

Centralized Admission: A Novel Student-Centric E-Governance Process

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ABSTRACT

e-governance initiative has helped many governmental organizations to carry out their services transparently, efficiently, and democratically. The admission process in many of the universities in Karnataka is usually manual. The process suffers from redundancy of data and workforce and the process itself is expensive. For the first time in any University in Karnataka, in 2009, an automated system for Post Graduate admissions was designed, developed and implemented for Bangalore University. This e-governance admission system has been in use in the University for the last four years. The process was started as a skeleton model and more services were added later in subsequent academic years during admission. It was found that the system was foolproof. It transformed the whole admission process into a single-window system. Admission Approval, Fee Payment, Hostel Admissions, and Issue of Library Cards were thus brought under a single-window system. This paper compares the novel e-governance initiative with that of the pervious system of admission. It also compares the Bangalore University model with other automated admission models in Karnataka. It investigates the performance of the e-governance initiative in reducing workforce and redundancy. It records the find that the e-governance process has helped the University and its stakeholders in rendering the admission system transparent. Many other Universities in Karnataka are now following this model for their admission.

General Terms

Centralized Admission, University

Keywords

e-governance, speedup, redundancy, automated system

1. INTRODUCTION

UNDP refers to e-governance as the multi-faceted use of ICT for improving collective governance that includes making delivery of services more accessible, efficient and responsive [1]. It is also the process of empowering the human race [2]. e-governance procedures automatically guarantees data or content in digital form, making them more amenable for future knowledge-management or data-mining exercises [2]. Generally there are four levels or stages of development of e-government services: 1.publishing 2.interacting 3.transacting, and 4.transforming [2, 3]. ‘Publishing’ means to provide information to the citizens, ‘interaction’ means to have a two-way communication between the citizen and the Government electronically, ‘transaction’ means to make online transactions between the Government and the citizen or vice versa, and ‘transform’ is to transform business paradigms.

This paper acquires importance as most of the Central Government Institutes have adopted Centralized Admissions. Some of the examples are Engineering [4, 5], Medical [6],

Management [7], Law [8] admissions. The Ministry of Human Resources, Government of India is also planning a pan-Indian entrance for Engineering and Medicine. Bangladesh was successful in implementing Centralized Admissions in many of the Universities in Bangladesh [9]. This paper studies the performance of Centralized Admission as an innovation. ‘Innovation’ refers to the process of adoption and implementation of new programs or methods of governing [10].

All the traditional universities in Karnataka [11, 12, 13, 14, 15] use the manual, decentralized model for admissions. This paper evaluates the automated centralized admission model of Bangalore University which was designed, developed and implemented for Bangalore University in 2009.

The state of Karnataka’s population is 61 million, the literacy rate is 75.60% (Male 82.85% and females 68.13%), the Gross Enrollment Ratio in Higher Education is 12.2%, and the official language is Kannada.

There are four automated models in Karnataka for admissions: (1) the Common Entrance Test (CET) model [16] for admission to undergraduate Engineering and Medicine courses, (2) the PG CET (Post-graduate Common Entrance Test) model [16] for admissions to Master of Computer Applications (MCA), Master of Business Administration (MBA) and Master in Technology (MTech), (3) Post Graduate Admissions for Health Sciences (PGET) [17, 18], and (4) Post Graduate Centralized Admissions (PGCA) of Bangalore University [19, 20, 21, 22, 23]. The first automated model is for undergraduate courses and the rest of the models are for admission to post-graduate courses in Karnataka. In the first model, 10+2 qualified students appear for an entrance examination conducted by the CET cell for admission to undergraduate Engineering and Medicine courses. Marks of Physics, Chemistry, and Mathematics of 10+2 are considered for ranking for Engineering courses and Physics, Chemistry, and Biology marks of 10+2 are considered for assigning rank in Medicine courses. A separate rank is given to students for Engineering and Medicine courses. Students have to appear for counseling based on the rank to choose a particular course and college. In the second model, students apply to MBA, M.Tech and MCA courses through a separate Application Form to the PG CET cell. A separate student-database is maintained for each of these courses. A separate rank is given to students for MBA, MCA and M.Tech courses based on the marks obtained by students at the degree and in the entrance examination. Counseling is conducted separately for all these courses. The third model is similar to the second model, but is for the Health Science courses. The fourth model is different from the first three models. In this model a single application is

submitted for many courses. In this paper, the fourth model is considered for evaluation.

Bangalore University [23] spans the five districts of Karnataka: Bangalore District, which is predominantly inhabited by an urban population, and four rural districts: Bangalore Rural, Kolar, Chikkaballapur, and Ramanagaram. The University has 657 affiliated colleges and the students' strength is little more than 0.3 million. Bangalore University offers sixty five post-graduate courses and the courses are classified into the following Faculties: Science, Arts, Commerce, Engineering, Education and Law. Bangalore University was established in the year 1964 and till 2009, admissions were decentralized. In the decentralized admission process, each department was entrusted with the responsibility of admitting students to their department and to affiliated colleges which run the course.

The following steps were followed for students' admission in the University: (1) Fee Payment for Application, and Issue of Application, (2) Seat matrix creation, (3) Application collection, (4) Scrutiny of Application, (5) Eligibility Computation, (6) Rank Generation, (7) Publishing the Rank and Merit List, (8) Call for correction to the Merit List, (9) Incorporation of requested correction and re-generation of the Rank List, (10) Counseling and seat allotment based on reservation rules, and (11) Fee collection from the admitted candidate. 'Scrutiny' is the process of verifying applicants' claims with documents attached to the application form. 'Eligibility check' is the process of checking whether the candidate is eligible to get admission to the course. Almost all the departments follow different eligibility criteria/rules. 'Counseling' is the process of inviting students according to merit order and allocating a particular college based on students' choice, availability of seats, and reservation rules.

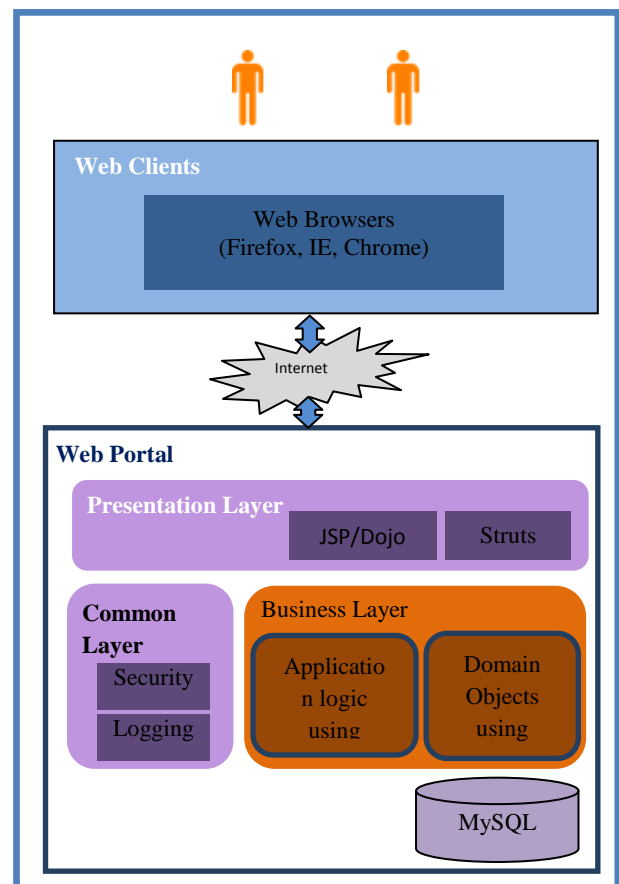
All admissions in the University adhere to reservation policy of the state of Karnataka [19, 20, 21, 22]. The Government of Karnataka, for implementing equity in society, has reserved seats in educational institutes for marginalized categories: Scheduled Caste (SC), and Scheduled Tribes (ST), and five Other Backward Castes (OBCs): Category I (I), 2A, 2B, 3A and 3B and the percentage of reservation is 15%, 3%, 4%, 15%, 4%, 4%, and 5% respectively. The remaining 50 percent is kept open for meritorious candidates of any category and for non-marginalized/non-OBC categories; the quota is called General Merit (GM). There is reservation of 5% each for students who have studied in the 'Kannada Medium' (KM) and students who have studied in 'Rural Areas' (RL) till standard X. There is no separate reservation for girls. There is one seat reserved in each post-graduate course for Transgenders. A separate reservation in each department is also maintained for students who have achieved in sports and cultural activities, which is called 'Supernumerary Category'. Following are some such categories: Sports, National Social Service, National Cadet Corps, Physically disabled, and Cultural.

In the manual, decentralized process, if a student wished to apply for more than one course, the student had to apply for each course separately with a separate application form along with photocopies of relevant documents to each application. The student had to submit the application to various departments separately, visit each department to find the eligibility and rank, and attend counseling in each department. The process was both expensive and cumbersome. Many poor, under-privileged students had to spend a lot of money

for many applications and photocopies, and travel to many departments within the University several times. From the University side, each application had to be scrutinized separately by teachers of the concerned department. Teachers had to verify the authenticity of students' records like caste-certificate, marks-cards, domicile-certificate, and supernumerary certificates. The verification took a lot of teachers' time, and caused duplication of work in the case of students who had applied for more than one course. After admitting a student in each department, the department sent the student's details and originals to the University administration for admission approval. The University administration verified the documents before the admission was approved. This duplicate verification process led to much delay and much manual monitoring. The process suffered from lack of uniformity across departments in implementing the "reservation-policy", and at times resulted in corrupt practices. The hostel admission in the manual process was separate, and a separate application form had to be submitted for hostel admission and separate counseling had to be conducted for hostel admissions.

To overcome these problems with the manual system, a Centralized Admission process was introduced in Bangalore University which was then adhered to for the next four years. In the Centralized Admission process, a student applies to many courses through one application form. Application collection, scrutiny, and counseling are conducted in one place. The Centralized Admission is automated. Figure 1 shows the Logical Architecture Diagram of the e-governance initiative.

Figure 1: Logical Architecture Diagram



The logical architecture is based on a physical n-tier model. Each tier or layer performs a specific function, encapsulates all of the information needed to provide a complete service. 1. User Interface/Client Presentation Tier: Presentation is managed using JSP/Dojo, Java Script, etc., provides a rich, web-based user interface (UI) on a browser based system. 2. Server-Side Presentation Tier: Most of the presentation logic is managed within the Web Servers utilizing JSPs, struts, XSL, etc., to support multiple browsers. The Web Framework encapsulates all common reusable application services. 3. Service and Business Domain Tier: Business logic is implemented in this tier using spring framework and plain Java objects. 4. External Services Tier: A relational database is integrated with the Business Domain Tier using hibernate.

A standby server is used for failover and recovery. Manual Entries are also made for cross-verification in case of any failure in the system. The server is highly available, the system up-time is 100%, and robust. The package finds eligibility and ranks for 31K candidates in less than a minute. During the counseling, a Seat-matrix dashboard is displayed at four different locations simultaneously. 20 seconds Refreshing time is used for refreshing the seat matrix.

Table 1 presents the difference between the manual and the automated system.

Table 1: Differences between manual and automated system

Details	Decentralized, and Manual System	Automated
Applying to many courses	With a separate Application Form and separate enclosures. Application Fee has to be paid separately	Single Application Form with one set of enclosures. Can also apply online. One Application Fee
Submission of Application Form	Submit to respective departments separately	Submit single application at one place
Scrutiny of Application	Verification in various departments	One verification at centralized location
Computing supernumerary weightage	Computation in various departments	One computation at centralized location
Announcement of Merit List, Rank List, etc.	Announced separately in each department	Announced at one place. Announced also through websites. Automated and customized SMS/mail sent to each applicant
Counseling	Separately conducted	Centralized automated counseling process
Hostel Admission	With separate application form and separate counseling	Automated admission
Grievance Redress Mechanism	Handled separately in each department	Handled at centralized place
Infrastructure	Redundant establishment of infrastructure such as computational facility, projection of seat matrix facility, CCTV, etc.	Establishment of infrastructure like computation facility, projection of seat matrix facility, CCTV, etc. only at centralized location

2. METHOD

Let c be the number of courses run by the university, n_u be the total number of unique applications received in the automated system, and n_c be the number of applications in the decentralized system for all courses. n_c can be computed as follows:

$$n_c = \sum_{i=1}^c n_i \quad (1)$$

Where n_i is the number of applications received for a course i .

Let C_{opt} be the courses-optimized factor which define number of a courses to which a student has applied. C_{opt} can be defined as follows:

$$C_{opt} = \frac{n_c}{n_u} \quad (2)$$

Let T_d be the time for data entry, T_s be the time for scrutiny, T_e be the time for computing eligibility, T_r be the time for generating rank list, $T_{e'}$ be the time for finding eligibility after request for correction, $T_{r'}$ be the time for generating rank after request for correction, T_c be the time for counseling, T_p be the time for supernumerary application scrutiny, and T_h be the time for hostel admissions. Let the total time for e-governance system be T_{tot}^{egov} , which can be computed as follows:

$$T_{tot}^{egov} = n_u(T_d + T_s + T_e + T_r + T_{e'} + T_{r'} + T_c + T_p + T_h) \quad (3)$$

Let T_{tot}^{manual} be time taken for manual system, which can be defined as

$$T_{tot}^{manual} = n_c(T_d + T_s + T_e + T_r + T_{e'} + T_{r'} + T_c + T_p + T_h) \quad (4)$$

The speedup S of the e-governance system over manual system can be defined as follows:

$$S = \frac{T_{tot}^{manual}}{T_{tot}^{egov}} \quad (5)$$

Let $n_u^{SC,ST,I}$ be the unique number of Scheduled Caste, Scheduled Tribes and Category I students, n_u^{others} be the unique number of other students (non SC, ST, and I), $n_c^{SC,ST,I}$ be the number of Scheduled Caste, Scheduled Tribes and Category I students if the system were to be manual, and n_c^{others} be the number of other students if the system were to be manual. Let f_{other} , and $f_{SC/ST/I}$ be the fee for other and SC/ST/I students. It is found that $f_{SC/ST/I} = 0.6 * f_{other}$. The fee in the e-governance system, f_{tot}^{egov} can be computed as follows:

$$f_{tot}^{egov} = n_u^{SC,ST,I} * f_{SC/ST/I} + n_u^{others} * f_{other} \quad (6)$$

Application Fee in the manual system, f_{tot}^{manual} can be computed as follows:

$$f_{tot}^{manual} = n_c^{SC,ST,I} * f_{SC/ST/I} + n_c^{others} * f_{other} \quad (7)$$

The application fee advantage for students from the e-governance system to that of manual system f_{dif} can be defined as follows:

$$f_{dif} = \frac{f_{tot}^{manual}}{f_{tot}^{egov}} \quad (8)$$

3. ANALYSIS

Data from the four-year centralized admission from 2009 till 2012 is used here for analysis. Using equation (1) and (2), it is found that courses-optimized metrics, $C_{opt} = 3.11$ in 2009 and $C_{opt} = 3.85$ in 2012, shows that average number of choices by a student to courses has increased slightly. The Courses-optimized metrics, C_{opt} also is a metrics which tells the redundancy of man-hours in the system. Table 2 shows courses-optimized metrics from 2009 to 2012.

Table 2: number of applications course-optimized matrix data

Year	n_c	n_u	C_{opt}
2009	21141	6800	3.11
2010	27340	7605	3.60
2011	26001	7201	3.61
2012	33943	8820	3.85

The speedup of the e-governance system over the manual system is calculated using equation (3), (4), and (5). Time for each activity is noted for a sample size. Time for each activity is averaged and relatively normalized to a scale of 1. For e-governance system, $T_d = 1$, $T_s = 2$, $T_{e'} = 0.1$, $T_c = 1$, $T_p = 1$. The parameters, $T_e = 0$, $T_r = 0$, $T_{r'} = 0$ since more than 30K applicants rank and eligibility is computed in less than a minute. Hence the effort in calculating eligibility and rank in e-governance system is much less than in the manual system and is negligible. The hostel admissions was manual till 2011, and hence effort for hostel admissions $T_h = 1$ for 2009 and 2010. The hostel admission module was added in 2011. To reduce the scrutiny effort, a first level scrutiny was introduced at the time of application collection, called 'acknowledgement issue', request for corrections was also reduced. In total the scrutiny effort was reduced by 25%, therefore $T_s = 1.5$ for 2011 and 2012. For manual system, $T_d = 1$, $T_s = 2$, $T_e = 0.25$, $T_{e'} = 0.2$, $T_c = 1$, and $T_h = 1$. The speedup for 2009 $S = 3.29$ and $S = 5.40$ for 2012. Table 3 shows speedup for the years, 2009 to 2012.

Table 4: Students details year-wise

year	$n_u^{SC,ST,I}$	n_u^{others}	$n_c^{SC,ST,I}$	n_c^{others}	f_{tot}^{egov}	f_{tot}^{manual}	f_{dif}
2009	2235	4565	8070	13071	5906.0 f	17913.0 f	3.03 f
2010	2499	5106	10024	17316	6605.4 f	23330.4 f	3.53 f
2011	2361	4845	9894	16107	6261.6 f	22043.4 f	3.52 f
2012	2849	5971	12771	21172	7680.4 f	28834.6 f	3.75 f

It is proved that the speedup has increased as more services were added to the system. Speedup of e-governance system also increases as the number of applicants increase. If we consider the admission approval process which is ignored in the equation, the e-governance systems speedup would have increased further.

Table 3: Speedup between manual and egov system

Year	T_{tot}^{egov}	T_{tot}^{manual}	S
2009	41480.0	136359.5	3.29
2010	46390.5	176343.0	3.80
2011	33124.6	167706.5	5.06
2012	40572.0	218932.4	5.40

f_{dif} is computed using equations (6), (7) and (8) and is shown in Table 4. The table shows fee advantage for the applicants in the e-governance system over the manual system. $f_{dif} = 3.03f$ in 2009 and $f_{dif} = 3.75f$ in 2012. It is also noted that as the number of unique students n_u increase there is more fee advantage. It was also found that the increase in the number of courses-optimized C_{opt} there is an increase in f_{dif} , which suggests that the manual system would be more expensive for students. Apart from the cost of the Application Form, there is expense incurred while photocopying documents to be attached to each of the Application Form, while traveling to many departments to verify the merit list, and rank list and also to attend the counseling. For the university, establishing redundancy infrastructure in each department for the manual system would have cost more than the centralized admission process.

Uniformity in implementing reservation policy was automatically enforced because of the centralized admission process. Transparency is the opening up of internal system and process to external audiences. Students are informed of the eligibility and rank by publishing the entire data in web. During the counseling, the availability of seat is displayed in many places for the benefit of students. Audit trials are also introduced to monitor any unauthorized changes to the centralized data. The system therefore proves transparent. Information dissemination is both in native and non-native language [24], therefore, unlike some of the e-governance initiatives in Karnataka, the centralized admissions online form is developed in both English and in the local language, Kannada. The manual application is also printed bilingually.

The ready data from the Centralized Admission has helped the decision makers. Some of the data which helped them are: number of students gender-wise, caste-wise, parental income-wise, category students admitted in general merit, number of seats available, percentage of un-filled seats in each course, and fee collected from students – all of which could be accessed in no time.

The centralized Admission has also helped in answering RTI queries regarding admissions [25].

The speedup suggested has decreased the effort and hence may have resulted in a decrease in number of days taken for the process. However, the number of days for admissions

remained the same in the e-governance system as compared to the manual process, because the number of people involved in the manual process was many times more than in the e-governance system.

Table 5: number of applications for supernumerary quota

Year	e-governance system	Manual system	Redundancy factor
2010	1141	4510	3.95
2011	1937	8302	4.28
2012	2528	11235	4.44

Table 5 lists the number of unique applications received for supernumerary quota in the e-governance system and the number of applications that would be received if the admissions were to be manual. The redundancy factor in computing weightage is also shown. The redundancy factor was 3.95 in the year 2009 and it was 4.44 in 2012. It is evident that the centralized admission has reduced the supernumerary evaluation which has also reduced the manpower requirement for supernumerary weightage computation.

applied, C_{opt} , speedup S of the e-governance system over manual system, and application fee advantage for students from the e-governance system to that of manual system f_{dif} . It was found that for the year 2009, $C_{opt} = 3.11$, $S = 3.29$, and $f_{dif} = 3.03f$ and for the year 2012 $C_{opt} = 3.85$, $S = 5.40$, and $f_{dif} = 3.75f$. It proved that in each successive year of admissions the speedup of the e-governance system over the manual system had increased and the fee-advantage had also increased. The e-governance Centralized Admissions has proved to be workforce saving, and also cost effective. It was found that the e-governance initiative has helped students, teachers, and the University. The initiative has reduced the redundancy of the work, and provided statistics for policy decision. The initiative also provided a repository of the students' database which helped the administration in various activities.

The admission was made in parallel in each of the disciplines: Science, Arts, Commerce, Education and Law faculty. It was found that there was uniformity in applying reservation policy, selection of candidates for Sports, Cultural, NCC, NSS, and other supernumerary seats.

Table 6: Comparison between various automated admission models in Karnataka

Metrics	Model 1 (CET)	Model 2 (PGCET)	Model 3 (PGET)	Model 4 (PGCA)
Applications for various courses	Single	Separate	Single	Single
Scrutiny of Application	Single	Multiple	Single	Single
Rank	Separate for each discipline	Separate for each courses	Single rank	Separate rank for each course
Fee-advantage		Separate fee for each course	One fee for any course	One fee for eight courses
Supernumerary weightage computation	Single	Not applicable	Not applicable	Single
Counseling	Block processing	Block processing	Sequential	Parallel for each course
Hostel Admission	Not handled	Not handled	Not handled	Handled

Table 6 compares Bangalore University's Centralized model with other automated models of admission in existence in the state of Karnataka. For the various courses, only Model 2 collects separate application form causing redundancy in data, and man-work. This is owing to multiple scrutiny for the same candidate if the candidate has applied for multiple courses. Because of separate application form for each course, there is no fee-advantage for the student. Model 3 is the only model which has single ranking system and all other models have separate rank for each course. Only Model 4 handles the hostel-admission. Model 3 adopts sequential counseling which is slow compared to other models. The block processing followed by Model 1 and Model 2 are faster and saves time compared to other models, but at the expense of on-the-fly options for students. Model 4 counsels students regarding seat-selection in parallel for each course.

4. CONCLUSION

An e-governance system for Centralized Admission process was designed, developed and introduced for the first time in any university of Karnataka in the year 2009. This incremental model was compared with that of the manual model introducing metrics such as: courses-optimized factor which defined the number of courses to which a student had

Four existing models of Centralized Admissions in Karnataka have been compared considering metrics such as: application for courses, scrutiny, rank, fee-advantage, supernumerary weightage computation, counseling, and hostel admission. It was found that separate application collection as followed in Model 2 suffers from redundancy and lacks fee-advantage. The Block processing followed in Model 1 and Model 2 is faster, and the novel Parallel counseling of Model 4 is relatively faster.

Owing to the advantages of the Centralized Admission, all Agricultural Universities in Karnataka have decided to implement Centralized Admissions.

The following recommendations are made to improve the the existing automated admission process: (1) Mobile penetration is more than the broad-band penetration in India, mobile applications can be built for submission of applications, viewing eligibility and rank, (2) scanned copy of the documents can be uploaded and can be verified through the computer to save paper, (3) The NeGP Community Service Centers (CSC) [26] can be used in rural area for filling the application and for other admission activities, (4) The System can be improved to move to 'transact' state of the e-governance by introducing online fee collection, (5)

University students' marks database can be integrated for marks scrutiny process, caste and income database of the government can be used for verification of the caste, and income of the applicants, (6) the system can also be implemented for under-graduate admissions, and (7) Intelligence can be built to automate the scrutiny process from the scanned copy of the attachments.

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