

# Knowledge Impact on Measurement: A Conceptual Metric for Evaluating Performance Improvement (PI) at the Kuwait Institute for Scientific Research (KISR)

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**Abstract**—Research and development R&D work involves enormous amount of work that has to do with data measurement and collection. This process evolves as new information is fed, new technologies are utilized, and eventually new knowledge is created by the stakeholders i.e., researchers, clients, and end-users. When new knowledge is created, procedures of R&D work should evolve and produce better results within improved research skills and improved methods of data measurements and collection. This measurement improvement should then be benchmarked against a metric that should be developed at the organization. In this paper, we are suggesting a conceptual metric for R&D work performance improvement (PI) at the Kuwait Institute for Scientific Research (KISR). This PI is to be measured against a set of variables in the suggested metric, which are more closely correlated to organizational output, as opposed to organizational norms. The paper also mentions and discusses knowledge creation and management as an added-value to R&D work and measurement improvement. The research methodology followed in this work is qualitative in nature, based on a survey that was distributed to researchers and interviews held with senior researchers at KISR. Research and analyses in this paper also include looking at and analyzing KISR's literature.

**Keywords**—Knowledge Creation, Performance Improvement (PI), Conceptual Metric, Knowledge Management (KM) added-value.

## I. INTRODUCTION

ONE of the biggest challenges facing management of any organization is the development of an effective performance improvement (PI) metric. How does an organization know whether it is improving or not? Using the wrong metric can easily create a false sense of security, hide structural problems, or in the worst case scenario, ruin the

organization. This problem is classically referred to as the trap of measuring A while hoping for B.

In private sector, measuring performance improvement (PI) appears pretty obvious; profitability of the company is the best indicator. But profitability is always biased and always comes at a cost to someone. Think of a company that brings in an ever-increasing ROI from year-to-year but heavily pollutes the environment to do so. Or, consider the case of “*Costco, a high-social capital, publicly traded company, which is devalued by Wall Street (compared with Wal-Mart) despite its remarkable success, because by paying employees high enough wages to earn their commitment, it fails to ‘squeeze every dollar of profit out of current sales by lowering cost.’*” [1]. In both cases, the cost of profitability, in the long-term, may be so high to the company (e.g., in the form of a polluted environment or in the form of un-committed, unhappy employees) that the company's ‘profitable’ practices may very well cause its own destruction. When it comes to the non-profit sector, measuring performance improvement (PI) becomes even more difficult and complex. This is because it is often very hard to measure quantitatively the improvement of a public good. For example, should a homeless shelter seek to improve its performance by increasing the number of beds it offers the homeless? Or by lowering the cost of the services it provides for them? Or by creating a follow-up program that seeks to transition the homeless to both homes and steady jobs? In this particular case, if the shelter picks the wrong performance metric, it can easily squander its resources and even subvert the very goals it is trying to promote.

Government-funded scientific research institutes like KISR in Kuwait, pose an even more vexing problem when it comes to measuring performance improvement. KISR's fixed budget each year comes from the government of Kuwait, and this budget covers mostly salaries of employees, and a small amount is assigned for internal small-scaled research projects. Other income comes from government clients that fund large-scaled research projects. Although their mandate is geared towards benefiting the public good, the benchmarks of that mandate are often worded out vaguely and in ways that are very difficult to measure. Currently, the only performance metric used to measure year-to-year performance variances at KISR is the number of brought-in contractual projects per

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department and the amount of funding assigned for these projects from clients inside Kuwait. It is a general and an adopted norm by department managers, division directors, and top management at KISR organization that the more brought-in projects and funding, the better the researchers' performance conducting R&D work. Not forgetting that these contractual research projects are funded by government agencies e.g., ministries or the Kuwait Foundation of Advanced Science (KFAS). Both of the latter mentioned factors i.e., number of projects and amount of funding have proven to be very ineffective in providing an indicator for actual organizational performance improvement. Therefore, the challenge that we now face at KISR, is to design a performance metric for R&D work that more accurately and objectively shows if particular researchers in divisions and departments actually have year-to-year performance improvement [2]. This performance improvement will be measured against a set of variables in the performance metric that are more closely correlated to organizational output, as opposed to organizational norms.

## II. WORK PERFORMANCE METRICS AT KISR

The current written mandate of the Kuwait Institute for Scientific Research (KISR) demonstrates exactly how difficult, precise and meaningful measurement of performance improvement can be. The main stated objectives of what KISR does or supposed to do are to:

- Conduct scientific research and studies concerned with the progress of national industry and which facilitate the preservation of the environment.
- Encourage Kuwaiti researchers to practice scientific research and nourish the spirit of research in the younger generation.
- Explore and study natural resources and means for exploiting them, energy and water resources, and methods to improve agriculture and develop aquatic resources.
- Render scientific, technological and research consultation services to the government and to national establishment.
- Follow up the development of scientific and technological progress, and adapt it in ways that conform to the local environment.
- Establish and foster relations, and carry out mutual research with higher education institutes, and the technological and scientific sectors in Kuwait and various parts of the world.
- Participate in the study of ways to verify the resources of the national economy by investing the results, of scientific and technological research in industry and directing it in the services of the State's economic and social development goals ([http://www.kisr.edu.kw/about\\_goals.asp](http://www.kisr.edu.kw/about_goals.asp)).

However, what KISR as a R&D organization does in practice is quite different from what it produces. New *knowledge* has been created which is considered as an added-value to the organization. Toyota Corporation, for example, may practice a new form of management based on continuous improvement, but it does not produce continuous

improvement any more than any other organization produces *knowledge* as an added-value. Organizations should be task-focused, which produce discrete products and services. These products and services may result in or be the result of new knowledge, other generated added-value factors and continuous improvement.

KISR has fallen into the trap of using performance metrics that are based on what KISR does and not on what KISR produces. In the past, a method for measuring performance improvement, based on a single factor of what KISR produces was suggested but not implemented. That method was to count the number of articles and research publications by KISR researchers against other similar R&D institutions. However, this method also potentially has the problem of measuring A while hoping for B, as it measures a quantity of forms and not what the forms contain or what value they have i.e., knowledge as an added-value. Neither the number of publications nor the establishment of relations with mutual research agencies in the world should be the purpose of an organization. The fostering of mutual relations, synergy and corporate research should be a natural outcome of a need that KISR researchers and staff have, that has developed as a result of a particular project or department needs, not as an end by itself. In like manner, the number of projects that each department contracts from government agencies per year, and the paper value of those projects are no more an indicator of performance improvement as opposed to measuring the performance improvement of Toyota when measuring how much *kaizen* (continuous improvement) it does, e.g. measuring the improved performance of production of Toyota's cars [3]. Neither KISR's stated objectives, nor their current performance metric of projects number and inter-governmental funding actually relate to KISR's primary output.

## III. WHAT IS THE OUTPUT OF KISR?

Scientific R&D, in general, consists of three basic practices: There is basic research, which is aimed purely at the creation of new scientific and technical knowledge. Its purpose is to advance understanding of phenomena. There is applied research, designed to implement new scientific and technical knowledge, which is work expected to have a practical, but not necessarily a commercial payoff. While basic research is aimed at knowledge for its own sake, applied research has practicality and utility as its goal. There is also development research in which new knowledge is embedded in a product or process and is honed for commercial application [4].

KISR, according to interviews conducted with senior researchers who have been with the organization since and before the invasion of Kuwait in 1990-1991, was primarily involved in applied research and considerable basic research until the invasion. There were serious attempts for developmental research, but never saw the light. However at present time, the actual not stated output of KISR is no longer basic research, and is mostly applied research aimed at the creation of new scientific and technical knowledge. This can be confirmed by looking at a sampling of KISR's output by department in the 6<sup>th</sup> strategic plan (2006-2010)

(<http://www.kisr.edu.kw>), which states the major research sectors and their activities as follows:

- **Petroleum Resources Division** (KISR's 6<sup>th</sup> Strategic Plan, 2005. pg. 21)
  - Solutions for problems accompanying oil production operations, resulting in improved production performance such as eliminating accompanying water extraction, corrosion, and chemical residues in facilities.
  - Databases for and mathematical modeling of Kuwait's oil reserves.
  - Scientific database of heavy Kuwaiti oils and improved catalysts to enhance refining performance in converting crude to light distillates in keeping with environmental standards.
  - Database of solutions for production problems for dissolvable or recycled plastic products.
- **Water Resources Division** (KISR's 6<sup>th</sup> Strategic Plan, 2005. pg. 23)
  - Estimations of unit costs for desalinated water and treated wastewater.
- **Economics and Urban Development Division** (KISR's 6<sup>th</sup> Strategic Plan, 2005. pg. 25)
  - Environmental database, and plans and programs to preserve and rehabilitate Kuwait's natural environment.
  - Database for the prediction of environmental hazards resulting from pollution to assist decision makers in insuring sustainable development.
  - Databases to guide detection of environmental change and predict natural dangers to assist decision makers in preserving the safety and stability of the environment.
  - Databases, aerial pollutant maps and a radioactive pollutant atlas for the State of Kuwait.
  - Databases of earthquake activities in exposed areas and precautions needed to deal with such events.
- **Biological Sciences & Food Resources Program** (KISR's 6<sup>th</sup> Strategic Plan, 2005. pg. 30)
  - Information on the relationship of plankton to the marine food chain and its effect of fisheries.
  - Database for determining the types of algae associated with fish fatalities.
- **Techno-Economics Program** (KISR's 6<sup>th</sup> Strategic Plan, 2005. pg. 33)
  - Economics databases and indicators for the service and industry sectors.
  - Studies and research to support the investment environment and economic activities in the country.
  - Economic feasibility studies, mathematical models and statistical analyses to support KISR's research activities.

In fact, as the data above suggest, KISR research activities is primarily measuring phenomena and producing data. KISR is considered as an outsource data measurement service provider. KISR provides statistical data about certain factors, phenomena and systems that are needed by other governmental agencies e.g., pollutants in soil and sea, effects of generated electromagnetic fields, and effects of nuclear radiation. And, as these agencies mature and grow, many of these statistical data gathering functions will be conducted in-house instead of outsourcing to KISR. The actual output of

KISR is not research projects; it is structured data that reveals measurements that provide KISR's clients with information about what to do, how to confront and act in case of critical situations. In short, KISR's primary task is measurement. Moreover, most clients i.e., the governmental agencies, who provide funding for projects at KISR, do not actually utilize the generated results of applied research. New knowledge is created and clients' participation in this process is major.

#### IV. PERFORMANCE METRICS AT KISR

In the 5<sup>th</sup> strategic plan (2000-2005) and also in the 6<sup>th</sup> strategic plan (2006-2010) (<http://www.kisr.edu.kw>), the following performance metrics were repeatedly suggested. As mentioned above, they were vaguely stated and not concisely triggered:

- 1- The levels of research activities and consultative services attained (such as scientific production, scientific quality of outcomes, human resources, administration, media and finances).
- 2- The preparedness of the scientific system, knowledge and management (such as human resources, infrastructure, research facilities, and databases).
- 3- KISR's status as a reference in science and technology S&T and as a think-tank to support Kuwait's decision makers.
- 4- The presence of KISR locally, regionally and internationally.
- 5- KISR's scientific and technological cooperation and partnerships with regional and international institutions.
- 6- KISR's customer database.
- 7- KISR's ability to develop individual financial revenues.

The first metric, the level of activities is measured consistently. This would tell us nothing about the cost or quality of KISR's primary task, which is measurement. It would merely tell us how many projects KISR had undertaken on behalf of other government agencies. This is exactly the benchmark that was discussed earlier regarding number of projects. Under this criterion, KISR executives and managers have an incentive to go out and get as many projects as possible and have these projects to be as expensive as possible. Because the number or quality of projects does not correlate to KISR's budget, this performance metric invariably leads to very long project lead times and what is commonly referred to as 'corruption'. The second metric, the preparedness of the scientific system refers to the process and not to the output. This is the same mistake as attempting to measure the performance improvement of Toyota by measuring its '*readiness to improve*' as opposed to how much better its cars perform. The third, fourth, fifth and sixth metrics, i.e. status, presence, mutual relations and customer database, are results of KISR's performance. If KISR has a performance improvement in its output it will have higher status, more presence, more mutual relations and a larger customer database. KISR can not simply go out and acquire status, presence, mutual relations and customers in the absence of providing more value to them. The final metric, KISR's ability to develop independent financial revenue is once again, linked to the quality and year-to-year performance

improvement of its output. KISR again can not simply go into the marketplace and acquire independent financial revenue.

#### V. A PROPOSED CONCEPTUAL METRIC FOR PI AT KISR

We have developed a framework of a metric aiming at measuring performance improvement (PI) at KISR that uses four variables, namely, *Time* for research duration, *Cost* incurred during research, and *Precision and Depth* of taking measurements i.e., T, C and P&D, as shown in figure 1 below. We have used results of interviews, surveys and sample case studies to develop typical performance curves that appear with regards to measurement during research projects at KISR. A sample of a typical research project P&D performance curves we have encountered and the way the performance metric works, are given below. Note that each curve is associated with P&D. The added-value knowledge creation during the course of conducting research at the organization should increase P&D of taking measurements, thus better performance improvement (PI).

The following categories represent the most common P&D (Precision & Depth) curves:

- (1) Linear: P&D increases as time and cost goes up proportionally.
- (2) C-P&D: Cost of P&D increases rapidly, time does not.
- (3) T-P&D: Time of P&D increases rapidly, cost does not.
- (4) Fixed T: Time is constant, regardless of cost.
- (5) Fixed C: Cost is constant, regardless of time.

Fig. 1 above also shows the typical P&D curve in dotted line for a better PI for the organization. Here is an explanation and an interpretation of P&D curves at KISR, as indicated in the figure:

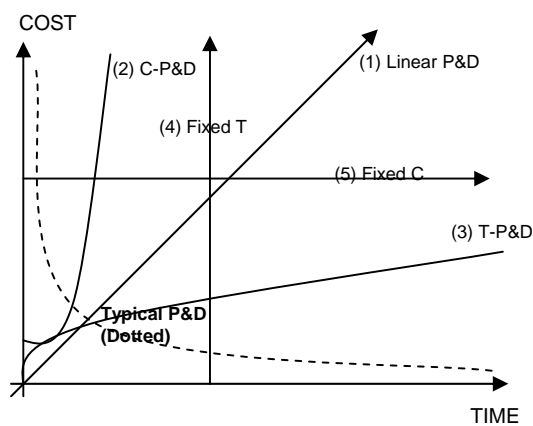


Fig. 1 A Typical curve to PI for Measurement, P&D in terms of Cost and Time, measuring the Performance Improvement (PI) in a Typical Research Project

First, the linear P&D curve; in this instance, the cost and time of obtaining a set of measurements holds at a ratio close to 1:1 for both precision and depth. This case is evident in most research projects at KISR, where cost of taking measurements goes up over duration times of projects' phases. KISR's PI is neutral in this case and no improvement is being

noticed. Second, the C-P&D Curve; in this instance, the cost of obtaining precision and/or depth of measurement increases dramatically, even though the time of obtaining measurement stays fairly constant. This happens at KISR when research projects reach their deadlines and must finish. Again no PI is evident in this case either. Third, the T-P&D Curve; in this instance, the time of obtaining precision and/or depth of measurement increases dramatically, even though the cost of obtaining measurement stays fairly constant. This situation occurs in some projects at KISR where human resources efforts and lots of time are actually wasted and inefficient work is produced. Thus, PI is low. Fourth, the fixed T-P&D curve; no matter how much money is put into obtaining a certain set of measurements, the time of obtaining the measurements stays constant, and eventually no PI will be noticed. Fifth, the fixed C-P&D curve: No matter how much time is put into obtaining a certain set of measurements, the cost of obtaining the measurements stays constant, and eventually as in the latter case, no PI will be noticed either. Finally, comes the typical situation where cost of taking a set of measurements for a certain research project drops exponentially over time. This is the most wanted situation by most managers of organizations, where the work exhibits effective use of human power and labor work, better utilities, advanced technologies, and most of all knowledge creation and good knowledge management (KM), yet PI is better and work is more efficient.

#### VI. KNOWLEDGE MANAGEMENT AT KISR (KM@KISR)

A knowledge management (KM) initiative was launched at KISR in the year 2000, with the intent of better transferring and sharing, archiving and utilizing the tacit and explicit knowledge of KISR researchers. The only pilot implementation of KM which was a software tool that was tested for an environmental database program was not successful. In the execution of the KM initiative, as with the entire KM program, benchmarks of PI correlated to the organizational output were never put into place. One of the most important hidden variables has emerged in our study of measuring measurement at KISR. This has been the lack of investigating why the KM initiative apparently failed because of not applying metrics of PI in the organization. KM is a strategic plan and a research project which was supposed to be forced and applied by management. However, the KM approach that was followed was purely technology-driven, and not dependent on the actual output of R&D at KISR. Evidently, we found that the lack of such investigation failed the KM project, whilst 'change management' and 'knowledge audit' were the proper procedures or approaches to start KM at KISR. While the KM pilot program or initiative might have been perceived as being both interesting and useful, it was ultimately irrelevant to the internal users of KISR, because its usage was not tied to measuring PI of the organization as a whole.

An example drawn from the department of advanced systems at KISR (DAS) will illustrate the above argument. A researcher at DAS who we interviewed conducts cyclic assessments of electricity transmission lines and transformer

stations for the Ministry of Electricity, as a major part in his project. His task is to go out to the field and measure how well the transmission lines are operating, and how efficiently the transformer stations are functioning. He also makes assessments about product life-cycles and provides annual reports that list suggested and recommended changes to any of the systems or devices on his route. The output of one report is measurement; measurement of the life-cycle of electrical devices and lines, measurement of efficiency of power transmission under variable conditions, measurement of transformer functionality and measurement of overall system performance. Therefore, the only meaningful indicator by which KISR can measure PI in this context, is to measure whether the time or cost i.e., resources consumption of these measurements varies from year to year, and whether or not this variance comes with an increase or decrease in either precision or depth of measurement. Let us examine each of these variables in more detail: precision, in this context might mean for example, the number of decimal places to which the inefficiency of certain transmission lines and materials is measured. Depth on the other hand, would refer to the frequency of intervals between measurements. Measurements done at ten-minute intervals versus one-week intervals would certainly provide a lot more data about how different environmental conditions affect performance. Likewise, measuring more precisely to a higher decimal place might yield data about the life-cycle of certain materials that could not be otherwise assessed. In both cases, depending on the needs of the client, more precise or more in-depth measurements could be made available, but at what benefit to the client and at what cost to KISR? That is the fundamental question that is at stake in looking at measuring measurement through the afore-mentioned performance metrics.

The context of KM can only be meaningful when assessing in the above context is first considered. Managing knowledge means having better access to relevant information when it is needed. Let us say for example, that instead of having the researcher taking one day and go on-site to ten different locations, an automatic sensor system could be installed across all of the transformer stations such that the information that he once gathered on-site could now be automatically collected remotely. Now, we can know effectively and meaningfully measurement of the cost versus added value of this KM application. While there might be a high upfront cost of the sensors, the cost over time would decline because it would mean fewer trips per month or week for the researcher. Therefore, the researcher would be free to teach others in the lab knowledge that s/he has that is unique to her/him. So, the researcher's effort and time being put into that are effectively utilized. In this case, once again it would be meaningful to assess the importance or added- value of a KM application to help the researcher better transfer and share the knowledge that s/he has inside his head to other junior and senior staff. By applying these derivative applications of KM properly, we can reach a typical situation where at implementation, the cost or time of either precision or depth of measurement decreases and/or the quality of value of more precise and more in-depth measurement increases for the client (the dotted curve in Fig. 1 above).

KM has failed because it has not been assessed in this context at KISR. There has not been a benchmark to use against which success could be measured. How can you determine who has won the race if for example nobody knows where the starting line? Or there was no way to determine if everyone started the race at the same time? Effectiveness of measurements and efficiency in R&D work necessitate application of benchmarks or metric systems. A KM system and application will only be meaningful and effective when the outputs at the organization can be assessed against critical resources like time and cost.

## VII. CONCLUSION

It is clear from the above, that the vaguely and not accurately defined stated metrics mentioned in the KISR's 5<sup>th</sup> and 6<sup>th</sup> strategic plans will take KISR no where with improving their performance. This metric has to be defined in terms of measurable factors, which is clearly demonstrated in the proposed performance improvement (PI). By using this PI metric of measurement precision and depth (P&D) in terms of time (T) and cost (C), we should now observe an objective and quantifiable year-to-year performance improvement from one measurement to another, hence from project compared to another one, and eventually from a particular department to another department. Evaluating the time and cost being spent for taking measurement against its precision and depth will allow KISR to develop new tools for self-analysis for more effectively evaluating how money is spent, how the time of researchers is spent, and how the organization performs as a whole. In terms of knowledge creation and other gained added-value factors, KISR will be able to pinpoint the right channels for building up and promoting relationships with clients. Knowledge creation will tremendously help KISR researchers to configure their research procedures accordingly and propose corporate research aimed at development in the country.

Taking measurements during research should evolve and improve as it is greatly related to knowledge creation; a process that relates researchers to clients who fund research projects. Both researchers and clients participate in knowledge creation. When both researchers and clients follow the right procedures for transferring and sharing knowledge, this will lead to a positive impact on performance improvement (PI). An exemplar of knowledge creation is taken from senior researchers during interviews, who claim that they always change procedures of taking various measurements according to clients' demands and requirements.

We also believe that KISR management has an important role in this process as well. KISR management needs to be transparent to researchers about what should the actual output be, and should realize and value knowledge creation. Knowledge creation has a great impact on performance improvement (PI) at KISR, and management must be aware of this fact. One of the most effective ways of doing that is by adopting and populating a comprehensive and accurate metric for measuring year-to-year performance improvements (PI) against for example a singular output variable, taking measurements. This metric can also be utilized for other

variables that relate to research projects e.g., utilized manpower and technology. In the many conducted interviews and surveys that we have undertaken at KISR to understand KISR's core output and to derive the proposed performance improvement (PI) metric, we have come to believe that deploying such a system throughout the organization will result in substantial performance gains over the next several years, and will help correct many of the existing inefficiencies.

#### APPENDIX

- A1. Survey questions.
- A2. Interview questions.
- A3. Survey results.

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He is currently a scientific researcher associate at Kuwait Institute for Scientific Research in Kuwait. Before joining research at KISR, he worked as an application programmer, system programmer, system analyst, and operations section head. He also worked as a computer instructor at Public Authority for Applied Education and Training in Kuwait. He actively participated in various committees in PAAET that related to recruitment, scholarships, and training. After he joined research he became very active in the Engineering division at KISR, where he worked on a main project to measure amounts of pollutants in water, oil and soil using a flurosensing custom-made device. He intensively used MATLAB and GIS applications for analyzing results.

Later after PhD, Dr. Hasan became interested in e-learning applications, and knowledge management. His research in KM reflects his past experience with researchers and what they transfer and share for effective collaboration. He became active in the KM project at KISR and he suggested a knowledge

audit to be undertaken before introducing an IT solution. He is an active member of KM group in Kuwait.



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Mark published:

- "Redefining Poverty" – Homeless Voice, January, 2004
- Interview: *Gazeta Olsztyńska*. July, 2003. I was interviewed regarding my assessment of reform in the Polish Education system.
- Interview: *Deutsch TV* – Poland, April, 2003. I was interviewed with Poland's former foreign minister regarding Poland's role in the Iraq war.
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#### A1. SURVEY QUESTIONS

1=Always, 2=Frequently, 3=Sometimes, 4=Infrequently, 5=Never

1. I collect data and/or record data from experiments.
2. I use data to solve problems for **government agencies**.
3. I use data to solve problems for **private sector companies**.
4. I maintain and/or repair existing systems in my department.
5. I do paperwork, such as filling out forms and applications.
6. I work on a team with other researchers and/or professionals.
7. When I work on a team, we rotate tasks.
8. I learn new skills that are **outside my area of expertise**.
9. I attend training seminars.
10. My research work is published in international journals.
11. I work overtime on a project or stay late at work.
12. I ask researchers in other fields to explain their work

to me.

13. I take part in projects that have a **high risk of failure**.

14. I would work for performance-based instead of salary-based pay.

15. I ask my supervisor about the strategic aspects of our work.

16. I would work for free to promote the general aims/vision of KISR.

17. I share my experiences and knowledge with my superiors.

18. The actual things I do at work are the same from day to day.

19. I complete tasks on my time because of my supervisor.

20. I am directly rewarded financially for coming up with new ideas and innovative solutions.

## A2. INTERVIEW QUESTIONS

Unstructured questions were addressed to department heads and project leaders in main research areas. Questions were focused on:

- KISR hierarchical structure, research areas, research and development in Kuwait, and problematic issues.
- Areas of potential support for R&D in Kuwait.
- Possible solutions for obstacles and funding resources for R&D.
- Critical research areas, outsourcing, and funding approaches.
- Research results and benefits to clients.
- Knowledge role in R&D progress.
- Coordination with local, regional, and world-wide institutions.

## A3. SURVEY RESULTS

### Methods Questions Analysis (question block 1-10)

(Selected questions only)

Question 1. 76% of survey respondents stated that a significant portion of their work consists of collecting data and or recording data from experiments. Technically, data collection is the work of technicians in the laboratory. The primary function of researchers should be the interpretation and application of data to solve problems. This singular statistic alone, about the way in which the time of researchers is spent, suggests that a significant change management program **must take effect** before any tool or database management system is implemented.

Question 2. 69% of researchers stated that they spend the majority of their time collecting data on behalf of government agencies.

Question 3. This statistic of 45% reflects that survey respondents did not necessarily understand the question correctly, as it contradicts the data that they have entered in question 2.

Question 5. 76% of researchers spend a significant portion of their time dealing with paperwork and filling out forms. While this time may be significantly cut through a comprehensive database system, the permission requirements and levels of approval needed to complete tasks are barriers to efficiency that have to be solved at the organizational level first.

Question 7. 57% of researchers do not rotate tasks when working on team projects. There is a suspicion that this statistic is actually higher, based on anecdotal evidence gathered during survey distribution and collection. This statistic indicates that **knowledge is not being shared between different members of project teams, independent of the software system being used by them to collect data**.

Question 8. The 71% positive response rate, that researchers do learn new skills outside their area of expertise, contradicts the data from question number 7. Or, rather, it suggests that if new skills and knowledge are being acquired a significant percent of the time, they are not being acquired through task rotation.

Question 9. Only 52% of survey respondents said that they attend training seminars on at least a frequent basis. This correlates positively to the data in question 7. Both of these statistics indicate that researchers are not, overall, exchanging or acquiring knowledge on a continuous basis.

### Motivation Questions Analysis (question block 11-20)

Question 11. 69% of researchers stated that they work overtime or stay late at work. This statistic can be validated through an examination of swipe card data based on afternoon exit swipes after 3 pm for researchers. Given anecdotal evidence about the general work culture at KISR, this number seems to reflect a high personal bias.

Question 12. 52% of researchers stated that they ask researchers in other fields to explain their work to them. This statistic may reflect a genuine state of affairs or it may also reflect a more personal and informal exchange of ideas, rather a systematic process of inquiry and knowledge sharing.

Question 14. 49% of researchers at KISR stated that they would work for performance-based instead of salary-based pay. Based on anecdotal evidence gathered during the administration of the survey, it appears that many respondents did not completely understand the terminology used. It is highly likely that the actual number of researchers that would immediately accept a switch to an explicitly based performance-payment system is substantially lower than what is indicated by this survey.

Question 16. 71% of respondents stated that they would work for free to promote the general aims and visions of KISR. This can also be easily tested experimentally. What this reflects is that many of the researchers have a positive image of the concept of KISR and believe in the general aims that it aspires to achieve.

Question 17. 76% of researchers stated that they often share their knowledge and experience with their superiors. One of the questions this survey did not address was what is the nature of that sharing experience? Is it primarily inquiry oriented or is it primarily critically oriented? In other words, are researchers sharing information with their superiors because they are engaged in a peer-level exchange of ideas or because they are engaged in other discourse activities, such as organizational criticism.

Question 20. 81% of respondents stated that they either are not or do not feel that they are ever rewarded directly financially for the contributions of their new ideas and innovations. Given the fact that there are not, to the knowledge of the survey team, any incentive systems in place that allow for profit-sharing in the sell or marketing of applied research into the open marketplace, this number is probably substantially closer to 100%.