust also noted some water leakage during rainy weather.
 - iii) Security is a potential problem. D. Rust reported that there have been 3-4 attempted break-ins-though no damaged or lost equipment.
 - b. The NSSL lunchroom (main bldg.) is small, poorly ventilated and poorly located for access by the workforce (to gain access, one must either exit the building or walk through a conference room).
 - c. The work areas within the building are insufficient for the equipment technicians (EI). Staff offices in several areas have been converted to electronics and equipment fabrication areas (and contain soldering equipment, wiring equipment, etc... on desktops).
 - d. Offices on the second floor of the main NSSL building are overcrowded. Individual offices appeared to have reasonable square footage, but, so many have been located on the second floor that there is significant crowding. To accommodate the large number of offices, aisles are narrow (in one case, a long access aisle is only one-person wide). The appearance is one of exploiting every nook for office space. In addition, data and information file storage is spilling into hallways, increasing the congestion.
 - e. Due to space limitations, storage trailers have been converted into temporary office space to house additional offices, and these also are overcrowded. Information storage has spilled out into every nook. For the trailer located west of the main building, files and equipment are being stored in the old radome, which it abuts.

- f. Because of limited floor space, small computer assembly and testing is being done in a makeshift room within the old radome southwest of the main NSSL building.
- g. The dock area on the west side of the main NSSL building has minimal temporary storage space for staging of incoming and outgoing cargo. In addition, the space shortage problem was compounded when the building mailroom was relocated to the dock holding area.
- h. Several ad hoc storage areas for data, equipment, etc, were observed throughout all buildings visited
- i. In virtually all office areas, partitions are being used to provide some degree of privacy. This has created an environmental control problem in some areas where "hot" and "cold" spots result from the restrictions to airflow.
- j. Some of the office areas, in particular on the second floor of the main building, appear worn and in need of refurbishment.
- k. The entryway to the main building has unused space, but the design of the building is such that it would be difficult to use it to reduce the space shortage without creating a cluttered appearance.

B. Storm Prediction Center (SPC):

1. Staffing Requirements: The SPC briefing indicated a constant staff requirement of 40 personnel for the foreseeable future.
2. Facility Requirements: The SPC briefing indicated more space would be required. The updated space requirements slide that was provided indicated a total space requirement of 18,332 gsf. However, these requirements also included common area space shared with NSSL (e.g., restrooms) and we were unable to determine from the information provided the amount of projected growth in space requirements.
3. Other Factors: None.
4. Observations:
 - a. Significant overcrowding exists in the SPC computer room. The net effect of dismantling AFOS and integrating AWIPS is a projected net increase in overcrowding.
 - b. Several (15) shift forecasters presently share five desks in a crowded room with modularized furniture. There is little, if any room to store personal reference information, etc.
 - c. Collaboration areas appeared somewhat crowded.
 - d. Because of space limitations, several offices and a conference room are housed in a trailer connected to the main building.
 - e. The SPC training area is an open office area and not well suited for training purposes-lacks privacy and quietness.
 - f. An ad hoc area outside the forecast operations area is used to provide media access. This area is too small and limits access to the observation window. Joe Schaefer reported that this area was particularly crowded several times this past spring with the media attention during tornado season.

- g. Dedicated ET workspace does not exist within the SPC portion of the building. Staff offices are being used for computer maintenance, etc.
- h. Use of modular furniture to create additional offices in larger rooms has created an environmental control problem. Several "hot" and "cold" spots exist in office areas on the north side of the main building.
- i. Storage of data and records in hallways and aisles increases the congestion.

C. Weather Forecast Office (WFO):

1. Staffing Requirements: The WFO briefing indicated a slight reduction from 31 to 26 persons. In addition to NOAA staffing, the WFO also employs 2-3 meteorology interns from Oklahoma University on an aperiodic basis.
2. Facility Requirements: The WFO briefing did not include any specific space requirements data. However, Dennis McCarthy indicated that no growth in required space is anticipated. His primary interest is in being collocated with the other NOAA organizations.
3. Other Factors: Rawinsonde operations must be collocated with the WFO because they are part-time operations.
4. Observations:
 - a. Most areas viewed did not have any overcrowding or other facility problems.
 - b. The ET work area was overcrowded; this was caused by a modification, which changed a portion of the ET work area to a computer room to house WSR-88D and AWIPS equipment.

D. WSR-88D Operations Support Facility (OSF):

1. Staffing Requirements: The OSF briefing did not include specific staffing requirements information.
2. Facility Requirements: The OSF briefing did not include any specific space requirements data. Jim Belville indicated that space was not a problem; his biggest concern was the split of his organization between North Campus Research Park and the South Campus office building.
3. Other Factors: The OSF briefing indicated that, regardless of the Consolidation scenario selected, existing OSF radar sites and supporting engineering should stay at Research Park because of the high cost of relocating the radars.
4. Observations:
 - a. Space at both the Research Park and South Campus facilities seemed sufficient to support existing mission requirements.
 - b. Some office areas have been converted to ET work areas because there aren't any dedicated ET workbench areas in either the Research Park or the South Campus facilities.

4. Assessments

A. NSSL: NSSL needs additional floor space to relieve overcrowding, to get people out of trailers, and to provide additional storage. Some redesign of NSSL space use is needed to fix problems, such as the lunchroom and ET work areas, and to improve environmental control. Renovation or refurbishment of deteriorating office areas is needed.

B. SPC: SPC needs additional floor space to relieve overcrowding, to get people out of trailers and to improve storage and the utilization of space. A media room is needed, ideally, located adjacent to the forecast operations area. This media room could serve as a conference room when not in use for the media. Some redesign of SPC space use is needed to fix problems in areas such as the training room and ET work areas, and to improve environmental control.

C. WFO: WFO does not appear to require additional floor space. Some minor redesign or reallocation of floor space would improve space utilization.

D. OSF: OSF does not appear to require additional floor space at this time. Some minor redesign or reallocation of floor space would improve its utilization.

5. The Value of Consolidation

From the above analysis, it is clear that enhanced facilities are required for the NOAA components in the Norman area. The Panel understands that currently two viable scenarios are being considered:

Scenario A: Consolidation of NSSL, SPC, WFO and all of OSF into one building on the North Campus.

Scenario B: Consolidation of NSSL, SPC, WFO, and the applications and training functions of OSF and co-location with the University of Oklahoma Department of Meteorology on the University's South Campus. The remaining components of the OSF would be aggregated on the North Campus in either a new facility, refurbished existing facilities, or some combination of the two.

The natural question arises as to the value of co-location - both in terms of actual operating cost savings and in terms of product quality, whether that product is associated with operations or research. The Panel considered four categories of potential benefits of co-location:

- Economies of Scale Associated with Consolidation of Functions
- Value of Interactions between Research and Operations Groups
- Value of Interactions between NOAA and University Research Groups
- Potential Enhancement of Outreach and Educational Activities.

We will discuss our evaluation of these four categories under both scenarios.

A. Economies of Scale Associated with Consolidation of Functions

This is the only one of the four areas where actual operating savings to the government can be **quantified**. The Panel was presented with lists of activities and functional categories that could

be consolidated which demonstrated substantial thought has been given to this issue. A substantive analysis, however, does not exist. For example, a common library was one functional area listed for consolidation. It was not clear where potential savings are expected whether in personnel, consolidation of subscriptions, etc.

While perhaps it is premature to expect such a detailed analysis, the Panel finds that creative thinking about potential savings may not have advanced as far as it could. The Panel perceives potential savings in shared technicians, workbench space, tools and test equipment. It does not appear, however, that a sufficient plan has been outlined that would accomplish such a consolidation. There are internal NOAA and potentially NOAA/OU organizational barriers that must be overcome. The Panel strongly suggests, however, that NOAA and OU find the flexibility in their managerial systems in order to reap the maximum benefits.

The Panel perceives substantial savings in this category from just a NOAA consolidation (Scenario A). It is clear, however, that additional savings could be obtained with cost sharing with the University under Scenario B.- We view this to be especially true if both NOAA and the University continue to pursue a strategy of enhancing their observational (especially mobile) capabilities. The commonality of need here is substantial and sharing of resources is essential.

B. Value of Interactions between Research and Operations Groups

First of all, it should be noted that all the involved organizations have some level of ongoing research. The primary function of the WFO and the SPC, however, are operational in nature and these will be referred to as "operational" groups. The value to the nation of interactions between researchers and operational personnel has been clearly demonstrated over the years dating back to the co-location of the scientists at the University of Chicago and the local forecast office during the 1940's. The U.S. Weather Research Program (USWRP) has highlighted the need for integration of research and operations and accomplishing such interactions is a major thrust of that program. NSSL and the National Weather Service have a long tradition of productive joint efforts dating back to the Joint Doppler Operations Project (JDOP) of the 1970s. The JDOP and successor programs, for example, directly resulted in development of the WSR-88D radar system and the concomitant improvement in the delivery of weather services to the public. Additionally, the research community benefited greatly. The feedback to the researchers from the large operational 88-D verification data base from different climatic regimes has stimulated researcher thinking on the structure and characteristics of tornadoes and tornadic thunderstorms.

Productive collaborations continue to the present time. The Panel notes the planned and ongoing participation of NSSL and OSF staff in the operations of both the SPC and the WFO. Under either Scenario A or B there may be some incremental gains in researcher/operational personnel interactions due to improved working conditions and the co-location of some of the OSF staff with the other units. The Panel, however, would expect the level of interaction between NOAA research and operational staff to remain essentially unchanged.

The real payoff in this category will come from Scenario B. As with NOAA staff, there have been successes with productive interactions between the University and the various NOAA entities. Many NOAA operational staff members are adjunct faculty and the students have benefited from their guidance and teaching activities. Conversely, the operational groups have access to faculty and students. Students are often employed as interns and provide a ready

source of needed personpower. These interactions are not limited to meteorology, but also apply to engineering fields. On the Panel's visit to OSF-South, the Panel learned of a valuable antenna simulator that was fabricated by engineering students as part of a senior project. This device is still in use today and has been exported to various field sites.

Interactions between OU Faculty and NOAA operational personnel have been somewhat limited over the years. Enhanced testing and feedback of advanced numerical modeling techniques and rapid prototyping of other forecasting techniques are one immediate benefit that likely would accrue from co-location.

C. Value of Interactions between NOAA and University Research Groups

The history of interactions between the various NOAA research groups does not have the long history of the operations/research interactions described above. This is primarily due to the fact that until fairly recently, the only NOAA research presence in Norman was at NSSL. The NOAA-to-NOAA research interactions appear to be quite good and the Panel would anticipate a high level of activity under either scenario.

As above, the potential gain is in the NOAA Research/University Research arena. In the past, many joint research activities have been successful. The latest example is the Verification of the Origin of Rotation in Tornadoes Experiment (VORTEX) which was led by the NSSL and the University of Oklahoma. The field phase of VORTEX was recently completed and appears to have been extremely successful.

The important factor for this analysis is not the successes, but rather the activities that have not met expectations. In discussions with University and NSSL personnel, several joint activities were noted where progress was not optimal. One specific example was the minimal involvement of the NSSL scientists in the activities of the Center for the Analysis of Prediction of Storms (CAPS) at the University of Oklahoma. While the interactions were nontrivial, they were not at a desired level. Shortcomings include the low level of NSSL scientists' involvement in the development of the Advanced Regional Prediction System (ARPS) and the difficulty CAPS has experienced in obtaining wideband WSR-88D data from a number of radars near the Oklahoma region.

No one would maintain that these and other problems are entirely the result of a physical separation. Collaborations have and can go on under such conditions. There is little doubt, however, that physical separations are an impediment to be overcome. It is also a fact that the demand placed on everyone's time, including scientists, has increased. As this trend continues, the negative impact of physical separation likely will increase.

Another factor that the Panel wishes to emphasize is the role of "serendipity" in the research process. Almost every researcher with a long and successful track record can relay stories of important research efforts that began by happenstance—an unplanned conversation around the coffee station; a discussion that began during a map discussion. While the impacts of these unplanned encounters are difficult to quantify, the potential positive impacts are substantial and should not be underestimated.

The Panel envisions substantial opportunity for rapid advancement in the area of mesoscale numerical weather prediction over the next few years. The collective research community in

Norman is recognized internationally as being leaders in this research. It is the Panel's considered opinion, that scientific productivity will be greatly enhanced under Scenario B. The Panel believes that the co-location of the University and NOAA scientists and operational personnel will substantially enhance the Storm and Mesoscale Ensemble Experiment (SAMEX) and the development of the Joint Mobile Research Facility. The Panel considers both of these to be cutting edge activities in mesoscale meteorological research.

D. Potential Enhancement of Outreach and Educational Activities.

The various NOAA research and operational organizations have an obligation in the outreach and educational arena. These include K-12, college and general public educational activities. Consolidation of the NOAA entities would enhance the quality and efficiency of tours, lectures and other informal communications. Additionally, both the WFO and SPC have heavy media interaction responsibilities. Co-location of these groups could allow shared resources to handle this task.

Co-location of the OU Department of Meteorology and the NOAA entities has several potential advantages. The most obvious are increased NOAA personnel interactions with students as teachers, advisors, mentors and employers. These opportunities apply to both meteorology and engineering.

Under a shared facility, a large conference room suitable for hosting a small to medium -sized conference could be justified. While the Norman weather community is large, it is somewhat "off the beaten path." Hosting of conferences is one mechanism to help solve the isolation problem.

One planned component of Scenario B potentially will be of great benefit to NOAA. OSF has a heavy training responsibility which is being met primarily by distance learning techniques. As part of the new South Campus site, the University plans to develop a distance learning and teletraining center. This provides NOAA with a substantial leveraging opportunity.

6. Conclusions

- Is a facility change or improvement needed?

NSSL and SPC areas badly need additional space, renovation and redesign/reallocation; in addition, upgrade of the work environments for both is highly desirable. The OSF and the WFO have adequate space and their facilities are in good condition. However, both could benefit from minor redesign and some relocation of functionality.

- Was the planning consistent with NOAA's mission and strategic plan?

The Panel believes that the planning to date is consistent with NOAA strategic plan. The Norman NOAA organizations' activities are central to the Advanced Short-Term Warning and Forecast Services of the agency. In turn, these activities are an essential component of NOAA Environmental Assessment and Prediction Mission.

The planning is also consistent with NOAA desire to develop public-private partnerships for the expansion and transfer of environmental knowledge and technologies. The NOAA organizations in Norman have a strong relationship with OU that has the potential for becoming even stronger. In partnership with OU, NOAA laboratories can also enhance outreach activities that are an important element of all federal agencies strategic plans.

- Was the planning sufficient for the physical facilities and their location and was it consistent with NOAA mission and good principles of efficiency and economy?

The Panel believes that the planning was extensive and that the requirements for additional space and modernization are justified. A number of analyses and studies were carried out including the one commissioned from CDFM2 Architecture, Inc., of Kansas City, Missouri, in December 1995. CDFM2 identified seven possible solutions for the consolidation program. A market analysis for these options was carried out by James E. Summers of Bliss Associates, Inc., in the spring of 1996.

Recent development of this past spring will require further analysis. According to presentations and discussions with NOAA and OU personnel during our visit, the Panel understands that the President of OU decided to give number one priority to the construction of a new building for the School of Meteorology and associated research units. He also decided to approach the Reynolds Foundation in Tulsa for capital funds. In making that decision he was in part attracted by the possibility of NOAA considering the South Campus Research Park for its consolidation efforts.

- Does it seem reasonable that the project planning proceed beyond Phase I?

Yes, the Panel considers reasonable that the project planning proceed beyond Phase I. To help the process, the Panel wishes to make some specific recommendations outlined in the next section.

7. Recommendations

A. Summary document

The Panel believes that it would be extremely useful if the Consolidation Project were to write a Summary Document to describe the status of the project at this time. Such a document would have been very useful for this Panel. Indeed, the Panel wishes to recommend that such a document become part of the PDAM Process Template. This Summary document is different from the Decision Package that completes Phase I of the process.

The Panel suggests that the Summary document address the following five items:

- Space
 - i) For each NOAA laboratory the projected number of civil servants and non-civil servant personnel should be indicated.
 - ii) For each NOAA laboratory the present and requested office space should be outlined.
 - iii) For each NOAA laboratory the present and requested laboratory space should be outlined.

iv) A summary table for present and requested office and laboratory space should be outlined.

- Savings of space due to consolidation

- i) Space requirements, current and projected, need to be presented for all agencies-including OU-in a standard format. Additionally, each should include stratification in terms of functions that are common to one or more offices to permit a more thorough assessment of economies of scale resulting from joint use.
- ii) NOAA and OU should explore and assess additional opportunities for collaboration within a combined building or facility. The Panel thinks additional arguments for consolidation could be made in terms of cost savings accrued from such things as common computer operations and architectures, common local area networks operations, common communications, storage, etc.

- A more thorough assessment of current versus projected space requirements should be accomplished. Areas where space requirements growth is identified should be more thoroughly assessed.

- Research/operational advantages to NOAA

For the case of a consolidation with OU, an attempt should be made to summarize the present benefits to NOAA and the potential increase of such benefits if a consolidation on the South Campus were to occur. The following items should be considered: potential new research interactions with direct benefit to NOAA; increase of the role of students in the research and operational activities of NOAA; benefits in training and outreach activities.

- Research and teaching advantages to OU

For the case of a consolidation with OU, an attempt should be made to summarize the present benefits to OU and the potential increase of such benefits if a consolidation on the South Campus were to occur. The following items should be considered: number of NOAA scientists who are adjunct; number of NOAA scientists who advise students; number of courses taught by NOAA scientists; number of internships provided by NOAA laboratories for OU students; potential increase in research interactions.

- Cost analysis

The Panel suggests that an updated and improved cost analysis be carried out. This cost analysis should include not only total cost, but also an analysis of cost versus benefit in terms of the cost differences between acceptable scenarios. The cost analysis presented to the Panel discussed "additional monies" required to complete the Norman Consolidation Project in terms of total cost-and implied subtly and unintentionally that No Action is an acceptable alternative and baseline for comparison. Given the Panel's assessments (section 4) and conclusions (section 6), we believe that NOAA will need to take action to address facility shortfalls. That action will, because increased and improved space is required, result in an increase in operations and maintenance (O&M) costs over what NOAA has in its current

O&M budget for the four organizations. It is the increased O&M cost which should serve as the baseline for the cost analysis of the various consolidation scenarios.

B. Timing

The potential consolidation with OU (Scenario B described in section 5) introduces a new time scale in the process. The Panel understands from the information presented that the Reynolds foundation will make a decision by next spring. If NOAA wants to explore the South Campus solution, it must be prepared to act on a relatively short time scale. The Panel encourages the Consolidation Project to examine the possibility of raising this issue with NOAA upper management.

8. Additional Comments

The Panel sees strong potential benefits for the **South** Campus consolidation that is worth an economic premium. The benefits to the nation are financial savings, enhanced scientific productivity and technology transfer. The additional benefits that will accrue to the nation from co-location as opposed to just NOAA consolidation are substantial. There are, of course, limits to the reasonableness of an acceptable premium, but without budget numbers, it is not possible for the Panel to comment further at this time.

The Panel believes that both NOAA and OU have an extraordinary opportunity of creating an exceptional University/ Government partnership. Both organizations are very strong in mesoscale research and have a long and successful history of interaction. The collocation will increase such interactions and will create a truly unique concentration of talents. The collocation will also be unique in combining under the same roof basic, applied and operational activities in an area where success depends critically on the interactions of all three activities.